Chapter 2 Part E:
Engine removal and overhaul procedures

Contents

Degrees of difficulty

Easy, suitable for novice with little experience 

Fairly easy, suitable for beginner with some experience 

Fairly difficult, suitable for competent DIY mechanic 

Difficult, suitable for experienced DIY mechanic 

Very difficult, suitable for expert DIY or professional 

Specifications

Engine codes

Refer to Specifications in relevant Part of Chapter 2.

Cylinder head

Camshaft bearing diameters:	
1.2 and 1.6 litre engines	See Chapter 2A or 2C
1.4 and 1.8 litre engines	26.045 to 26.070 mm
Valve seat angle:	
Except 1.2 litre engine	45° ± 5'
1.2 litre engine	45° ± 20'
Tappet running clearance in head:	
1.4 litre engine	0.016 to 0.055 mm
1.8 litre engine	0.025 to 0.066 mm

Valves

Valve stem diameter:	
Inlet:	
1.2 litre engine	5.974 to 5.992 mm
1.4 and 1.6 litre engines	6.982 to 7.000 mm
1.8 litre engine	6.975 to 6.990 mm
Exhaust:	
1.2 litre engine	5.974 to 5.992 mm
1.4 litre engine	6.982 to 7.000 mm
1.6 litre engine	6.974 to 6.992 mm
1.8 litre engine	6.960 to 6.975 mm
Valve face angle:	
Except 1.2 litre engine	45° 30' ± 5'
1.2 litre engine	45° 30' ± 20'
Valve stem-to-guide clearance:	
1.2 litre engine	0.030 to 0.066 mm
1.4 and 1.6 litre engines	0.022 to 0.058 mm
1.8 litre engine	0.032 to 0.065 mm

Camshaft

Camshaft bearing running clearance (1.4 and 1.8 litre engines)	0.030 to 0.070 mm
Camshaft endfloat (1.4 and 1.8 litre engines)	0.100 to 0.230 mm

Auxiliary shaft (1.6 litre engine)

Shaft bearing running clearance	0.040 to 0.091 mm
Shaft bearing diameters:	
Innermost bearing	35.593 to 35.618 mm
Outermost bearing	31.940 to 31.960 mm

Cylinder block

Bore diameter:	
1.2 litre engine	70.800 to 70.830 mm
1.6 litre engine	86.400 to 86.430 mm
1.4 and 1.8 litre engines	70.800 to 70.830 mm
Undersizes	Increments of 0.010 mm

Pistons and piston rings

Piston diameter:	
Grade A:	
1.2 litre engine	70.760 to 70.770 mm
1.6 litre engine	86.352 to 86.362 mm
1.4 and 1.8 litre engines	81.952 to 81.962 mm
Grade B:	
1.2 litre engine	70.770 to 70.780 mm
1.6 litre engine	86.359 to 86.371 mm
1.4 and 1.8 litre engines	81.959 to 81.971 mm
Grade C:	
1.2 litre engine	70.780 to 70.790 mm
1.6 litre engine	86.368 to 86.378 mm
1.4 and 1.8 litre engines	81.968 to 81.978 mm
Piston-to-bore clearance:	
Except 1.2 litre engine	0.038 to 0.062 mm
1.2 litre engine	0.030 to 0.050 mm
Maximum difference in weight between pistons	± 5g
Gudgeon pin diameter:	
1.2 litre engine	17.970 to 17.974 mm
1.6 litre engine	21.990 to 21.995 mm
1.4 and 1.8 litre engines	19.996 to 20.000 mm
Gudgeon pin to piston clearance:	
Except 1.2 litre engine	0.002 to 0.011 mm
1.2 litre engine	0.008 to 0.016 mm
Piston ring-to-ring wall clearance:	
Top compression ring:	
1.2 litre engine	0.000 to 0.060 mm
1.4 litre engine	0.050 to 0.090 mm
1.6 litre engine	0.035 to 0.075 mm
1.8 litre engine	0.050 to 0.085 mm
2nd compression ring:	
1.2 litre engine	0.000 to 0.055 mm
1.4 litre engine	0.040 to 0.075 mm
1.6 litre engine	0.020 to 0.060 mm
1.8 litre engine	0.040 to 0.075 mm
Oil scraper ring:	
1.2 litre engine	0.000 to 0.055 mm
1.4 litre engine	0.075 to 0.105 mm
1.6 litre engine	0.065 to 0.095 mm
1.8 litre engine	0.030 to 0.065 mm
Piston ring end gap:	
Top compression ring:	
1.2 litre engine	0.200 to 0.400 mm
1.4 litre engine	0.250 to 0.500 mm
1.6 litre engine	0.200 to 0.450 mm
1.8 litre engine	0.300 to 0.500 mm
2nd compression ring:	
1.2 litre engine	0.250 to 0.450 mm
1.4 litre engine	0.300 to 0.500 mm
1.6 litre engine	0.250 to 0.500 mm
1.8 litre engine	0.300 to 0.500 mm
Oil scraper ring:	
1.2 litre engine	0.200 to 0.450 mm
1.4 litre engine	0.400 to 1.400 mm
1.6 litre engine	0.400 to 1.400 mm
1.8 litre engine	0.250 to 0.450 mm

Connecting rods

Gudgeon pin-to-small end clearance:	
1.4 litre engine	0.006 to 0.016 mm
1.6 litre engine	0.009 to 0.020 mm
1.8 litre engine	0.006 to 0.020 mm

Crankshaft

Main bearing journal diameters:	
1.2 litre engine:	
Grade 1	47.982 to 47.988 mm
Grade 2	47.988 to 47.994 mm
Grade 3	47.994 to 48.000 mm
1.6 litre engine:	
Grade 1	50.790 to 50.800 mm
Grade 2	50.780 to 50.790 mm
1.4 and 1.8 litre engines:	
Grade 1	52.994 to 53.000 mm
Grade 2	52.988 to 52.994 mm
Grade 3	52.982 to 52.988 mm
Crankpin journal diameters:	
1.2 litre engine:	
Grade A	41.990 to 42.008 mm
1.4 litre engine:	
Grade A	40.884 to 40.890 mm
Grade B	40.878 to 40.884 mm
Grade C	40.872 to 40.878 mm
1.6 litre engine:	
Grade A	45.513 to 45.523 mm
Grade B	45.503 to 45.513 mm
1.8 litre engine:	
Grade A	50.799 to 50.805 mm
Grade B	50.793 to 50.799 mm
Grade C	50.787 to 50.793 mm
Main bearing running clearance:	
1.2 litre engine	0.025 to 0.040 mm
1.6 litre engine	0.019 to 0.050 mm
1.4 and 1.8 litre engines	0.025 to 0.052 mm
Big-end bearing running clearance:	
1.2 litre engine	0.024 to 0.060 mm
1.6 litre engine	0.025 to 0.063 mm
1.4 and 1.8 litre engines	0.030 to 0.056 mm
Crankshaft endfloat:	
1.2 and 1.6 litre engines	0.055 to 0.265 mm
1.4 and 1.8 litre engines	0.059 to 0.161 mm

Torque wrench settings

Refer to Specifications in relevant Part of Chapter 2.

1 Engine and transmission removal - preparation and precautions

If you have decided the 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 workshop or garage isn't available, at the very least a flat, level, clean work surface is required.

If possible, clear some shelving close to the work area, and use it to store the engine components and ancillaries as they are removed and dismantled. In this manner, the components stand a better chance of staying clean and undamaged during the overhaul. Laying out components in groups together with their retaining nuts and bolts, etc will save time and avoid confusion when the engine is refitted.

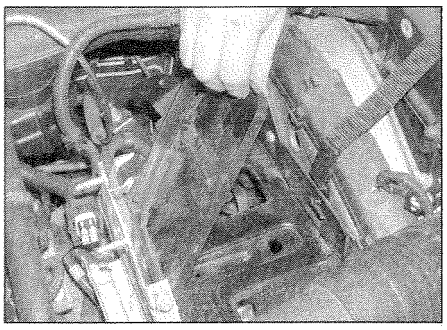
Clean the engine compartment and engine/transmission before beginning the removal procedure; this will help visibility and help to keep tools clean.

The help of an assistant should be available; there are certain instances when one person cannot safely perform all of the operations required to remove the engine from the vehicle. Safety is of primary importance, considering the potential hazards involved in this kind of operation. A second person should always be in attendance to offer help in an emergency. If this is the first time you have removed an engine, advice and aid from someone more experienced would also be beneficial.

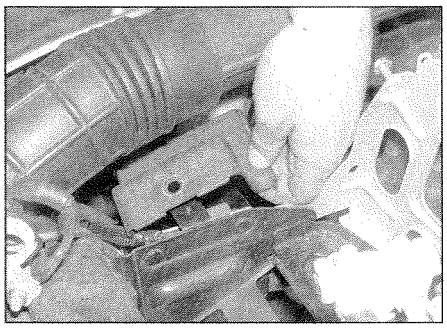
Plan the operation ahead of time. Before starting work, obtain (or arrange for the hire of) all of the tools and equipment you will need. Access to the following items will allow the task of removing and refitting the engine/transmission to be completed safely and with relative ease; a heavy-duty trolley jack - rated in excess of the combined weight of the engine and transmission, complete sets of spanners and sockets (see Tools and working facilities), wooden blocks, and plenty of rags and cleaning solvent for mopping up spilled oil, coolant and fuel. A selection of different-sized plastic storage boxes will also prove useful for keeping dismantled components grouped together. If any of the equipment must be hired, make sure that you arrange for it in advance, and perform all of the operations possible without it beforehand; this may save you time and money.

Plan on the vehicle being out of use for quite a while, especially if you intend to carry out an engine overhaul. Read through the whole of this section and work out a strategy based on your own experience and the tools, time and workspace available to you. Some of the overhaul processes may have to be carried out by a FIAT dealer or an engineering works - these establishments often have busy schedules, so it would be prudent to consult them before removing or dismantling the engine, to get an idea of the amount of time required to carry out the work.

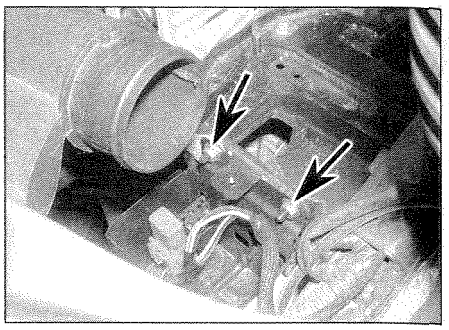
When removing the engine from the vehicle, be methodical about the disconnection of



2.7a Removing the battery drip tray



2.7b Lift off the fuse/relay carrier lid . . .



2.7c . . . for access to the mounting nuts

external components. Labelling cables and hoses as they are removed will greatly assist the refitting process.

Always be extremely careful when lifting the engine/transmission assembly from the engine bay. Serious injury can result from careless actions. If help is required, it is better to wait until it is available rather than risk personal injury and/or damage to components by continuing alone. By planning ahead and taking your time, a job of this nature, although major, can be accomplished successfully and without incident.

On all models described in this manual, the engine and transmission are removed as a complete assembly downwards from the engine compartment.

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

Note 1: *The engine is lowered from the engine compartment as a complete unit with the transmission; the two are then separated for overhaul.*

Note 2: *On 1.2 and 1.8 litre models with air conditioning, the air conditioning system must be discharged before the engine is removed. This work MUST be carried out by a FIAT dealer or air conditioning specialist, and it is advisable to have this done before starting to remove the engine.*

Removal

1 Select a solid, level surface to park the vehicle upon. Give yourself enough space to move around it easily. Apply the handbrake, and securely chock the rear wheels as an added precaution - the front of the car has to be raised significantly to withdraw the engine, so the car will be at quite an angle.

2 On models not fitted with alloy wheels, remove the front wheel trims and loosen the driveshaft nuts. The nuts are tightened to a very high torque, so only use good-quality, close-fitting tools to loosen them. This task is most safely performed while the front wheels are still on the ground. Leave the nuts in place, hand-tight.

3 Depressurise the fuel system as described in the relevant part of Chapter 4.

4 Remove the battery as described in Chapter 5A.

5 Where applicable, unscrew the nuts and disconnect any additional wiring attached to the battery positive terminal, noting its location for refitting.

6 On 1.6 litre models, remove the engine management ECU as described in Chapter 4B, Section 4.

7 Remove the plastic drip tray from the main battery tray, disconnecting the drain tube from it. Remove the fuse/relay carrier from the battery tray, labelling and disconnecting the wiring plugs as necessary **(see illustrations)**.

8 Unscrew the bolts securing the battery tray to the body, and remove the tray from the engine compartment **(see illustration)**.

9 Drain the cooling system as described in Chapter 1.

10 Disconnect the hoses from the radiator, expansion tank and thermostat housing. At the rear of the engine compartment, disconnect the hoses leading through the bulkhead to the heater. Label any hose whose fitted location is not obvious.

11 To improve working room, remove the two bolts securing the air intake at the front of the engine compartment, and lift the intake out of position, detaching it from the intake duct.

12 To avoid any possibility of damage to the radiator as the engine is removed, refer to Chapter 3 and remove the radiator.

13 Loosen the hose clips and disconnect the air duct which runs from the air cleaner to the inlet manifold; also disconnect any associated breather pipes.

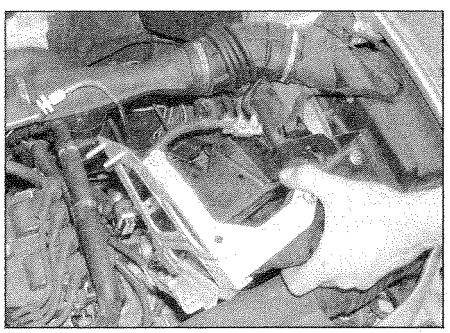
14 Taking precautions against fuel spillage, disconnect the fuel supply and return connections with reference to the relevant part of Chapter 4.

15 Again referring to Chapter 4, disconnect the fuel injection wiring from the throttle body or fuel rail.

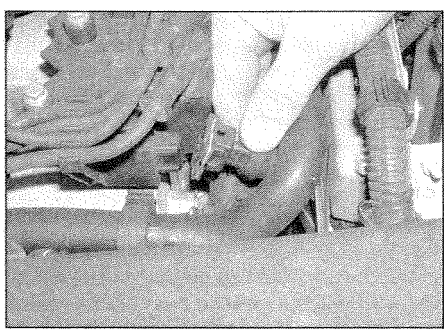
16 Disconnect the LT wiring plug from the ignition coil assembly **(see illustration)**. On 1.8 litre models, refer to Chapter 5B and unbolt the coil wiring harness from the cylinder head; disconnect the harness at the large wiring connector at the left-hand end of the cylinder head.

17 Disconnect the accelerator cable as described in the relevant part of Chapter 4.

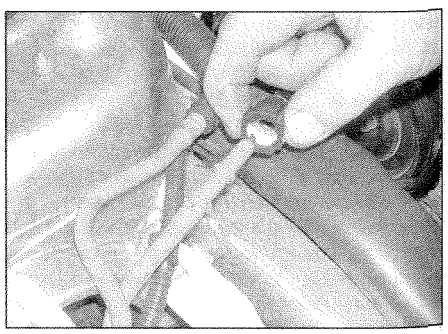
18 Trace the (blue) pipes from the charcoal canister (mounted in the right-hand rear corner of the engine compartment, or under the right-hand wheel arch), and disconnect the pipes at the connections on the inner wing **(see illustration)**.



