






# Chapter 2 Part A: OHV and HCS engines

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## Degrees of difficulty

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

### General

Engine type . . . . .	Four-cylinder, in-line overhead valve
Capacity:	
1.1 litre:	
OHV engines . . . . .	1117 cc
HCS engines . . . . .	1118 cc
1.3 litre . . . . .	1297 cc
Bore:	
All except 1.1 litre HCS engine . . . . .	73.96 mm
1.1 litre HCS engine . . . . .	68.68 mm
Stroke:	
All except 1.1 litre OHV engine . . . . .	75.48 mm
1.1 litre OHV engine . . . . .	64.98 mm
Compression ratio:	
1.1 litre OHV engines (pre-1986) . . . . .	9.15:1
1.1 litre OHV engines (1986 onwards) . . . . .	9.5:1
1.1 litre HCS engines . . . . .	9.5:1
1.3 litre OHV engines . . . . .	9.3:1
1.3 litre HCS engines . . . . .	9.5:1
Firing order . . . . .	1-2-4-3 (No 1 at timing cover end)

### Cylinder block

Material . . . . .	Cast iron
Number of main bearings:	
1.1 litre . . . . .	3
1.3 litre . . . . .	5
Cylinder bore diameter:	
All except 1.1 litre HCS engines:	
Standard (1) . . . . .	73.940 to 73.950 mm
Standard (2) . . . . .	73.950 to 73.960 mm
Standard (3) . . . . .	73.960 to 73.970 mm
Standard (4) - all except HCS engines . . . . .	73.970 to 73.980 mm
Oversize 0.5 mm . . . . .	74.500 to 74.510 mm
Oversize 1.0 mm . . . . .	75.000 to 75.010 mm

## 2A•2 OHV and HCS engines

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### Cylinder bore diameter (continued):

#### 1.1 litre HCS engine:

Standard (1) .....	68.680 to 68.690 mm
Standard (2) .....	68.690 to 68.700 mm
Standard (3) .....	68.700 to 68.710 mm
Oversize 0.5 mm .....	69.200 to 69.210 mm
Oversize 1.0 mm .....	69.700 to 69.710 mm

#### Main bearing shell inner diameter:

Standard .....	57.009 to 57.036 mm
0.254 mm undersize .....	56.755 to 56.782 mm
0.508 mm undersize .....	56.501 to 56.528 mm
0.762 mm undersize .....	56.247 to 56.274 mm

Camshaft bearing inner diameter .....	39.662 to 39.682 mm
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### Crankshaft

#### Main bearing journal diameter:

Standard .....	56.990 to 57.000 mm
Standard with yellow dot (1.1 litre only) .....	56.980 to 56.990 mm
0.254 mm undersize .....	56.726 to 56.746 mm
0.508 mm undersize .....	56.472 to 56.492 mm
0.762 mm undersize .....	56.218 to 56.238 mm

#### Main bearing running clearance:

All except 1.3 litre HCS engine .....	0.009 to 0.046 mm
1.3 litre HCS engine .....	0.009 to 0.056 mm

#### Crankpin (big-end) diameter:

##### OHV engines:

Standard .....	42.99 to 43.01 mm
0.254 mm undersize .....	42.74 to 42.76 mm
0.508 mm undersize .....	42.49 to 42.51 mm
0.762 mm undersize .....	42.24 to 42.26 mm

##### HCS engines:

Standard .....	40.99 to 41.01 mm
0.254 mm undersize .....	40.74 to 40.76 mm
0.508 mm undersize .....	40.49 to 40.51 mm
0.762 mm undersize .....	40.24 to 40.26 mm

#### Thrustwasher thickness:

Standard .....	2.80 to 2.85 mm
Oversize .....	2.99 to 3.04 mm

#### Crankshaft endfloat:

OHV engines .....	0.079 to 0.279 mm
HCS engines .....	0.075 to 0.285 mm

Maximum permissible journal and crankpin ovality and taper .....	0.0254 mm
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### Camshaft

Number of bearings .....	3
Drive .....	Single chain
Thrust plate thickness .....	4.457 to 4.508 mm
Camshaft bearing diameter .....	39.615 to 39.636 mm
Camshaft bearing bush internal diameter .....	39.662 to 39.682 mm
Camshaft endfloat .....	0.02 to 0.19 mm
Number of links/Length of drive chain .....	46/438.15 mm