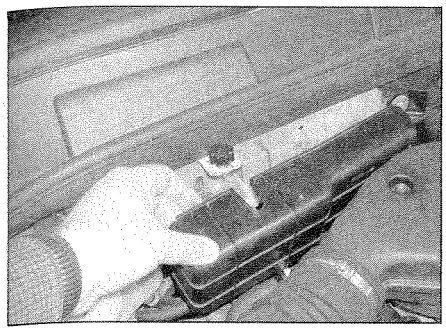
2.8 Removing the battery tray



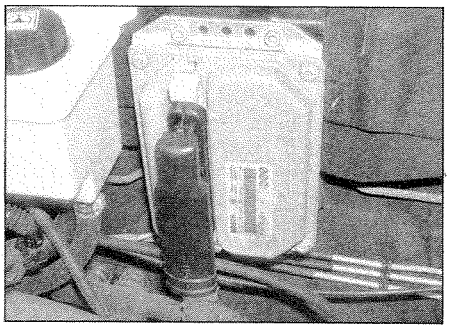
2.16 Disconnecting the LT wiring plug



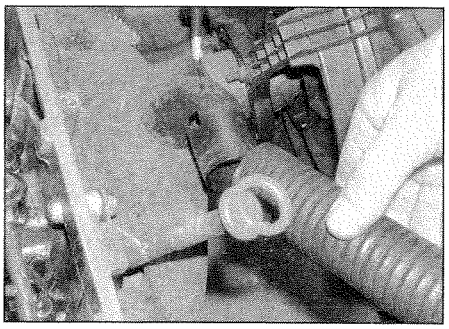
2.18 Disconnecting the charcoal canister pipes



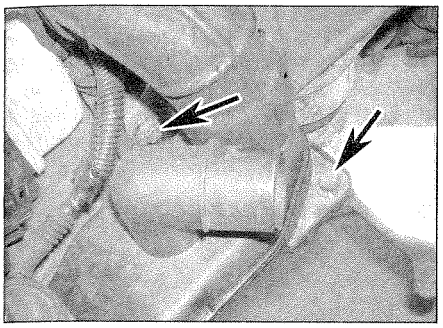
2.20a Removing the cover from the bulkhead fuse/relay bracket



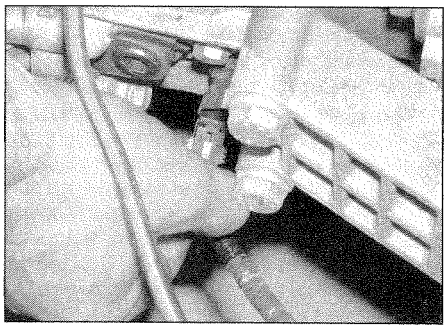
2.20b On 1.4 litre models, disconnect the ECU multi-plug



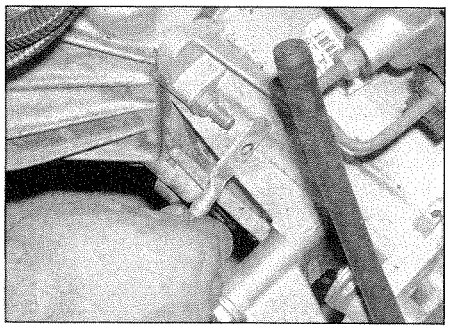
2.21a On 1.4 litre models, disconnect the flexible hot-air duct . . .



2.21b . . . then remove the mounting bolts (arrowed) and remove the air inlet elbow from the inner wing



2.22a Disconnecting the reversing light switch . . .



2.22b . . . and the earth lead at the front of the transmission

19 Disconnect the vacuum pipe from the brake servo.

20 At the engine compartment bulkhead, loosen the screw and remove the plastic cover from the relay carrier bracket. Labelling the wiring if necessary, disconnect the wiring plugs from the relays and other components. On 1.4 litre models, also disconnect the ECU wiring plug from the bulkhead **(see illustrations)**.

21 On 1.4 litre models, disconnect the hot-air flexible duct from the shroud over the exhaust manifold. To make room for the engine to be removed, unbolt the air inlet elbow from the right-hand inner wing **(see illustrations)**.

22 On manual transmission models, carry out the following:

*a) Disconnect the reversing light switch, earth lead and reverse gear inhibitor cable (as applicable) from the transmission housing, noting their locations **(see illustrations)**.*

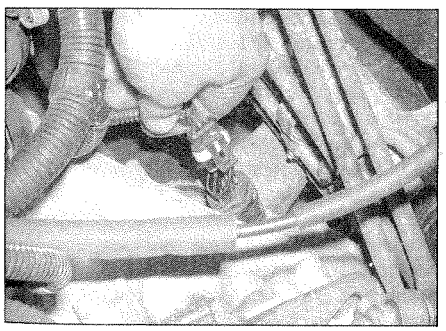
*b) Disconnect the speedometer wiring plug from the rear of the transmission **(see illustration)**.*

c) On models with a cable clutch, disconnect the clutch cable from the transmission (refer to Chapter 6).

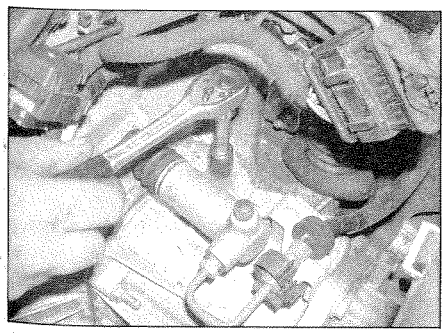
*d) On models with a hydraulic clutch, unbolt the clutch slave cylinder from the top of the transmission, then fit a cable-tie around it to prevent the piston coming out. Position the cylinder to one side **(see illustrations)**.*

*e) Disconnect the gearchange control cables and rods, referring to Chapter 7A as necessary. Details vary according to model, but dismantling procedures are self-evident. Disconnecting the cable end fittings either involves prising off the ball-and-socket joint, or unscrewing the through-bolt and nut **(see illustrations)**. Mark the components if necessary, to aid refitting.*

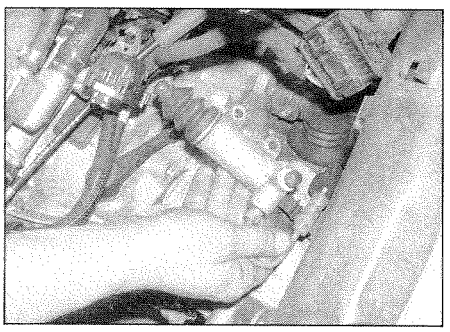
*f) Drain the transmission oil using the information in Chapter 7A **(see illustration)**.*



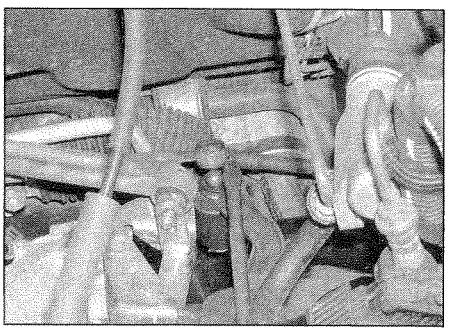
2.22c Disconnecting the speedometer wiring plug



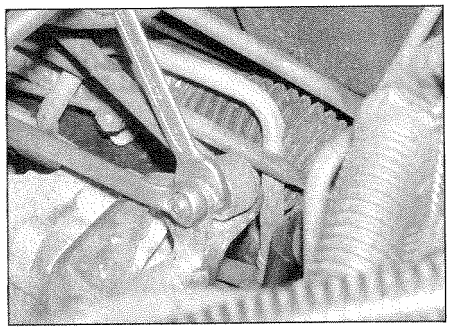
2.22d Unbolt the clutch slave cylinder . . .



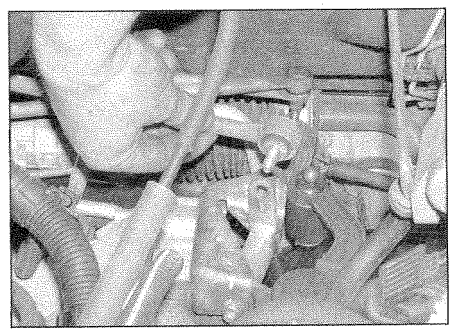
2.22e . . . and move it to one side



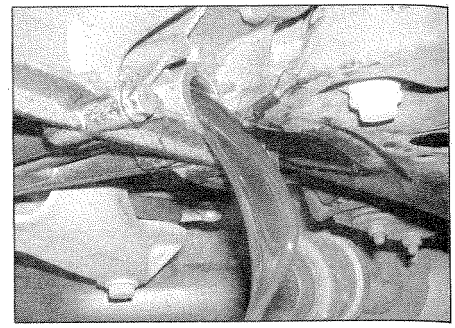
2.22f Prising off the ball-and-socket joint, using a screwdriver



2.22g Unscrew the through-bolt and nut . . .



2.22h . . . and separate the gearchange rods



2.22i Draining the transmission oil

23 On automatic transmission models, carry out the following:

a) Remove the three bolts securing the selector cable mounting bracket to the top of the transmission, prise off the cable end fitting, and move the bracket aside ***(see illustration)****.*

b) Disconnect the earth lead from below the transmission selector lever ***(see illustration)****.*

c) Disconnect the three wiring plugs in the immediate vicinity of the transmission.

d) Disconnect the speedometer wiring plug from the rear of the transmission.

e) Unbolt the pipe and wiring harness support bracket fitted just behind the transmission selector lever.

f) Drain the transmission fluid as described in Chapter 7B, Section 2.

24 Where applicable, prise up the cover over the starter motor. Disconnect the starter motor wiring, noting the location of each wire, and the fitted sequence of the nuts and washers **(see illustration)**.

25 Drain or syphon the fluid from the power steering reservoir, then refer to Chapter 10, Section 22, and disconnect the fluid pipes (and wiring, where applicable) from the power steering pump, taking precautions against further fluid spillage. Cover the pump connections, to prevent the ingress of dirt. On some models (such as those with the 1.6 litre engine), it is possible to unbolt the steering pump from the engine, and leave it in the engine compartment.

26 On 1.8 litre models, carry out the following:

a) Unbolt the power steering fluid reservoir from the bulkhead, and tie it to the engine for removal.

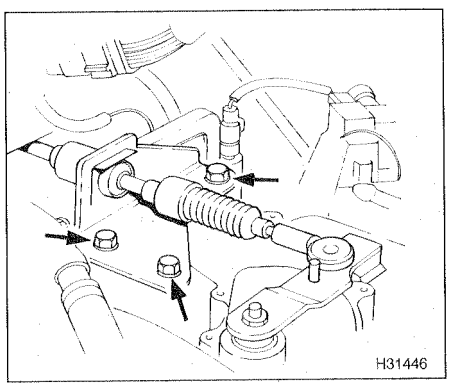
b) Disconnect the oxygen sensor wiring from the clip at the front of the thermostat housing. Trace the wiring back to the wiring plug, and disconnect it.

c) Unbolt the engine oil dipstick from the exhaust manifold.

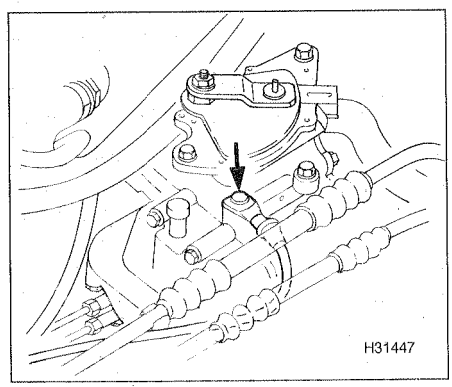
d) Where applicable, have the air conditioning system discharged by a FIAT dealer or suitable specialist.

e) Pull up the weatherstrip from the rear of the engine compartment, then remove the four screws securing the section of plastic scuttle panel on the passenger side. To remove the panel, it will also be necessary to remove the passenger wiper blade.

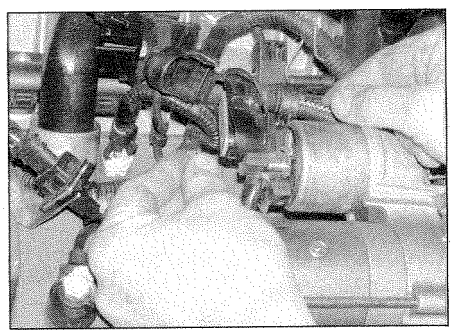
f) Remove the glovebox as described in Chapter 11. Working in the glovebox aperture, disconnect the wiring plugs from the engine management ECU, and from the various relays, etc, marking each as necessary for position. Approximately eight plugs must be disconnected, according to model. Feed the wiring harness through the aperture created by removing the plastic scuttle panel, into the engine compartment, and tie it to the engine.



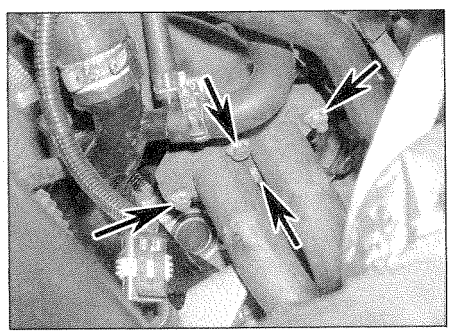
2.23a Remove the selector cable mounting bracket bolts (arrowed)



2.23b Disconnect the transmission earth lead



2.24 Disconnecting the starter motor wiring



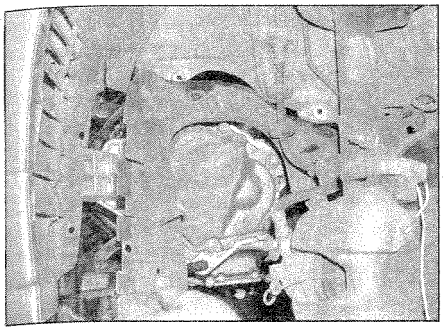
2.30 Exhaust manifold-to-downpipe nuts (arrowed)

27 If not already done, loosen the front wheel bolts, then jack up the front of the car and support it on axle stands. Remove the front wheels. Note that the car must (eventually, if not now) be raised to a sufficient height that the engine/transmission can be removed from below.

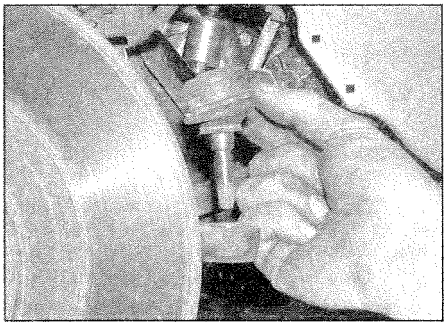
28 Locate the oxygen sensor at the top of the exhaust downpipe, immediately below the exhaust manifold. Trace the wiring from the sensor back to its wiring plug, and disconnect it.

29 Referring to Chapter 4C as required, loosen the bolts securing the exhaust downpipe to the catalytic converter.

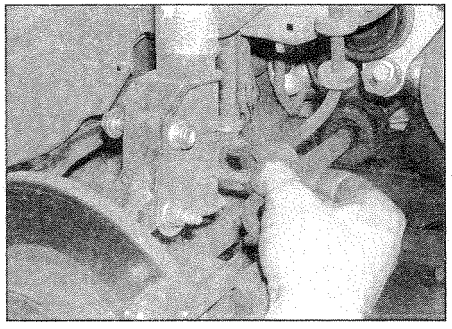
30 Remove the manifold-to-downpipe nuts, and separate the downpipe from the manifold **(see illustration)**. In some cases, the manifold studs will come out with the nuts - this poses no great problem, and the studs can be refitted if they are in good condition. For preference, however, a complete set of studs and nuts should be obtained as required, as the old ones are likely to be in less-than-perfect condition.



2.33 Removing the left-hand wheelarch inner access panel



2.34 Separating a track rod end balljoint



2.35 Pull the brake hose from the clip on the suspension strut

31 Remove the exhaust downpipe-to-catalytic converter bolts, and remove the downpipe from under the car. Take care while the downpipe is removed that the oxygen sensor is not knocked - it is fragile. Also, if necessary, tie the catalytic converter up at the front, to support it while the downpipe is removed.