### Piston and piston rings

#### Diameter:

##### All except 1.1 litre HCS engines:

Standard (1) .....	73.910 to 73.920 mm
Standard (2) .....	73.920 to 73.930 mm
Standard (3) .....	73.930 to 73.940 mm
Standard (4) .....	73.940 to 73.950 mm
0.5 mm oversize .....	74.460 to 74.485 mm
1.0 mm oversize .....	74.960 to 74.985 mm

##### 1.1 litre HCS engines:

Standard (1) .....	68.65 to 68.66 mm
Standard (2) .....	68.66 to 68.67 mm
Standard (3) .....	68.67 to 68.68 mm
0.5 mm oversize .....	69.20 to 69.21 mm
1.0 mm oversize .....	69.70 to 69.71 mm

Piston-to-bore clearance .....	0.015 to 0.050 mm
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#### Piston ring end gap:

Compression .....	0.25 to 0.45 mm
Oil control .....	0.20 to 0.40 mm

**Cylinder head**

Material .....	Cast iron
Maximum permissible cylinder head distortion measured over entire length .....	0.15 mm
Minimum combustion chamber depth after skimming:	
OHV engines .....	9.07 mm
HCS engines .....	14.4 ± 0.15 mm
Valve seat angle .....	45°
Valve seat width:	
OHV engines:	
Inlet .....	1.20 to 1.75 mm
Exhaust .....	1.20 to 1.70 mm
HCS engines (inlet and exhaust) .....	1.18 to 1.75 mm
Seat cutter correction angle:	
Upper .....	30°
Lower .....	75°
Valve guide bore (standard) .....	7.907 to 7.938 mm

**Valves - general**

Operation .....	Cam followers and pushrods
Valve timing:	
Pre-1986 OHV engines:	
Inlet valve opens .....	21° BTDC
Inlet valve closes .....	55° ABDC
Exhaust valve opens .....	70° BBDC
Exhaust valve closes .....	22° ATDC
1986 onwards OHV engines:	
Inlet valve opens .....	14° BTDC
Inlet valve closes .....	46° ABDC
Exhaust valve opens .....	65° BBDC
Exhaust valve closes .....	11° ATDC
1.1 litre HCS engines:	
Inlet opens .....	14° BTDC
Inlet closes .....	46° ABDC
Exhaust opens .....	49° BBDC
Exhaust closes .....	11° ATDC
1.3 litre HCS engines:	
Inlet opens .....	16° BTDC
Inlet closes .....	44° ABDC
Exhaust opens .....	51° BBDC
Exhaust closes .....	9° ATDC
Valve clearance (cold):	
Inlet .....	0.22 mm
Exhaust:	
OHV engines .....	0.59 mm
HCS engines .....	0.32 mm
Cam follower diameter .....	13.081 to 13.094 mm
Cam follower clearance in bore .....	0.016 to 0.062 mm
Valve spring free length:	
OHV engines:	
Pre-1986 .....	42.0 mm
1986 onwards:	
1.1 litre .....	41.2 mm
1.3 litre .....	42.4 mm
HCS engines .....	41.0 mm

**Inlet valve**

Length:	
OHV engines .....	105.45 to 106.45 mm
HCS engines .....	103.70 to 104.40 mm
Head diameter:	
OHV engines:	
Pre-1986 .....	38.02 to 38.28 mm
1986 onwards:	
1.1 litre .....	32.89 to 33.15 mm
1.3 litre .....	38.02 to 38.28 mm
HCS engines:	
1.1 litre .....	32.90 to 33.10 mm
1.3 litre .....	34.40 to 34.60 mm

## 2A•4 OHV and HCS engines

### Inlet valve (continued)

Stem diameter:	
OHV engines:	
Standard	7.866 to 7.868 mm
0.076 mm oversize	7.944 to 7.962 mm
0.38 mm oversize	8.249 to 8.267 mm
HCS engines:	
Standard	7.025 to 7.043 mm
0.076 mm oversize	7.225 to 7.243 mm
0.381 mm oversize	7.425 to 7.443 mm
Valve stem clearance in guide	0.021 to 0.070 mm

### Exhaust valve

Length:	
OHV engines:	
Pre-1986	105.15 to 106.15 mm
1986 onwards	106.04 to 107.04 mm
HCS engines	104.02 to 104.72 mm
Head diameter:	
OHV engines	29.01 to 29.27 mm
HCS engines	28.90 to 29.10 mm
Stem diameter:	
OHV engines:	
Standard	7.846 to 7.864 mm
0.076 mm oversize	7.922 to 7.940 mm
0.38 mm oversize	8.227 to 8.245 mm
HCS engines:	
Standard	6.999 to 7.017 mm
0.076 mm oversize	7.199 to 7.217 mm
0.381 mm oversize	7.399 to 7.417 mm
Valve stem clearance in guide	0.043 to 0.092 mm