32 If not already done, loosen the driveshaft nuts. The nuts are tightened to a very high torque, so only use good-quality, close-fitting tools to loosen them. If the job is being done with the car raised, make sure that it is securely supported, as considerable force may be needed to loosen the nuts.

33 To improve access to the suspension components and the driveshafts, remove the access panels fitted in the inner wheel arch liners. It will be necessary on most models to remove the front section of the liner, as well as the inner section. The access panels are secured by a combination of bolts and plastic studs **(see illustration)**. It may be necessary to disconnect the brake pad wear sensor wiring to remove the panels.

34 Unscrew the nuts retaining the track rod ends on the swivel hubs, and use a balljoint separator tool to disconnect them **(see illustration)**.

35 Release the flexible brake fluid hoses and ABS/pad wear sensor wiring from the front suspension struts **(see illustration)**.

36 Unscrew the two nuts/bolts securing the right-hand swivel hub assembly to the front suspension strut, then move the hub assembly outwards, taking care not to strain the flexible brake hose **(see illustration)**. Release the outer end of the driveshaft from the hub assembly.

37 Move the driveshaft to one side, then temporarily refit the hub assembly to the strut. Note that it is not recommended to allow the driveshaft to hang down under its own weight, or to turn the inner or outer joints through too acute an angle, or the joints may separate and be damaged.

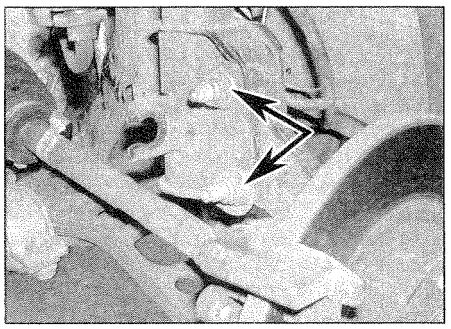
38 Disconnect the left-hand driveshaft using the procedure described in paragraphs 36 and 37.

39 On 1.6 litre models, remove the three bolts securing the inner end of the left-hand driveshaft **(see illustration)**. At the inner end of the right-hand driveshaft, release the inner CV boot from the transmission.

40 On 1.8 litre models, loosen and remove the socket-headed flange bolts securing the inner ends of the driveshafts **(see illustration)**.

41 Using a suitable flat-bladed tool between the driveshaft inner joint and the transmission housing as necessary, prise out and separate the inner ends of the driveshafts from the transmission **(see illustration)**. Be prepared for oil or fluid spillage if the transmission was not drained. Remove the driveshafts from under the car.

42 On automatic transmission models, loosen the union nuts and disconnect the fluid pipes at the side of the transmission. Again, be prepared for fluid spillage. Move the pipes out of the way, so that they are not damaged as the engine is lowered.

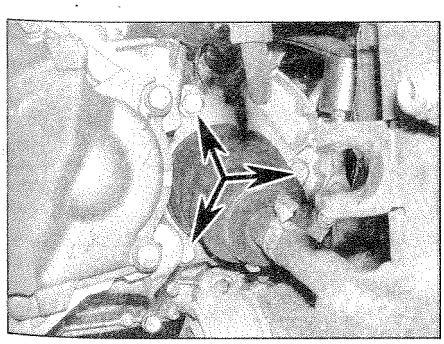


2.36 Suspension strut-to-swivel hub securing nuts (arrowed)

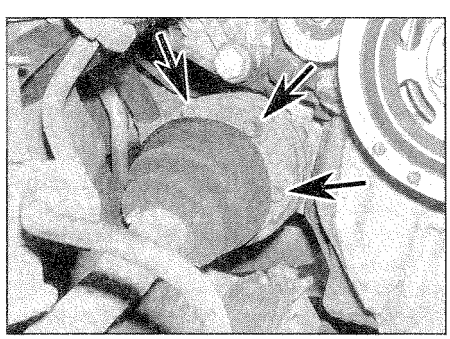
43 At this stage, the front of the car must be raised sufficiently to allow the engine/transmission assembly to be lowered and removed from under the front of the car. This will entail raising the car much higher than would normally be the case for most servicing work. Do not, however, be tempted to use makeshift means of support - before proceeding further, make sure the car is stable.

44 Connect a hoist and raise it so that the weight of the engine and transmission are just supported. Arrange the hoist and sling so that the engine and transmission are kept level when they are being withdrawn from the vehicle.

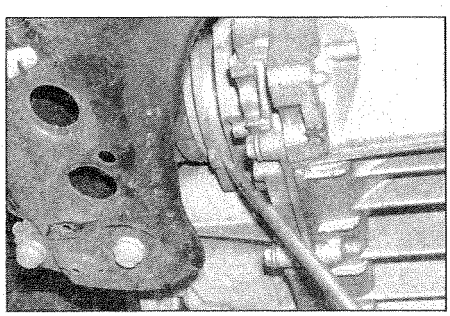
45 Unscrew and remove the engine and transmission mountings, referring to the relevant Part of Chapter 2 as necessary. Where possible, leave the bonded rubber mountings attached to the support points; this



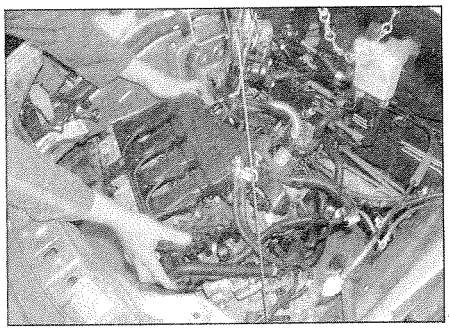
2.39 Driveshaft flange bolts (arrowed) - 1.6 litre model



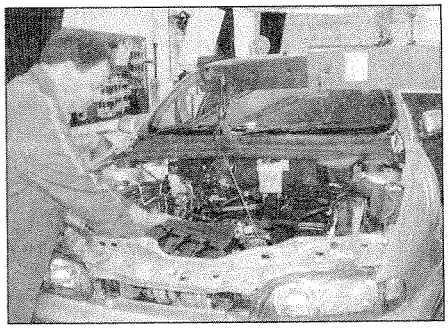
2.40 Driveshaft flange bolts on a 1.8 litre model



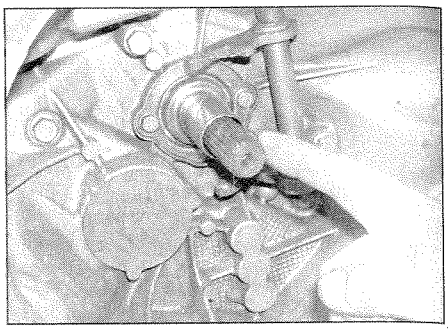
2.41 Using a large flat-bladed screwdriver to separate the driveshaft inner ends from the transmission



2.48a As the engine is lowered, guide it past the subframe



2.48b Lowering the engine out of the car



2.61 Apply grease to the transmission input shaft splines

will avoid the need for realignment during refitting. On models fitted with a reaction rod on the right-hand mounting, the rod should be removed completely, to make engine removal easier.

46 Check around the engine and transmission assembly from above and below, to ensure that all associated attachments are disconnected and positioned out of the way. Engage the services of an assistant to help in guiding the assembly clear of surrounding components.

47 Consider how the engine will be removed from under the car, before lowering it. If a wheeled trolley is available, this makes the task of moving the engine much easier. If the engine is dropped onto its sump, the sump may be damaged; a piece of old foam or carpet will offer some protection. If the engine is lowered onto a piece of carpet or a sheet of wood, this can be used to drag the engine out from under the car, without damage.

48 Carefully lower the engine/transmission assembly clear of the mountings, guiding the assembly past any obstructions, and taking care that surrounding components are not damaged. Remove the assembly from the front of the car **(see illustrations)**.

49 Once the engine/transmission assembly is clear of the vehicle, move it to an area where it can be cleaned and worked on.

Separation

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

51 Note the routing and location of any wiring on the engine/transmission assembly, then methodically disconnect it.

52 Remove the starter motor (Chapter 5A).

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

Manual transmission models

54 Support the transmission with blocks of wood. The transmission is secured to the engine by a combination of bolts, and studs and nuts. A locating dowel is fitted to the top bolt location. Unscrew the transmission-to-engine nuts and bolts, noting their locations.

55 Lift the transmission directly from the engine, taking care to keep it level so that the transmission input shaft does not hang on the clutch. Recover the backplate, which will fall out as the engine and transmission are separated.

56 Refer to Chapter 6, and remove the clutch release mechanism, pressure plate and friction plate.

Automatic transmission models

57 Mark the position of the torque converter with respect to the driveplate, using chalk or a marker pen. Remove the six socket-head bolts that secure the driveplate to the torque converter; turn the engine over using a socket and wrench on the crankshaft sprocket to rotate the driveplate and expose each nut in turn.

58 The transmission is secured to the engine by ten bolts of three different lengths - note their positions as they are removed.

59 Starting at the bottom, remove all the bolts, then carefully draw the transmission away from the engine, resting it securely on wooden blocks. Recover the backplate, which will fall out as the engine and transmission are separated.

Caution: Take care to prevent the torque converter from sliding off the transmission input shaft - hold it in place as the transmission is withdrawn.

60 Place a length of batten across the open face of the bellhousing, fastening it with cable-ties, to keep the torque converter in place in its housing.

Reconnection

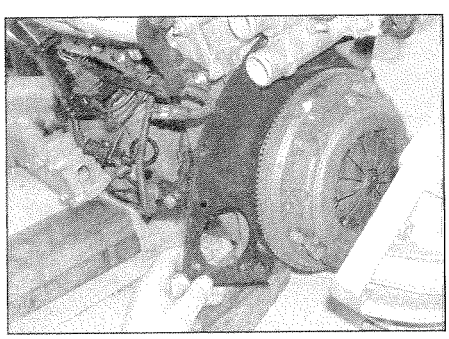
Manual transmission models

61 Smear a little high-melting-point grease on the splines of the transmission input shaft **(see illustration)**. Do not use an excessive amount, as there is the risk of contaminating the clutch friction plate.

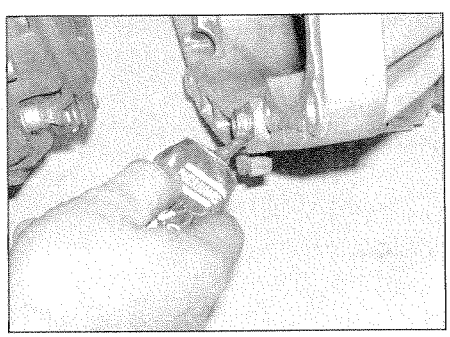
62 Refit the backplate, then carefully offer up the transmission to the cylinder block, guiding it onto the dowel **(see illustrations)**.

63 Refit the bellhousing bolts and nuts, hand-tightening them to secure the transmission in position **(see illustration)**.

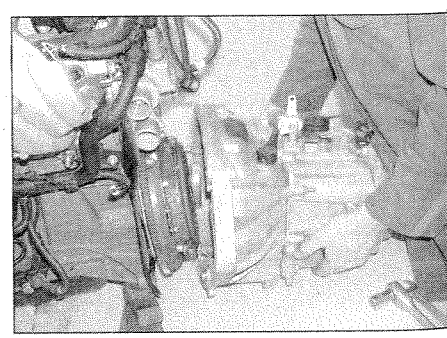
Note: *Do not tighten them to force the engine and transmission together.* Ensure that the bellhousing and cylinder block mating faces will butt together evenly without obstruction, before tightening the bolts and nuts fully.



2.62a Refitting the backplate



2.62b To ease fitting, apply a little grease to the locating dowel



2.62c Fitting the transmission back on the engine

Automatic transmission models

64 Remove the torque converter restraint from the face of the bellhousing. Check that the torque converter is still fully engaged with the transmission fluid pump.

65 Refit the backplate, then carefully offer up the transmission to the cylinder block. Observe the markings made during the removal, to ensure correct alignment between the torque converter and the driveplate.

66 Refit the bellhousing bolts to the positions noted on removal, hand-tightening them to secure the transmission in position. **Note:** *Do not tighten them to force the engine and transmission together.* Ensure that the bellhousing and cylinder block mating faces will butt together evenly without obstruction, before tightening the bolts and nuts fully.

All models

67 Refit the transmission lower cover, tightening the bolts securely.

68 Refit the starter motor, referring to Chapter 5A if necessary.

69 Reconnect any wiring on the engine/transmission assembly, routing it as noted on removal.

Refitting

70 Manoeuvre the engine and transmission into place under the front of the car.

71 Attach the hoist or engine support bar to the engine.

72 With the help of an assistant, carefully lift the assembly up into the engine compartment and onto the engine mountings, taking care not to damage the surrounding components.

73 Reconnect the engine/transmission mountings, and tighten the nuts and bolts.

74 When the engine is securely reconnected, disconnect the hoist from the engine.

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

a) Ensure that all sections of the wiring harness follow their original routing; use new cable-ties to secure the harness in position, keeping it away from sources of heat and abrasion.

b) On vehicles with manual transmission, check and if necessary adjust the gearchange linkage with reference to Chapter 7A.

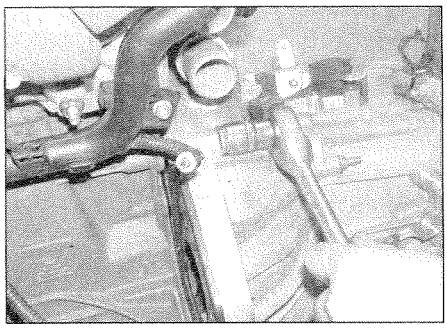
c) On vehicles with automatic transmission, check and if necessary adjust the kick-down and selector cables with reference to Chapter 7B.

d) Ensure that all hoses are correctly routed and are secured with the correct hose clips, where applicable. If the hose clips cannot be used again; proprietary worm-drive clips should be fitted in their place.

e) Refill the cooling system as described in Chapter 1.

f) Refill the engine with appropriate grade and quantity of oil (Chapter 1).

g) Refill or top-up the transmission oil or fluid (see Chapter 1 or Chapter 7).



2.63 Fit and tighten the engine-to-bellhousing bolts

h) Check and if necessary adjust the auxiliary drivebelt(s) with reference to Chapter 1.

i) Check and if necessary adjust the accelerator cable with reference to Chapter 4.

j) When the engine is started for the first time, check for air, coolant, lubricant and fuel leaks from manifolds, hoses etc. If the engine has been overhauled, read the notes in Section 12 before attempting to start it.

3 Engine overhaul - preliminary information

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

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

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

a) Power steering pump if removed with the engine (Chapter 10).

b) Air conditioning compressor (Chapter 3) - where applicable.

c) Alternator (including mounting brackets) and starter motor (Chapter 5A).

d) The ignition system and HT components including all sensors, HT leads (where applicable) and spark plugs (Chapters 1 and 5).

e) The fuel injection system components (Chapter 4A and 4B).

f) All electrical switches, actuators and sensors, and the engine wiring harness (Chapter 4A and 4B, and Chapter 5B).

g) Inlet and exhaust manifolds (Chapter 4).

h) Engine oil dipstick and tube (relevant Part of Chapter 2).

i) Engine mountings (relevant Part of Chapter 2).

j) Flywheel/driveplate (relevant Part of Chapter 2).

k) Clutch components (Chapter 6) - manual transmission.

l) Coolant pump (Chapter 3).

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

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

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

a) Flywheel/driveplate.

b) Timing belt, sprockets, and tensioner.

c) Inlet and exhaust manifolds.

d) Cylinder head.

e) Sump.

f) Oil pump.

g) Pistons and crankshaft.

4 Cylinder head - dismantling, cleaning, inspection and reassembly

Note 1: *New and reconditioned cylinder heads are available from the manufacturer or engine overhaul specialists. Be aware that some specialist tools are required for the dismantling and inspection procedures, and new components may not be readily available. It may therefore be more practical and economical for the home mechanic to purchase a reconditioned head, rather than dismantle, inspect and recondition the original head.*

Note 2: *On 1.2 and 1.6 litre engines, camshaft and tappet removal is described in Chapter 2A or 2C respectively.*

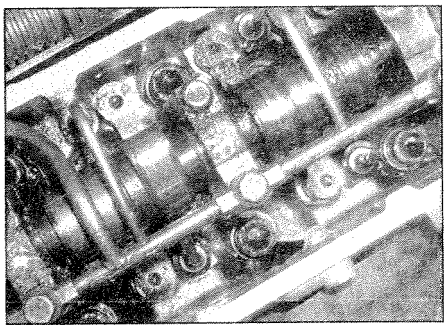
Dismantling

1 On 1.4 and 1.8 litre engines, remove the camshaft sprocket with reference to Chapter 2B or 2D.

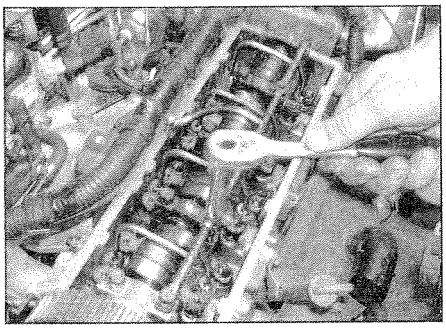
2 Remove the cylinder head as described in the relevant Part of this Chapter.

3 If not already done, remove the inlet and exhaust manifolds with reference to the relevant Part of Chapter 4.

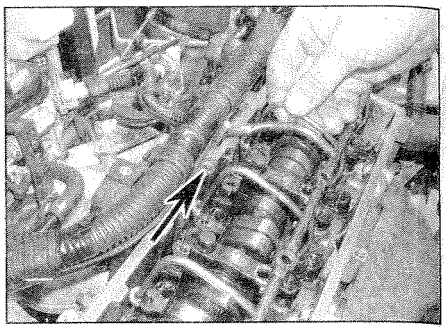
4 Unbolt and remove the ignition coil mounting.



4.7 Mark the camshaft bearing caps for position and orientation - 1.4 litre engine shown



4.8a Unbolt the oil feed pipe . . .



4.8b . . . then prise out the oil feed stub (location arrowed) and remove it

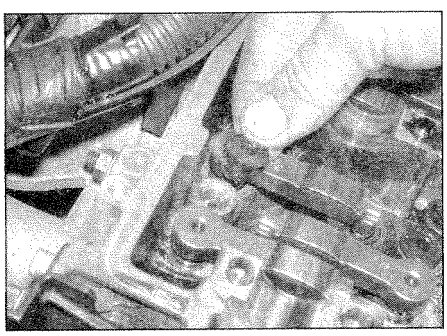
5 On 1.2 litre engines, unscrew the coolant temperature sensor from the thermostat housing on the left-hand end of the cylinder head. Unbolt and remove the thermostat housing, and recover the gasket.

1.4 and 1.8 litre engines

6 Unbolt and remove the coolant pump from the right-hand end of the cylinder head, and recover the gasket.

7 Mark the positions of the camshaft bearing caps, numbering them from the timing end, and marking them so they are refitted the right way round (on 1.4 litre engines, the curved surface on the caps faces the rear) **(see illustration)**.

8 On 1.4 litre engines, unbolt and remove the lubrication pipe (prise the oil feed stub out with a screwdriver). Recover the oil feed pipe seals which fit into the cylinder head - new seals must be fitted on completion **(see illustrations)**.



4.8c Recover the oil feed pipe oil seals

9 Unscrew the remaining bolts and take off the bearing caps **(see illustration)**.

10 Lift the camshaft(s) carefully from the cylinder head, checking that the hydraulic tappets (and followers on 1.4 litre engines) are not withdrawn by the 'adhesion' of the oil **(see illustration)**. On 1.4 litre engines, note that the pair of inlet valves per cylinder are operated by the wider camshaft lobes.

11 Remove the hydraulic tappets (and followers on 1.4 litre engines), but keep them in their originally fitted order. Stand the hydraulic tappets in an oil bath, so that the oil does not drain from them.

All engines

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

13 Release the valve spring compressor and remove the upper spring seat, valve spring(s), and lower spring seat. The 1.2 and 1.4 litre engines have one spring per valve - the other engines have two; note how they are fitted. Also identify the upper and lower spring seats, to avoid confusion on refitting.

14 Withdraw the valve from the head gasket side of the cylinder head, then use a pair of pliers to extract the valve stem oil seal from the top of the guide. If the valve sticks in the guide, carefully deburr the end face with fine abrasive paper. Repeat this process for the remaining valves.

15 It is essential that each valve is stored together with its collets, spring(s), and spring seats. The valves should also be kept in their correct sequence, unless they are so badly worn that they are to be renewed. If they are going to be kept and used again, place each valve assembly in a labelled polythene bag or similar small container, labelled as follows **(see illustration)**:

a) No 1 valve is at the timing end of the engine.

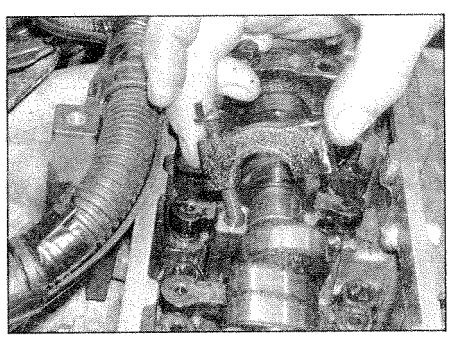
b) On 1.4 litre engines, there are two inlet valves per cylinder - the inlet valves are smaller than the exhaust valve, and are operated by the wider camshaft lobes. Number the inlet valves 1 to 8, the exhaust valves 1 to 4.

c) On 1.2 and 1.8 litre engines, exhaust valves are at the front, inlet valves at the rear. Number the inlet and exhaust valves 1 to 8.

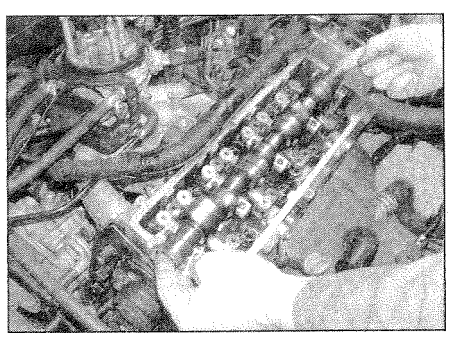
d) On 1.6 litre engines, inlet valves are at the front, exhaust valves at the rear. Number the inlet and exhaust valves 1 to 8.

Cleaning

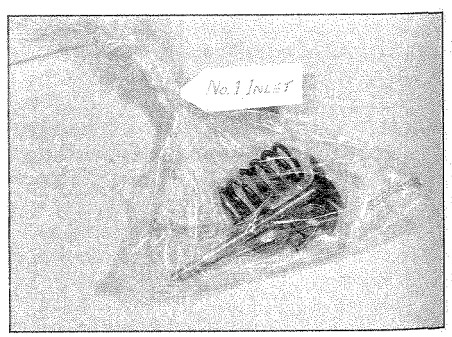
16 Using a suitable degreasing agent, remove all traces of oil deposits from the cylinder head, paying particular attention to the journal bearings, valve follower bores, valve guides and oilways. Scrape off any traces of old gasket from the mating surfaces,



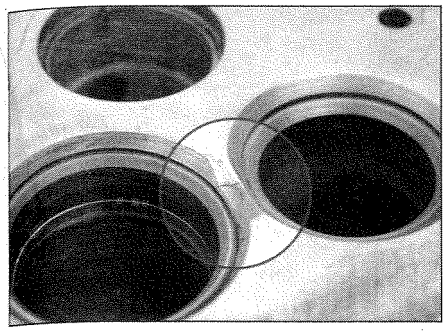
4.9 Removing one of the camshaft bearing caps



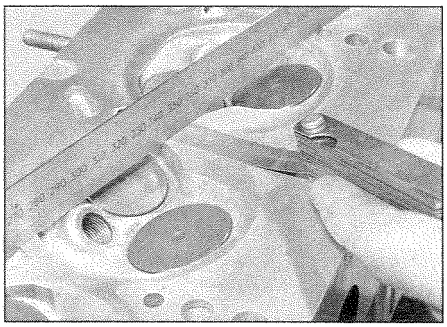
4.10 Lifting out the camshaft on a 1.4 litre engine



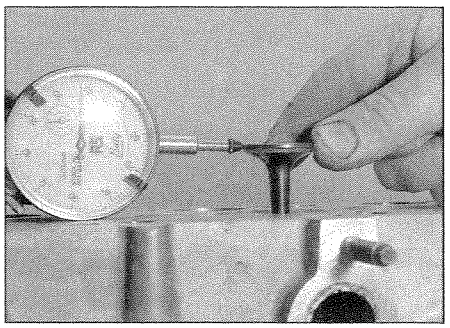
4.15 Keep the valve components together in a labelled bag or box



4.20 Look for cracking between the valve seats



4.21 Measuring the distortion of the cylinder head gasketed surface



4.23a Measure the deflection of the valve in its guide, using a dial gauge

taking care not to score or gouge them. If using emery paper, do not use a grade of less than 100. Turn the head over and using a blunt blade, scrape any carbon deposits from the combustion chambers and ports.

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

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

18 Clean the valve heads and stems using a fine wire brush. If the valve is heavily coked, scrape off the majority of the deposits with a blunt blade first, then use the wire brush.

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

19 Thoroughly clean the remainder of the components using solvent, and allow them to dry completely. Discard the oil seals, as new items must be fitted when the cylinder head is reassembled.

Inspection

Cylinder head

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

21 Use a straight-edge and feeler blade to check that the cylinder head gasket surface is not distorted **(see illustration)**. If it is, it may be possible to have it machined (skimmed), provided not too much material is removed. Minimum head heights are not quoted by FIAT, so seek the advice of an engine overhaul specialist.

22 Examine the valve seats in each of the combustion chambers. If they are severely pitted, cracked, or burned, they will need to be renewed or re-cut by an engine overhaul specialist. If they are only slightly pitted, this can be removed by grinding-in the valve heads and seats with fine valve-grinding compound, as described below.

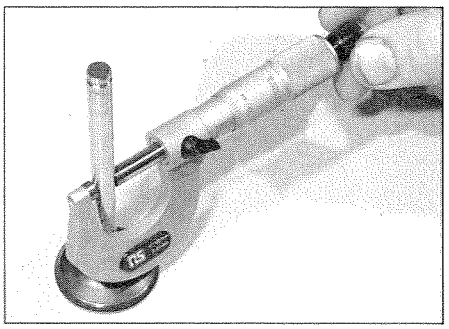
23 Check the valve guides for wear by inserting the relevant valve, and checking for side-to-side motion of the valve. A very small amount of movement is acceptable. If the movement seems excessive, remove the valve. Measure the valve stem diameter at several points, and renew the valve if it is worn **(see illustrations)**. If the valve stem is not worn, the wear must be in the valve guide, and the guide must be renewed. The renewal of valve guides is best carried out by an engine overhaul specialist, who will have the necessary tools available.

24 If renewing the valve guides, the valve seats should be re-cut or re-ground only *after* the guides have been fitted.

Camshaft(s), tappets and followers - 1.4 and 1.8 litre engines

25 Inspect the camshaft(s) for wear on the surfaces of the lobes and journals. Normally their surfaces should be smooth and have a dull shine; look for scoring and pitting. Accelerated wear will occur once the hardened exterior of the camshaft has been damaged **(see illustration)**.

26 Examine the bearing cap and journal surfaces for signs of wear **(see illustration)**.

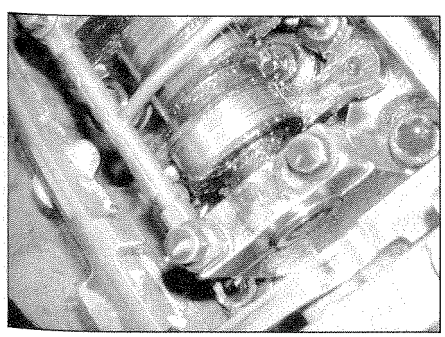


4.23b Measuring the diameter of a valve stem

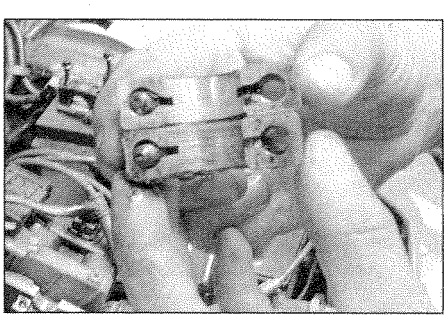
27 If excessive cam lobe wear is noted, examine the relevant tappet and/or follower(s) for similar signs of wear. It is advisable to renew the camshaft, tappets (and followers, on the 1.4 litre engine) as a set, even if only one lobe is worn; this is particularly true if the car has completed a large mileage.

28 To measure the camshaft endfloat, temporarily refit the camshaft, then push the camshaft to one end of the cylinder head as far as it will travel. Attach a dial test indicator to the cylinder head and zero it, then push the camshaft as far as it will go to the other end of the cylinder head and record the gauge reading **(see illustration)**. Verify the reading by pushing the camshaft back to its original position and checking that the gauge indicates zero again.

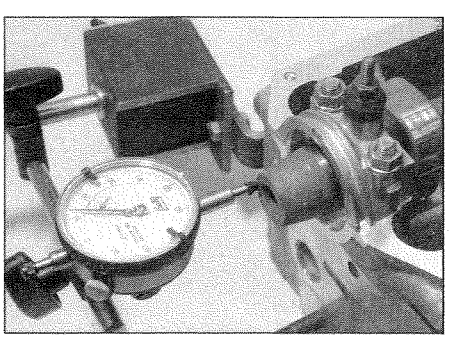
29 The camshaft bearing running clearance may be checked using Plastigauge as described later in this Chapter.



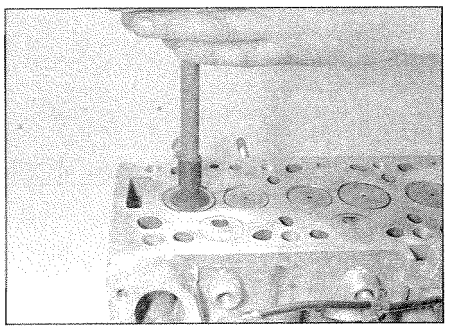
4.25 An example of a badly-worn camshaft lobe



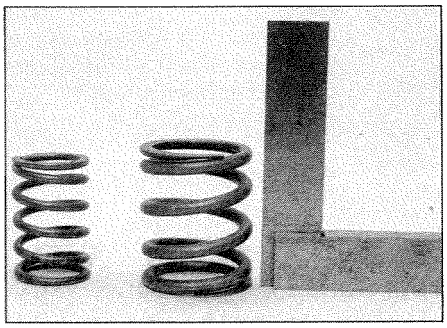
4.26 Examining the camshaft bearing caps - the top one is fine, the bottom one is badly worn



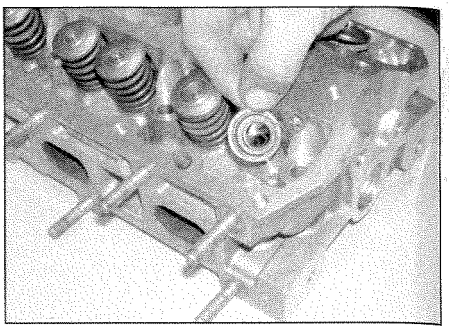
4.28 Checking the camshaft endfloat using a dial gauge



4.37 Grinding-in a valve



4.41 Checking the squareness of a valve spring



4.43a Fit the lower spring seat . . .

30 Where the camshaft and bearings are worn excessively, consider renewing the complete cylinder head together with camshaft(s), tappets (and followers, on the 1.4 litre engine). A reconditioned head may be available from engine repairers. Tappet (and/or follower) wear serious enough to warrant new components will be obvious on inspection.

31 On 1.4 litre engines, clean out the camshaft oil feed pipe assembly before refitting. This can be achieved using an aerosol can of engine degreasant, or carburettor cleaner. Make sure the solvent is drained off before the pipe is refitted.

Valves and associated components

32 Examine the head of each valve for pitting, burning, cracks, and general wear. Check the valve stem for scoring and wear ridges. Rotate the valve, and check for any obvious indication that it is bent. Look for pits or excessive wear on the tip of each valve stem. Renew any valve that shows any such signs of wear or damage.

33 If the valve appears satisfactory at this stage, measure the valve stem diameter at several points using a micrometer. 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.

34 If the valves are in satisfactory condition, they should be ground (lapped) into their respective seats, to ensure a smooth, gas-tight seal. To complete this process, you will need a quantity of fine/coarse grinding paste and a grinding tool - this can either be of the dowel and rubber sucker type, or the automatic type which are driven by a rotary power tool.

35 If the seat is only lightly pitted, or if it has been re-cut, fine grinding compound *only* should be used to produce the required finish. Coarse valve-grinding compound should *not* be used, unless a seat is badly burned or deeply pitted. If this is the case, the cylinder head and valves should be inspected by an expert, to decide whether seat re-cutting, or even the renewal of the valve or seat insert (where possible) is required.

36 Valve grinding is carried out as follows. Place the cylinder head upside-down on a bench.

37 Smear a trace of (the appropriate grade of) valve-grinding compound on the seat face, and attach the grinding tool onto the valve head. With a semi-rotary action, grind the valve head to its seat, lifting the valve occasionally to redistribute the grinding compound **(see illustration)**. A light spring placed under the valve head will greatly ease this operation.

38 If coarse grinding compound is being used, work only until a dull, matt even surface is produced on both the valve seat and the valve, then wipe off the used compound, and repeat the process with fine compound. When a smooth unbroken ring of light grey matt finish is produced on both the valve and seat, the grinding operation is complete. *Do not* grind-in the valves any further than absolutely necessary, or the seat will be prematurely sunk into the cylinder head.

39 When all the valves have been ground-in, carefully wash off *all* traces of grinding compound using paraffin or a suitable solvent, before reassembling the cylinder head.

40 Examine the valve springs for signs of damage and discoloration. If possible, compare the length of the springs with new ones, and renew them if necessary.

41 Stand each spring on a flat surface, and check it for squareness **(see illustration)**. If any of the springs are damaged, distorted or have lost their tension, obtain a complete new set of springs. It is normal to renew the valve springs as a matter of course if a major overhaul is being carried out.

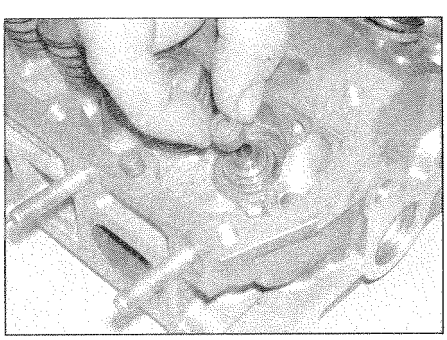
42 Renew the valve stem oil seals regardless of their apparent condition.

Reassembly

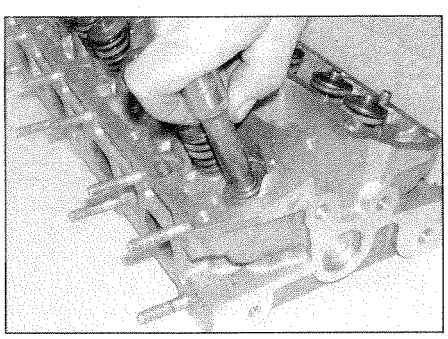
43 Refit the lower spring seat then, working on the first valve, dip the new valve stem seal in fresh engine oil. Carefully locate it onto the guide. Take care not to damage the seal as it is passed over the valve stem. Use a suitable socket or metal tube to press the seal firmly onto the guide **(see illustrations)**.

44 Lubricate the stems of the valves, and insert the valves into their original locations **(see illustration)**. If new valves are being fitted, insert them into the locations to which they have been ground.

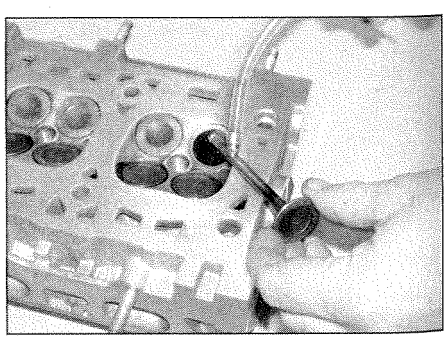
45 Locate the valve spring (or the inner and outer springs, on 1.6 and 1.8 litre engines) on top of the lower seat, then refit the upper spring seat **(see illustrations)**.



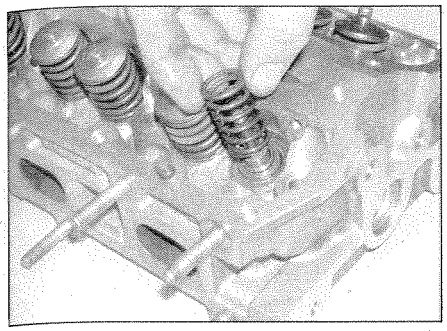
4.43b . . . then the valve stem oil seal . . .



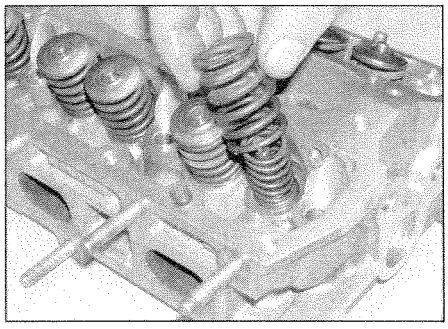
4.43c . . . pressing the seal home using a deep socket



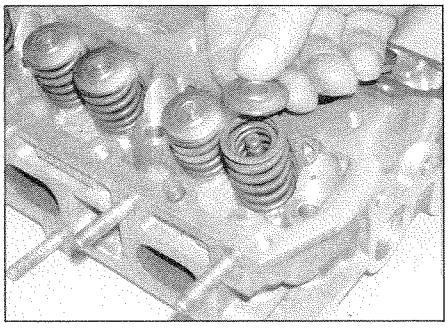
4.44 Oil the valve stems before fitting



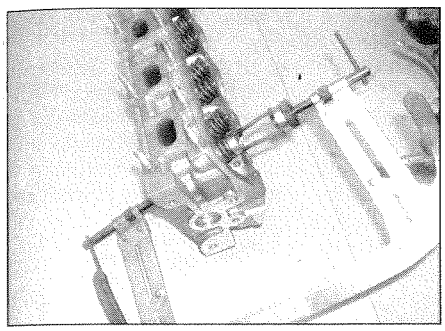
4.45a Locate the inner . . .



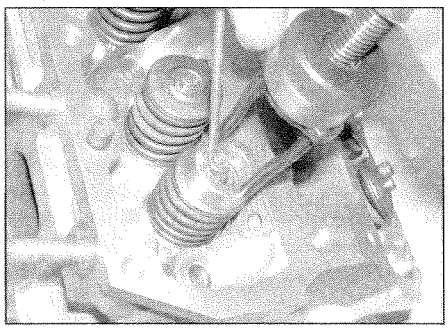
4.45b . . . and outer valve springs (1.6 litre engine shown) . . .



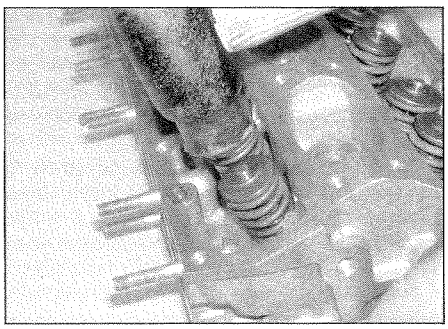
4.45c . . . then fit the upper spring seat



4.46a Fit the valve spring compressor . . .



4.46b . . . then insert the split collets, using a small screwdriver to guide them in



4.47 Using a hide mallet to settle the valve components

46 Compress the valve spring(s), and locate the split collets in the recess in the valve stem **(see illustrations)**. Release the compressor, then repeat the procedure on the remaining valves.

> **HAYNES HINT** *Use a dab of grease to hold the collets in position on the valve stem while the spring compressor is released.*

47 With all the valves installed, place the cylinder head flat on the bench and, using a hammer and interposed block of wood (or a hide mallet), tap the end of each valve stem to settle the components **(see illustration)**.

1.4 and 1.8 litre engines

48 Fit the hydraulic tappets (to their original positions, if they were not renewed). On 1.4 litre engines, similarly refit the followers **(see illustrations)**. Lubricate all components with fresh oil as they are fitted.

49 Oil the journals, then locate the camshaft(s) in the cylinder head. The cam lobes of No 1 cylinder should be facing upwards (ie No 1 cylinder at TDC).

50 Refit the bearing caps in their correct positions, together with new camshaft oil seal(s). On 1.4 litre engines, locate the lubrication pipe and new end seals on the head, and press in the oil feed stub before refitting the bolts. Tighten the bearing cap bolts by a quarter-turn at a time, to the specified torque.

51 On the 1.4 litre engine, FIAT state that the camshaft should be turned so that each of the hydraulic tappets is held fully compressed for 15 minutes - this will bleed any air from the tappets, which would otherwise impair their correct operation when the engine is eventually started.

52 Refit the coolant pump, using a new gasket. Refer to Chapter 3 as necessary.

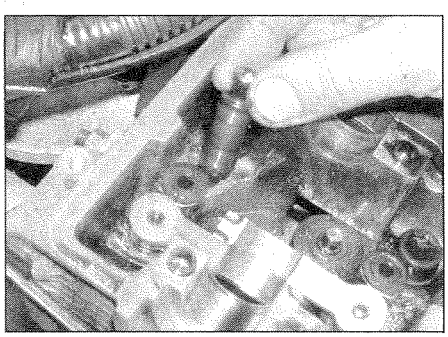
All engines

53 Further refitting is a reversal of the relevant removal procedure.

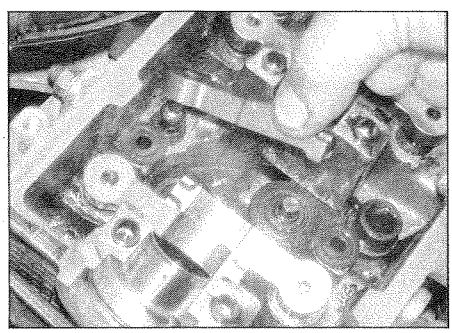
5 Pistons and connecting rods - removal, inspection, and big-end running clearance check

Removal

1 Remove the sump and oil pump pick-up with reference to the relevant Part of Chapter 2.



4.48a On 1.4 litre engines, refit the hydraulic tappets . . .



4.48b . . . and followers

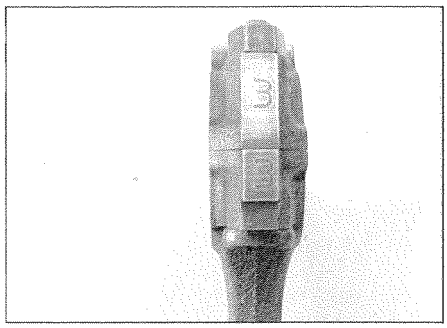
On 1.6 litre engines, remove the oil pump completely, as described in Chapter 2C.

2 The big-end bearing shells can be renewed without having to remove the cylinder head, if the caps are unbolted and the piston/connecting rod pushed gently about one inch up the bore (the crankpin being at its lowest point). If these shells are worn, however, the main bearing shells will almost certainly be worn as well. In this case, the crankshaft should be removed for inspection.

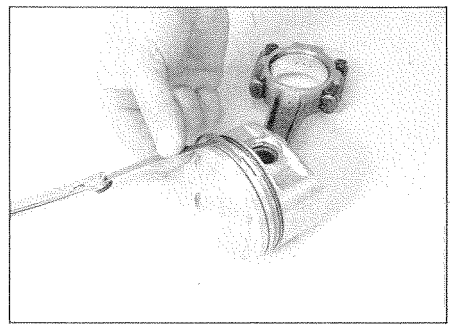
3 To remove the pistons and connecting rods, remove the cylinder head first, as described in the relevant Part of Chapter 2.

4 On the 1.2 litre engine, to improve access, remove the ten bolts securing the vibration damping plate to the main bearing caps, and remove the plate, noting which way round it fits.

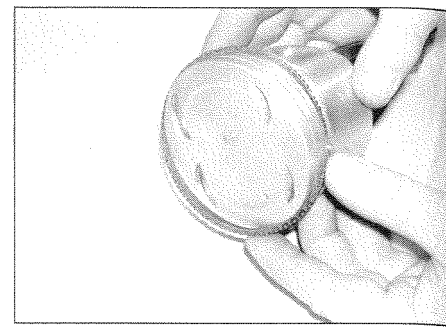
5 The big-end caps and the connecting rods should be numbered 1, 2, 3 and 4 from the



5.5 No 3 connecting rod and bearing cap markings



5.11a Using a feeler blade to remove the second compression ring



5.11b Removing the oil scraper expander ring

timing belt cover end of the engine. Note which side the marks appear, relative to the front- or rear-facing side of the engine, for use when refitting. If no marks are present, make your own marks using a centre-punch **(see illustration)**.

6 Turn the crankshaft as necessary to bring the first crankpin to its lowest point, then unscrew the bolts (or nuts, on the 1.6 litre engine) and remove the big-end cap and shell bearing.

7 On the 1.6 litre engine, wrap a piece of tape around the big-end cap bolts (which remain in the connecting rod). The tape is intended to prevent the bolt threads from scratching the crankshaft journals as the connecting rods are removed.

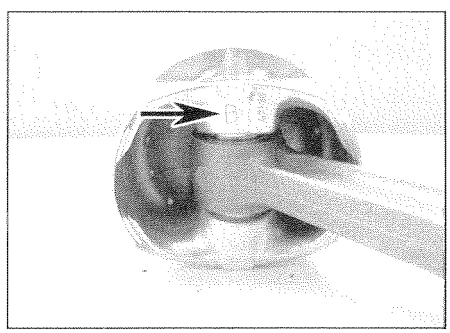
8 Push the piston/rod assembly up the bore and out of the cylinder block. There is one reservation; if a wear ridge has developed at the top of the bores, remove this by careful scraping before trying to remove the piston/rod assemblies. The ridge will otherwise prevent removal, or will break the piston rings during the attempt.

9 Remove the remaining pistons/rods in a similar way. If the bearing shells are to be used again, tape them to their respective caps or rods.

Inspection

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

11 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. Be careful not to scratch the piston with the ends of the ring. The rings are brittle, and will snap if they are spread too far. They are also very sharp - protect your hands and fingers. Always remove the rings from the top of the piston. Keep each set of rings with its piston if the old rings are to be re-used. Note the fitted order of all components, which ring is fitted to which groove, and which way up each is fitted **(see illustrations)**.



5.15 Piston size class marking (arrowed) on underside of piston

12 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.

13 Remove the carbon from the ring grooves in the piston, using an old ring. Break the ring in half to do this (be careful not to cut your fingers - piston rings are sharp). Be careful to remove only the carbon deposits - do not remove any metal, and do not nick or scratch the sides of the ring grooves.

14 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 ring grooves are clear. Fit the rings to their respective grooves, making sure they are positioned the correct way round where applicable.

15 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 refitted **(see illustration)**. Normal piston wear shows up as even vertical wear on the piston thrust surfaces, and slight looseness of the top ring in its groove. New piston rings should always be used when the engine is reassembled.

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

17 Look for scoring and scuffing on the piston 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 lubrication systems should be checked thoroughly.

18 Scorch marks on the sides of the pistons show that piston ring blow-by has occurred. A hole in the piston crown, or burned areas at the edge of the piston crown, indicates that abnormal combustion 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 ignition timing, or a fuel system fault which has led to the engine running on too weak a fuel/air mixture.

19 Corrosion of the piston, in the form of pitting, indicates that coolant has been leaking into the combustion chamber and/or the crankcase. Again, the cause must be corrected, or the problem may persist in the rebuilt engine.

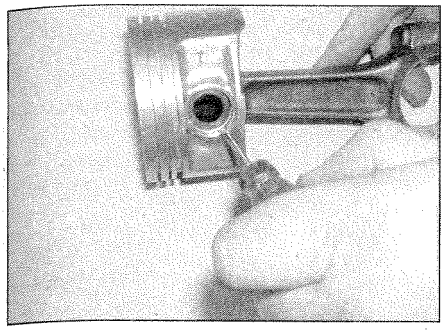
20 Examine each connecting rod carefully for signs of damage, such as cracks around the big-end and small-end bearings. Check that the rod is not bent or distorted. Damage is highly unlikely, unless the engine has been seized or badly overheated. Detailed checking of the connecting rod assembly can only be carried out by an engine repair specialist with the necessary equipment.

21 Although not essential, it is highly recommended that the big-end cap bolts (and nuts, on 1.6 litre engines) are renewed as a complete set prior to refitting. On 1.6 litre engines, the bolts can be tapped out of the connecting rods for renewal.

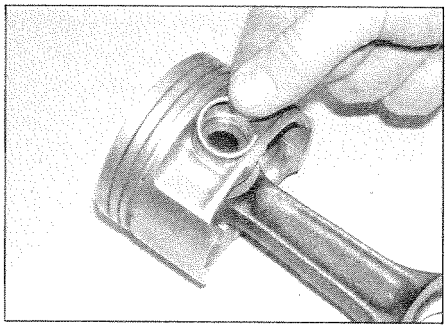
22 On 1.2 litre engines, piston and/or connecting rod renewal should be entrusted to an engine repair specialist, who will have the necessary facilities to remove and install the gudgeon pins. The gudgeon pins can only be removed or refitted after heating the pistons and connecting rods to 240°C.

23 On engines except the 1.2 litre, the gudgeon pins are of the floating type, secured in position by two circlips. On these engines, the pistons and connecting rods can be separated as follows.

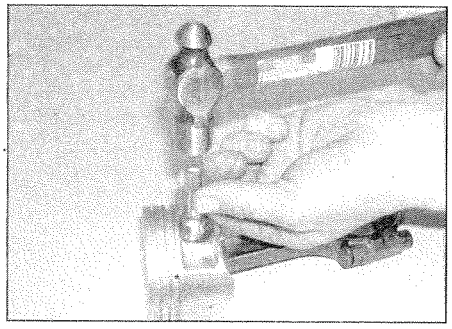
24 Using a small flat-bladed screwdriver, prise out the circlips, and remove the gudgeon pin **(see illustrations)**. Identify the piston and rod to ensure correct reassembly. Discard the circlips - new ones *must* be used on refitting.



5.24a Using a small screwdriver . . .



5.24b . . . prise out the gudgeon pin circlip . . .



5.24c . . . and using a suitable socket if necessary . . .

25 Examine the gudgeon pin and connecting rod small-end bearing for signs of wear or damage. Bush renewal should be entrusted to an engine overhaul specialist.

26 The connecting rods themselves should not be in need of 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.

27 Examine all components, and obtain any new parts as necessary. If new pistons are purchased, they will be supplied complete with gudgeon pins and circlips.

28 On reassembly, position the piston on the connecting rod. Apply a smear of clean engine oil to the gudgeon pin. Slide it (or tap it) into the piston and through the connecting rod small-end. Check that the piston pivots freely on the rod, then secure the gudgeon pin in position with two new circlips. Ensure that each circlip is correctly located in its groove in the piston.

Refitting and big-end bearing running clearance check

29 Prior to refitting the piston/connecting rod assemblies, it is recommended that the big-end bearing running clearance is checked as follows.

Big-end bearing running clearance check

30 Clean the backs of the bearing shells, and the bearing locations in both the connecting rod and bearing cap.

31 Press the bearing shells into their locations, ensuring that the tab on each shell engages in the notch in the connecting rod and cap **(see illustrations)**. Take care not to touch any shell's bearing surface with your fingers. If the original bearing shells are being used for the check, ensure that they are refitted in their original locations. The clearance can be checked in either of two ways.

32 One method is to refit the big-end bearing cap to the connecting rod, ensuring that they are fitted the correct way around, with the bearing shells in place. With the cap retaining nuts/bolts correctly tightened, use an internal micrometer or vernier caliper to measure the internal diameter of each assembled pair of bearing shells. If the diameter of each corresponding crankshaft journal is measured and then subtracted from the bearing internal diameter, the result will be the big-end bearing running clearance.

33 The second, and more accurate method is to use a product called Plastigauge. Ensure that the bearing shells are correctly fitted, then place a strand of Plastigauge on each (cleaned) crankpin journal.

34 Refit the (clean) piston/connecting rod assemblies to the crankshaft, and refit the big-end bearing caps, using the marks made or noted on removal to ensure that they are fitted the correct way around.

35 Tighten the bearing cap nuts/bolts, taking care not to disturb the Plastigauge or rotate the connecting rod during the tightening sequence.

36 Dismantle the assemblies without rotating the connecting rods. Use the scale printed on the Plastigauge envelope to measure the crushed Plastigauge strand, and thus obtain the big-end bearing running clearance.

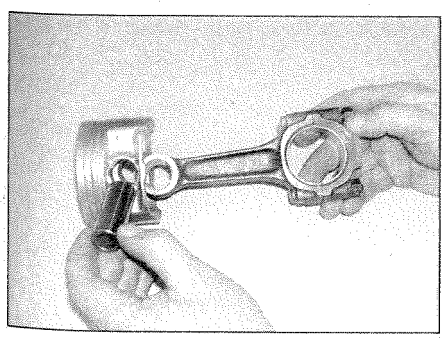
37 If the clearance is significantly different from that expected, the bearing shells may be the wrong size (or excessively worn, if the original shells are being re-used). Make sure that no dirt or oil was trapped between the bearing shells and the caps or block when the clearance was measured. If the Plastigauge was wider at one end than at the other, the crankshaft journal may be tapered.

38 On completion, carefully scrape away all traces of the Plastigauge material from the crankshaft and bearing shells. Use your fingernail, or some other object which is unlikely to score the bearing surfaces.

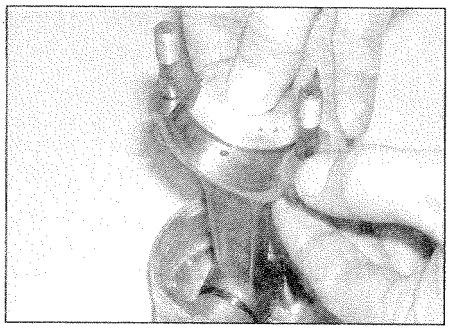
Final piston/connecting rod refitting

39 Ensure that the bearing shells are correctly fitted. If new shells are being fitted, ensure that all traces of the protective grease are cleaned off using paraffin. Wipe dry the shells and connecting rods with a lint-free cloth.

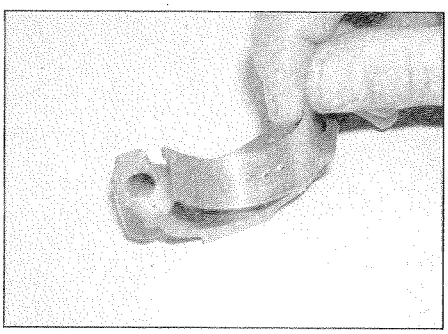
40 Lubricate the cylinder bores, the pistons, and piston rings, then lay out each



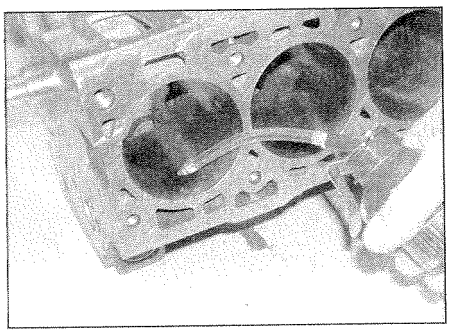
5.24d . . . tap or push out the gudgeon pin



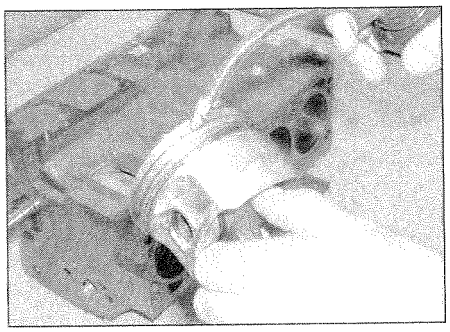
5.31a Fit the bearing shells to the connecting rods . . .



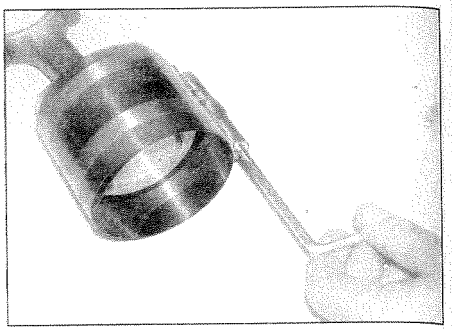
5.31b . . . and big-end bearing caps



5.40a Lubricate the cylinder bores . . .



5.40b . . . pistons, and piston rings



5.41 Clamp the piston rings using a piston ring compressor

piston/connecting rod assembly in its respective position **(see illustrations)**.

41 Start with assembly No 1. Position the piston ring gaps 120° apart, then clamp them in position with a piston ring compressor **(see illustration)**.

42 Insert the piston/connecting rod assembly into the top of cylinder, making sure it is the correct way round, as follows:

a) On 1.2 litre engines, the arrows on the piston crowns point to the timing belt end of the engine.

b) On 1.4 and 1.6 litre engines, the arrow markings on the base of the pistons indicate the direction of engine rotation, and should point to the front of the engine (as seen installed in the car). Some models may have a punched mark off-centre in the piston crown, which should be nearest the timing belt end and front of the engine ***(see illustrations).***

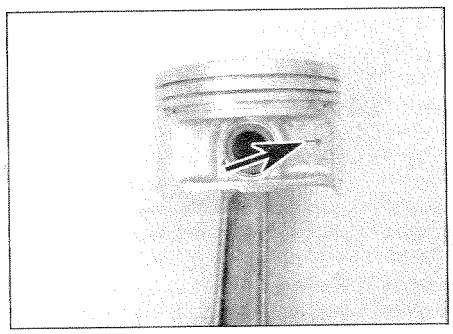
c) On 1.8 litre engines, the larger recesses in the piston crowns are for the inlet valves, so these must be positioned on the inlet side of the engine (the rear of the engine, as seen installed in the car).

43 Using a block of wood or hammer handle against the piston crown, tap the assembly into the cylinder until the piston crown is flush with the top of the cylinder **(see illustration)**.

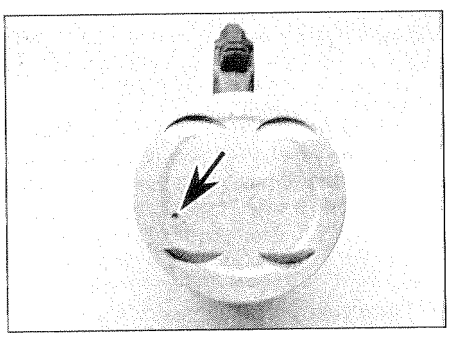
44 Ensure that the bearing shell is still correctly installed. Liberally lubricate the crankpin and both bearing shells **(see illustration)**. Taking care not to mark the cylinder bores, pull the piston/connecting rod assembly down the bore and onto the crankpin.

45 On 1.6 litre engines, remove the tape from the connecting rod bolt threads (where used).

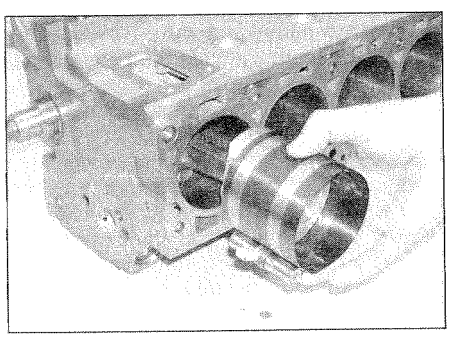
46 Refit the big-end bearing cap, tightening its retaining bolts or nuts finger-tight at first **(see illustrations)**. Note that the faces with the identification marks must match (which means that the bearing shell locating tabs abut each other).



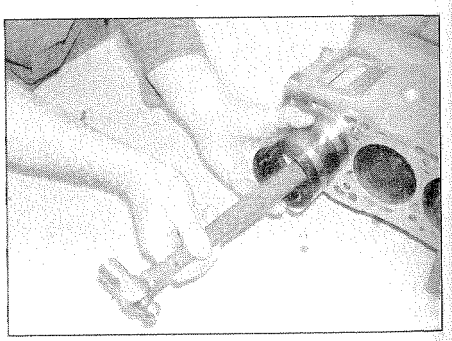
5.42a Arrow marking (arrowed) on piston indicates direction of rotation



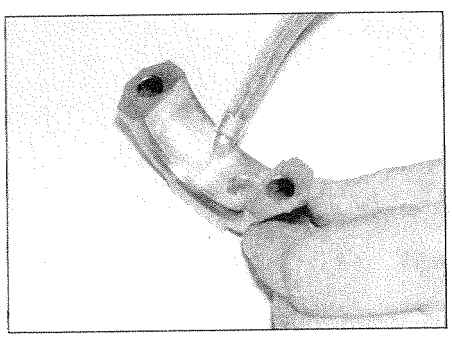
5.42b Punch mark (arrowed) on piston crown



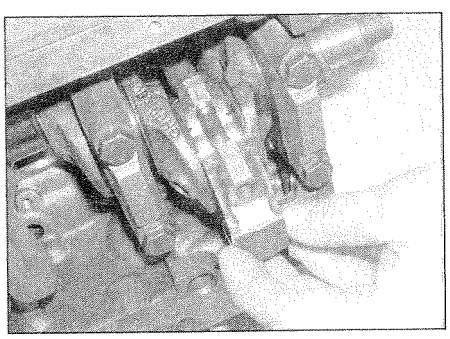
5.42c Inserting the piston/connecting rod assembly



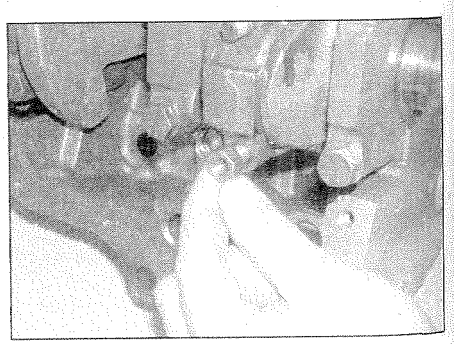
5.43 Tapping the assembly into the cylinder



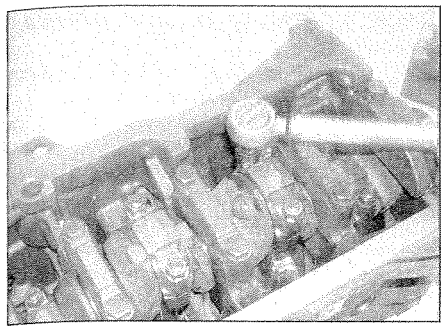
5.44 Lubricating a big-end bearing shell



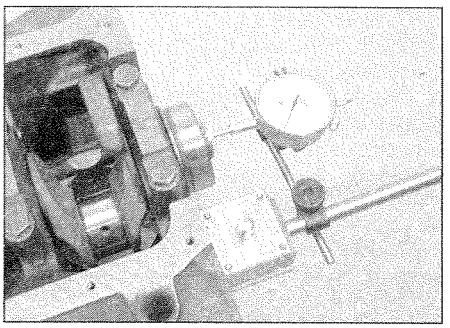
5.46a Refit the big-end bearing caps . . .



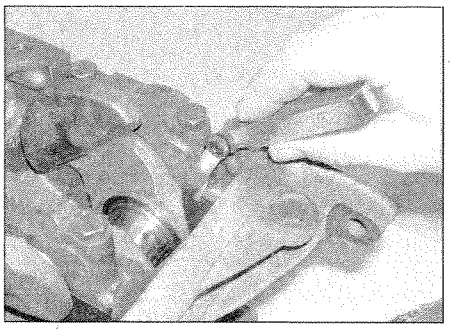
5.46b . . . and secure with the nuts (as on 1.6 litre engine shown) or bolts



5.47 Tightening the big-end bearing caps



6.4 Checking crankshaft endfloat with a dial gauge



6.5 Using feeler blades to assess crankshaft endfloat - 1.6 litre engine shown

47 Tighten the bearing cap retaining nuts or bolts evenly and progressively to the specified torque setting **(see illustration)**. On 1.4 and 1.8 litre engines, tighten the bolts to the Stage 1 torque, then angle-tighten them to the specified angle using an angle-measuring gauge.

48 Once the bearing caps have been correctly tightened, rotate the crankshaft. Check that it turns freely; some stiffness is to be expected if new components have been fitted, but there should be no signs of binding or tight spots.

49 Refit the remaining three piston/connecting rod assemblies in the same way.

50 On 1.2 litre models, refit the vibration damping plate to the main bearing caps, tightening the bolts securely.

51 Refit the cylinder head, oil pump (or pick-up) and sump with reference to the relevant Part of Chapter 2.

6 Crankshaft - removal and inspection

Removal

1 Remove the sump, oil pump and pick-up tube, and the flywheel/driveplate as described in the relevant Part of Chapter 2. Where applicable, unbolt and remove the oil spill tube from the base of the engine.

2 Remove the pistons and connecting rods, as described in Section 5. However, if no work is to be done on the pistons and connecting rods, there is no need to remove the cylinder head, or to push the pistons out of the cylinder bores. The pistons should just be pushed far enough up the bores that they are positioned clear of the crankshaft journals.

3 Unbolt the crankshaft rear oil seal housing from the cylinder block, and recover the gasket (where fitted).

4 Before removing the crankshaft, check the endfloat using a dial gauge **(see illustration)**. Push the crankshaft fully one way, and then zero the gauge. Push the crankshaft fully the other way, and check the endfloat. The result can be compared with the specified amount, and will give an indication as to whether new thrustwashers are required.

5 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 use feeler blades to measure the gap - on all engines except the 1.6 litre, measure between the centre main bearing thrustwasher and the crankshaft web; on 1.6 litre engines, measure between the rear main bearing and the crankshaft web **(see illustration)**.

6 Note the markings on the main bearing caps. There should be one line on the cap nearest the timing end, two on the second cap, C on the centre cap, then three and four lines on the remaining caps. Alternatively, on some engines there are no notches on the cap nearest the timing end (No 1 cylinder), one notch on No 2 cap, two notches on No 3 cap, and three notches on No 4 cap. If you are in any doubt about the markings on your engine, make your own using paint or a centre-punch **(see illustrations)**.

7 Loosen and remove the main bearing cap retaining bolts, and lift off each bearing cap. Recover the lower bearing shells, and tape them to their respective caps for safe-keeping.

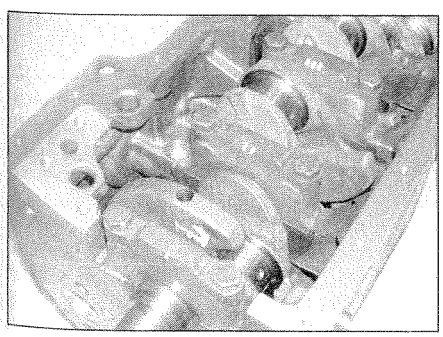
8 Lift the crankshaft from the crankcase, and remove the upper bearing shells from the crankcase. If the shells are to be used again, keep them identified for position. Where applicable, also remove the thrustwashers from their position either side of the centre main bearing (1.4 and 1.8 litre engines) or rear main bearing (1.6 litre engines). On 1.2 litre engines, the upper half of the centre main bearing shell has thrust flanges.

Inspection

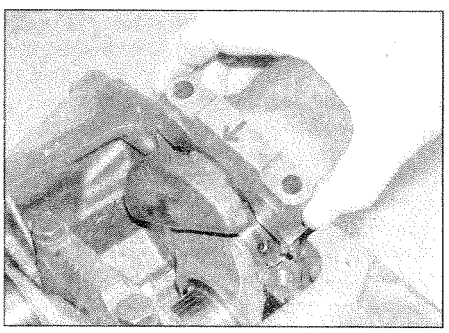
9 Wash the crankshaft in a suitable solvent and allow it to dry. Flush the oil holes thoroughly, to ensure that are not blocked - use a pipe cleaner or a needle brush if necessary. Remove any sharp edges from the edge of the holes which may damage the new bearings when they are installed.

10 Inspect the main bearing and crankpin journals carefully; if uneven wear, cracking, scoring or pitting are evident, the crankshaft should be reground by an engineering workshop, and refitted to the engine with undersize bearings.

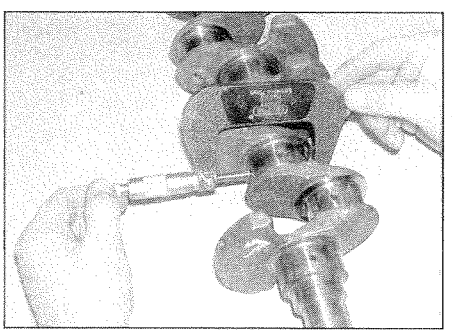
11 Use a micrometer to measure the diameter of each main bearing journal **(see illustration)**. Taking a number of measurements on the surface of each journal will reveal if it is worn unevenly. Differences in diameter measured at 90° intervals indicate that the journal is out-of-round. Differences in



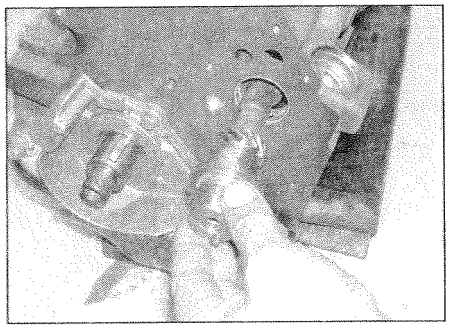
6.6a Showing the notches identifying the main bearing cap locations



6.6b On this engine, we marked the rear cap to show its fitted direction



6.11 Checking the crankshaft journals using a micrometer



7.3 Withdrawing the auxiliary shaft

diameter measured along the length of the journal, indicate that the journal is tapered. Again, if wear is detected, the crankshaft can be reground by an engineering workshop and refitted with undersize bearings.

12 Check the oil seal journals at either end of the crankshaft. If they appear excessively scored or damaged, they may cause the new seals to leak when the engine is reassembled. It may be possible to repair the journal; seek the advice of an engineering workshop.

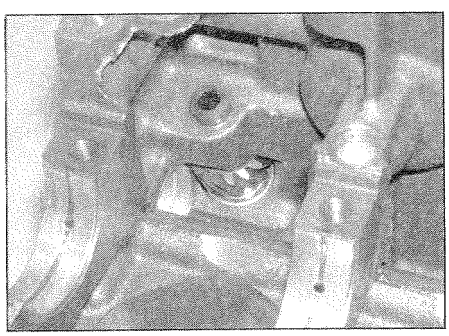
13 Measure the crankshaft runout by setting up a DTI gauge on the centre main bearing journal and rotating the shaft in V - blocks. The maximum deflection of the gauge will indicate the runout. Take precautions to protect the bearing journals and oil seal mating surfaces from damage during this procedure. A maximum runout figure is not quoted by the manufacturer, but use the figure of 0.05 mm as a rough guide. If the runout exceeds this figure, crankshaft renewal should be considered - consult your FIAT dealer or an engine rebuilding specialist for advice.

14 Refer to Section 9 for details of main and big-end bearing inspection.

7 Auxiliary shaft (1.6 litre engines) - removal, inspection and refitting

Removal

1 Remove the auxiliary shaft sprocket as described in Chapter 2C, Section 5.



7.5 Auxiliary shaft oil pump driven gear

2 Unscrew the three bolts, and withdraw the auxiliary shaft flange from the engine. Recover the gasket.

3 The auxiliary shaft can now be withdrawn from the engine **(see illustration)**. Note that, if the oil pump has not been removed, the oil pump driveshaft will turn as the shaft is removed.

4 Turn the auxiliary shaft as necessary so that it does not hang up on the bearings inside the engine. Keep the shaft horizontal as it is withdrawn; force should not be used, or required, otherwise the shaft and bearings could be damaged.

Inspection

5 Check the condition of the oil pump drivegear. If the teeth are excessively worn, it is likely that a new shaft will be needed, but consult an engine rebuilding specialist first. Also check the condition of the driven gear mounted in the crankcase **(see illustration)**.

6 Examine the shaft's two bearings for signs of scoring or excessive wear. If a micrometer is available, the bearing diameters can be checked against the specified values.

7 If the shaft bearings are worn, it is likely that the shaft bushes in the cylinder block will also be worn. Renewal is possible, but a press will be required, making this a job for an engine specialist.

Refitting

8 Refitting is a reversal of removal, using a new flange gasket. It is advisable to fit a new auxiliary shaft oil seal, as described in Chapter 2C, Section 9. If the oil pump has not been removed, check (by turning the auxiliary shaft) that the oil pump drive is working properly.

8 Cylinder block/crankcase - cleaning and inspection

Cleaning

1 Remove all external components and brackets from the block, including (as applicable) the rear engine plate, oil pressure switch, breather pipe, coolant pump and alternator/power steering pump/air conditioning compressor mounting brackets.

2 For complete cleaning, the core plugs should ideally be removed. Drill a small hole in the plugs, then insert a self-tapping screw into the hole. Pull out the plugs by pulling on the screw with a pair of grips, or by using a slide hammer.

3 Where applicable, undo the retaining bolts and remove the piston oil jet spray tubes from inside the cylinder block.

4 Scrape all traces of gasket from the cylinder block/crankcase, taking care not to damage the gasket/sealing surfaces.

5 Remove all oil gallery plugs (where fitted). The plugs are usually very tight - they may have to be drilled out, and the holes re-tapped. Use new plugs when the engine is reassembled.

6 If the block is very dirty have it steam-cleaned, otherwise use paraffin to clean it.

7 Clean all oil holes and oil galleries again and dry thoroughly, then apply a light film of oil to all mating surfaces, to prevent rusting. Smear the cylinder bores with a light coating of oil.

8 All threaded holes must be clean, to ensure accurate torque readings during reassembly. To clean the threads, run the correct-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.

9 Apply suitable sealant to the new oil gallery plugs, and insert them into the holes in the block. Tighten them securely.

10 Where applicable, refit the piston oil jet spray tubes to the cylinder block, and securely tighten the retaining bolts. Bend over the tabs to lock the bolts.

11 Fit the new core plugs with sealant applied to their perimeters before using a suitable metal tube to drive them squarely into position.

Inspection

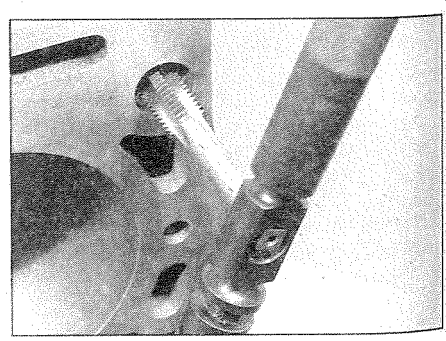
12 Visually check the cylinder block for cracks and corrosion. Look for stripped threads in the threaded holes. If there has been any history of internal water leakage, it may be worthwhile having an engine overhaul specialist check it with special equipment.

13 Check each cylinder bore for scuffing and scoring. Check for signs of a wear ridge at the top of the cylinder, indicating that the bore is excessively worn.

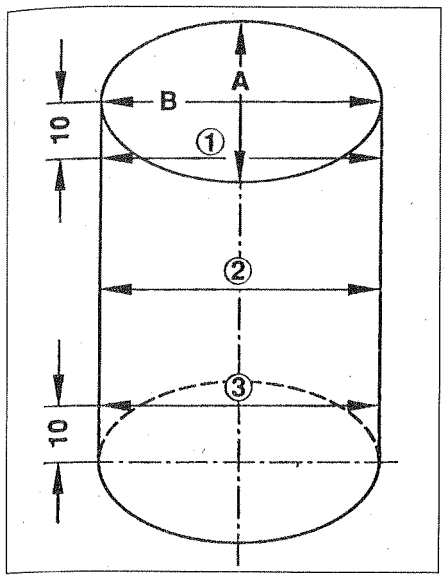
14 If the necessary measuring equipment is available, measure the bore diameters at the top (just under the wear ridge), centre, and bottom, parallel to the crankshaft axis **(see illustration)**.

15 Next, measure the bore diameters at the same three locations, at right-angles to the crankshaft axis. If there is any doubt about the condition of the cylinder bores, seek the advice of a FIAT dealer or suitable engine reconditioning specialist.

16 If the engine is not going to be reassembled right away, cover it with a large plastic



8.8 To clean the cylinder block bolt threads, run a correct-size tap into the holes



8.14 Three bore measurement points - dimensions in mm

A Measure at right-angles to the crankshaft axis
B Measure in line with the crankshaft axis

bag to keep it clean and prevent rusting. If the engine is ready for reassembly, refit all the components and brackets removed.

9 Main and big-end bearings - inspection and selection

Inspection

1 Even though the main and big-end bearings should be renewed during the engine overhaul, the old bearings should be retained for close examination, as they may reveal valuable information about the condition of the engine **(see illustration)**. The bearing shells are available in different thicknesses to match the diameter of the journal.

2 Bearing failure can occur due to lack of lubrication, the presence of dirt or other foreign particles, overloading the engine, or corrosion. Regardless of the cause of bearing failure, the cause must be corrected (where applicable) before the engine is reassembled, to prevent it from happening again.

3 When examining the bearing shells, remove them from the cylinder block/crankcase, the main bearing caps, the connecting rods and the connecting rod big-end bearing caps. Lay them out on a clean surface in the same general position as their location in the engine. This will enable you to match any bearing problems with the corresponding crankshaft journal. *Do not* touch any shell's bearing surface with your fingers while checking it.

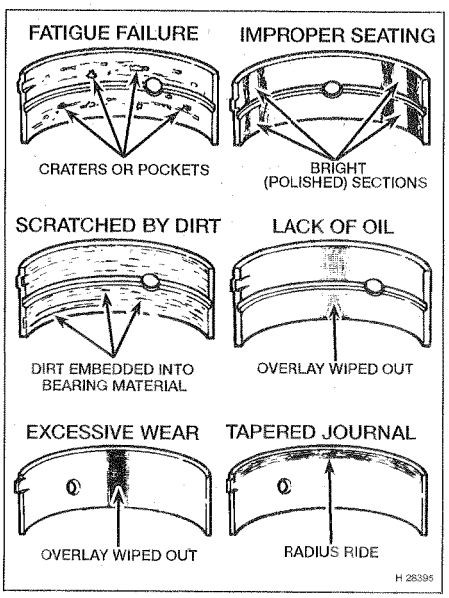
4 Dirt and other foreign matter gets into the engine in a variety of ways. It may be left in the engine during assembly, or it may pass through filters or the crankcase ventilation system. It may get into the oil, and from there into the bearings. Metal chips from machining operations and normal engine wear are often present. Abrasives are sometimes left in engine components after reconditioning, especially when parts are not thoroughly cleaned using the proper cleaning methods.

5 Whatever the source, these foreign objects 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. The best prevention for this cause of bearing failure is to clean all parts thoroughly, and keep everything spotlessly-clean during engine assembly. Regular engine oil and filter changes are also recommended.

6 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 can be the result of misaligned oil holes in a bearing shell, will also oil-starve a bearing, and destroy it.

7 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.

8 Driving habits can have a definite effect on bearing life. Full-throttle, low-speed operation (labouring the engine) puts very high loads on bearings, tending 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.



9.1 Typical bearing failures

9 Short-distance driving leads to corrosion of bearings, because insufficient engine heat is produced to drive off the condensed water and corrosive gases. These products collect in the engine oil, forming acid and sludge. As the oil is carried to the engine bearings, the acid attacks and corrodes the bearing material.

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

11 *Do not* touch any shell's bearing surface with your fingers during reassembly; there is a risk of scratching the delicate surface, or of depositing particles of dirt on it.

12 As mentioned at the beginning of this Section, the bearing shells should be renewed as a matter of course during engine overhaul; not to do so is false economy.

Selection

13 Main and big-end bearings are available in standard sizes and a range of undersizes to suit reground crankshafts - refer to *Specifications* for details. The engine reconditioner will select the correct bearing shells for machined crankshaft.

14 The running clearances can be checked when the crankshaft is refitted with its new bearings.

10 Engine overhaul - reassembly sequence

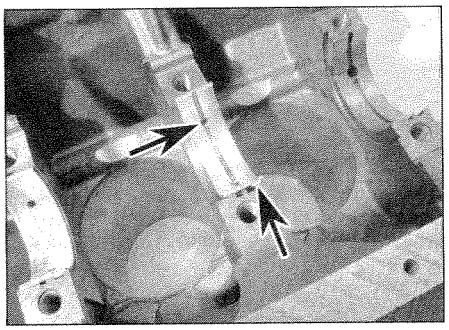
2E

1 Before reassembly begins, ensure that all new parts have been obtained, and that all necessary tools are available. Read through the entire procedure to familiarise yourself with the work involved, and to ensure that all items necessary for reassembly of the engine are at hand. In addition to all normal tools and materials, thread-locking compound will be needed. A tube of sealant will also be required for the joint faces that are fitted without gaskets.

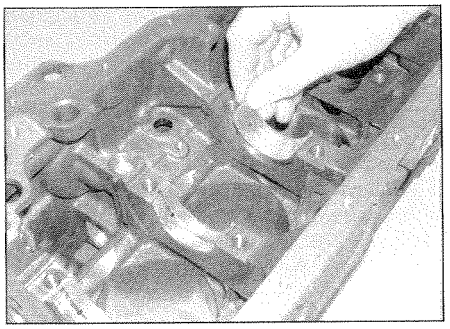
2 In order to save time and avoid problems, engine reassembly can be carried out in the following order:

a) Crankshaft (Section 11).
b) Piston/connecting rod assemblies (Section 5).
c) Oil pump (relevant Part of Chapter 2).
d) Sump (relevant Part of Chapter 2).
e) Flywheel (relevant Part of Chapter 2).
f) Cylinder head (relevant Part of Chapter 2).
g) Coolant pump (see Chapter 3)
h) Timing belt tensioner and sprockets, and timing belt (relevant Part of Chapter 2).
i) Engine external components.

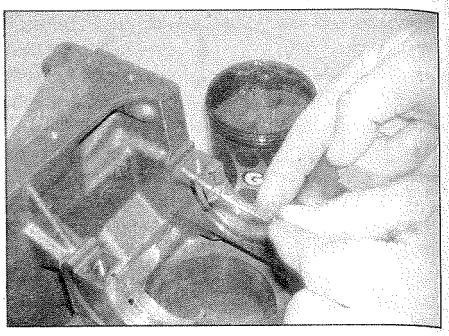
3 At this stage, all engine components should be absolutely clean and dry, with all faults repaired. The components should be laid out on a completely clean work surface.



11.3 Bearing shell partially fitted, showing lug and oil hole (arrowed)



11.5 Fitting the plain centre bearing on a 1.6 litre engine



11.6 Fitting the crankshaft thrustwashers on a 1.6 litre engine

11 Crankshaft - refitting and main bearing running clearance check

Crankshaft - initial refitting

1 Crankshaft refitting is the first stage of engine reassembly following overhaul. At this point, it is assumed that the crankshaft, cylinder block/crankcase and bearings have been cleaned, inspected and reconditioned or renewed.

2 Place the cylinder block on a clean, level work surface, with the crankcase facing upwards. Where necessary, unbolt the bearing caps and lay them out in order to ensure correct reassembly. If they are still in place, remove the bearing shells from the caps and the crankcase, and wipe out the inner surfaces with a clean rag - they must be kept spotlessly clean. Clean the bearing cap bolts, and check their threads for signs of damage.

3 Clean the rear surface of the new bearing shells with a rag, and fit them on the bearing saddles. Ensure that the orientation lugs on the shells engage with the recesses in the saddles, and that the oil holes are correctly aligned **(see illustration).** Do not hammer or otherwise force the bearing shells into place. It is critically important that the surfaces of the bearings are kept free from damage and contamination.

4 On 1.2 litre engines, locate the bearing shell with the thrust flanges into the centre main bearing position.

5 On 1.6 litre engines, the centre main bearings are plain - ie they do not have lubrication grooves **(see illustration).**

6 On engines except the 1.2 litre, fit the crankshaft thrustwashers to their relevant locations (where necessary, stick them in position with a little grease). On 1.6 litre engines, the washers are fitted to No 5 main bearing; on the 1.4 and 1.8 litre engines, the washers fit around the centre main bearing **(see illustration).**

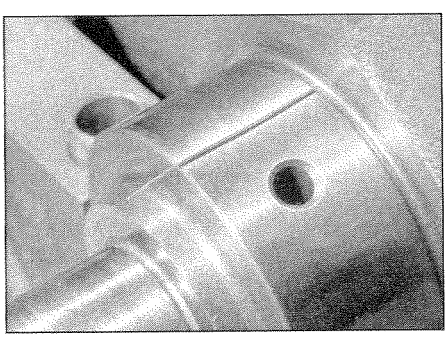
7 Give the newly-fitted bearing shells and the crankshaft journals a final clean with a rag. Check that the oil holes in the crankshaft are free from dirt, as any left here will become embedded in the new bearings when the engine is first started.

8 Carefully lay the crankshaft in the crankcase, taking care not to dislodge the bearing shells.

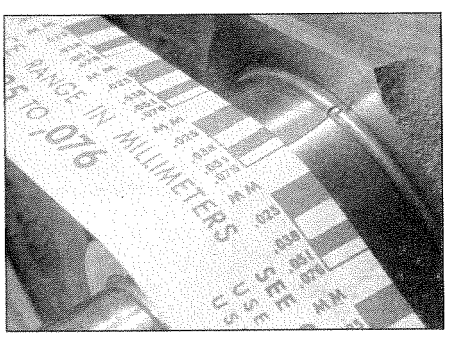
Main bearing running clearance check

9 When the crankshaft and bearings are refitted, a clearance must exist between them to allow lubricant to circulate. This clearance is impossible to check using feeler blades, but a product called Plastigauge can be used. This consists of a thin strip of soft plastic that is crushed between the bearing shells and journals when the bearing caps are tightened up. The width of the crushed strip then indicates the size of the clearance gap.

10 Cut off five pieces of Plastigauge, just shorter than the length of the crankshaft journal. Lay a piece on each journal, in line with its axis **(see illustration).**



11.10 Lay a piece of Plastigauge on each journal, in line with the crankshaft axis



11.15 Measure the width of the crushed Plastigauge, using the scale provided

11 Wipe off the rear surfaces of the new lower half main bearing shells and fit them to the main bearing caps, again ensuring that the locating lugs engage correctly.

12 Fit the caps in their correct locations on the bearing saddles, using the manufacturers markings as a guide. Ensure that they are correctly orientated - the caps should be fitted such that the recesses for the bearing shell locating lugs are on the same side as those in the bearing saddle.

13 On engines except the 1.2 litre, fit the remaining crankshaft thrustwashers, using the information in paragraph 6.

14 Insert and tighten the main bearing bolts until they are all correctly torqued. Do not allow the crankshaft to rotate at all whilst the Plastigauge is in place. Progressively unbolt the bearing caps and remove them, taking care not to dislodge the Plastigauge.

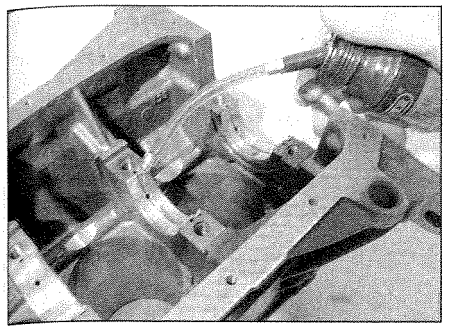
15 The width of the crushed Plastigauge can now be measured, using the scale provided **(see illustration).** Use the correct scale, as both imperial and metric are printed. This measurement indicates the running clearance - compare it with that listed in *Specifications.*

16 If the clearance is outside the tolerance, it may be due to dirt or debris trapped under the bearing surface; try cleaning them again and repeat the clearance check. If the results are still unacceptable, re-check the journal diameters and the bearing sizes. Note that if the Plastigauge is thicker at one end, the journals may be tapered and as such, will require regrinding.

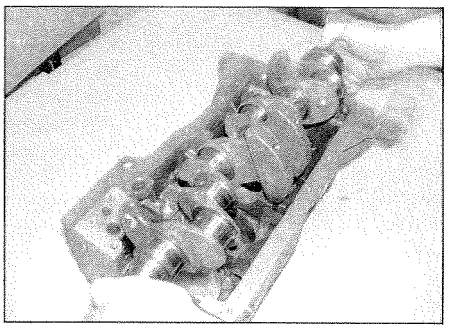
17 When you are satisfied that the clearances are correct, carefully remove the remains of the Plastigauge from the journals and bearing faces. Use a soft, plastic or wooden scraper, as anything metallic is likely to damage the surfaces.

Crankshaft - final refitting

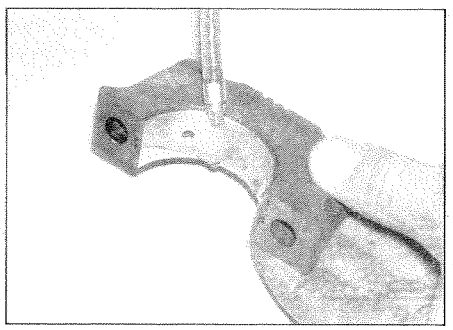
18 Lift the crankshaft out of the crankcase. Wipe off the surfaces of the bearings in the crankcase and the bearing caps. Where applicable (see paragraph 6), fit the thrust washers, using grease to hold them in position. Ensure they are seated correctly in the machined recesses, with the oil grooves facing outwards



11.19 Lubricate the crankcase main bearing shells



11.20 Fitting the crankshaft



11.21 Lubricate the main bearing cap shells - plain No 3 shell on a 1.6 litre engine shown

19 Liberally coat the bearing shells in the crankcase with clean engine oil **(see illustration)**.

20 Lower the crankshaft into position in the crankcase **(see illustration)**.

21 Lubricate the lower bearing shells in the main bearing caps with clean engine oil. Make sure that the locating lugs on the shells are still engaged with the corresponding recesses in the caps **(see illustration)**.

22 Fit the main bearing caps in the correct order and orientation. Lightly oil the bearing cap bolt threads, then insert the bolts, and hand-tighten them only **(see illustrations)**.

23 Working from the centre bearing cap outwards, tighten the main bearing bolts to their specified torque **(see illustration)**. On all engines except the 1.6 litre, the bolts are tightened in two stages - tighten all the bolts to the Stage 1 setting before tightening further through the specified angle (use an angle-measuring gauge if possible, to ensure accuracy).

24 Fit a new oil seal to the crankshaft rear oil seal housing (or fit a new oil seal housing, as applicable). Apply grease to the seal lips. Where applicable, tighten the housing bolts securely, ensuring that the edge of the housing is kept square to the edge of the crankcase. On 1.6 litre engines, similarly refit the front oil seal flange, using a new seal - refer to Chapter 2C.

25 Check that the crankshaft rotates freely by turning it by manually. If resistance is felt, re-check the running clearances, as described above.

26 Carry out a check of the crankshaft endfloat as described in Section 6. If the thrust surfaces of the crankshaft have been checked and new thrust bearings (or main bearings, on the 1.2 litre engine) have been fitted, then the endfloat should be within specification.

27 Refit the pistons and connecting rods as described in Section 5.

28 Refit the flywheel/driveplate, oil pump and pick-up tube, and sump with reference to the relevant Parts of Chapter 2. Where applicable, refit the oil spill tube to the base of the engine before fitting the sump.

12 Engine - initial start-up after overhaul and reassembly

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

2 Remove the spark plugs, then remove the fuel pump fuse or relay (refer to Chapter 12 if necessary).

3 Turn the engine on the starter until the oil pressure warning light goes out. Refit the spark plugs, and reconnect the ECU.

4 Start the engine, noting that this may take a little longer than usual, due to the fuel system components having been disturbed.

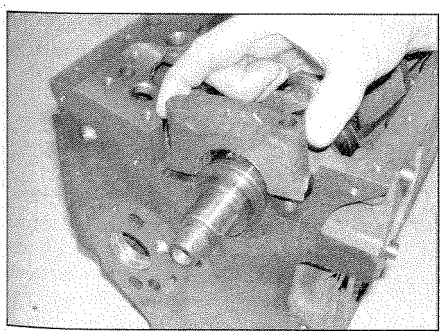
5 While the engine is idling, check for fuel, water and oil leaks. Don't be alarmed if there are some odd smells and smoke from parts getting hot and burning off oil deposits.

6 Assuming all is well, keep the engine idling until hot water is felt circulating through the top hose, then switch off the engine.

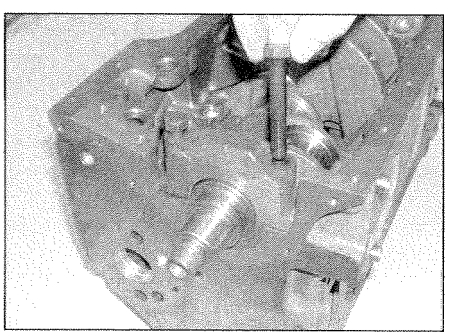
7 Recheck the oil and coolant levels as described in Chapter 1, and top-up as necessary.

8 There is no need to re-tighten the cylinder head bolts once the engine has first run after reassembly.

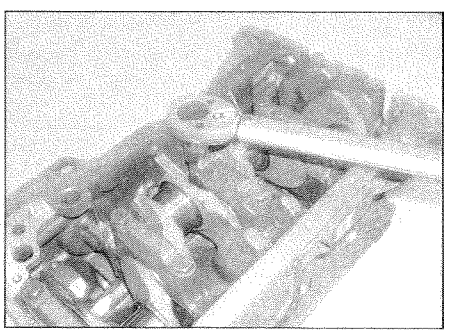
9 If new pistons, rings or crankshaft bearings have been fitted, the engine must be treated as new, and run-in for the first 500 miles (800 km). *Do not* operate the engine at full-throttle, or allow it to labour at low engine speeds in any gear. It is recommended that the oil and filter be changed at the end of this period.



11.22a Fit the main bearing caps . . .



11.22b . . . and loosely fit the retaining bolts



11.23 Tighten the main bearing cap bolts to the specified torque