### Lubrication system

Oil pump type	Rotor, external driven by gear on camshaft
Minimum oil pressure at 80° C (175° F):	
Engine speed 750 rpm	0.6 bar (8.5 lbf/in <sup>2</sup> )
Engine speed 2000 rpm	1.5 bar (21.3 lbf/in <sup>2</sup> )
Oil pressure warning lamp operates	0.32 to 0.53 bar (4.5 to 7.5 lbf/in <sup>2</sup> )
Relief valve opens	2.41 to 2.75 bar (34.3 to 39.1 lbf/in <sup>2</sup> )
Oil pump clearances:	
Outer rotor-to-body	0.14 to 0.26 mm
Inner-to-outer rotor	0.051 to 0.127 mm
Rotor endfloat	0.025 to 0.06 mm

### Torque wrench settings

	Nm	lbf ft
Main bearing cap bolts	88 to 102	65 to 75
Connecting rod (big-end bearing cap) bolts:		
OHV engines	29 to 36	21 to 27
HCS engines:		
Stage 1	4	3
Stage 2	Tighten by a further 90°	Tighten by a further 90°
Rear oil seal retainer bolts	16 to 20	12 to 15
Flywheel bolts	64 to 70	47 to 52
Timing chain tensioner	7 to 9	5 to 7
Camshaft thrust plate	4 to 5	3 to 4
Camshaft sprocket bolt	16 to 20	12 to 15
Timing cover bolts	7 to 10	5 to 8
Crankshaft pulley bolt:		
OHV engines	54 to 59	40 to 44
HCS engines	100 to 120	74 to 89
Oil pump to crankcase	16 to 20	12 to 15
Oil pump cover bolts	8 to 12	6 to 9
Sump bolts:		
Stage 1	6 to 8	4 to 6
Stage 2	8 to 11	6 to 8
Stage 3	8 to 11	6 to 8
Sump drain plug	21 to 28	15 to 21
Oil pressure switch	13 to 15	10 to 11

**Torque wrench settings (continued)**

	Nm	lbf ft
Rocker shaft pedestal bolts	40 to 46	30 to 34
Cylinder head bolts:		
OHV engines:		
Stage 1	10 to 15	8 to 11
Stage 2	40 to 50	30 to 37
Stage 3	80 to 90	59 to 66
Stage 4 (after 10 to 20 minutes)	100 to 110	74 to 81
HCS engines:		
Stage 1	30	22
Stage 2	Tighten by a further 90°	Tighten by a further 90°
Stage 3	Tighten by a further 90°	Tighten by a further 90°
Rocker cover	4 to 5	3 to 4
Engine to transmission	35 to 45	26 to 33
Right-hand engine mounting to body	41 to 58	30 to 43
Right-hand engine mounting bracket to engine	54 to 72	40 to 53
Right-hand engine mounting rubber insulator to brackets	70 to 95	52 to 70
Front transmission mounting bracket to transmission (pre-1986)	41 to 51	30 to 38
Front and rear transmission mounting bolts (pre-1986)	52 to 64	38 to 47
Transmission mountings to transmission (1986 onwards)	80 to 100	59 to 74
Transmission support crossmember to body (1986 onwards)	52	38

**1 General information****OHV engines**

The 1.1 litre and 1.3 litre OHV engines are of four-cylinder, in-line overhead valve type (hence OHV), mounted transversely together with the transmission, at the front of the car.

The crankshaft on 1.1 litre engines is supported in three shell type main bearings, whereas the 1.3 litre unit features a five main bearing crankshaft. Apart from this difference and other minor alterations, the two engines are virtually the same in design and construction.

The connecting rods are attached to the crankshaft by horizontally split shell type big-end bearings and to the pistons by interference fit gudgeon pins. The aluminium alloy pistons are of the slipper type and are fitted with three piston rings; two compression and one oil control.

The camshaft is chain driven from the crankshaft and operates the valves via pushrods and rocker arms. The inlet and exhaust valves are each closed by a single valve spring and operate in guides integral with the cylinder head. The oil pump and distributor are driven by a skew gear on the camshaft while an eccentric cam operates the fuel pump lever.

The oil pump is mounted externally on the cylinder block just below the distributor, and the full flow type oil filter is screwed directly into the oil pump. Engine oil contained in the sump is drawn through a strainer and pick-up tube by an externally mounted oil pump of twin rotor design. The oil is then forced through the full-flow, throw-away type oil filter. Oil pressure is regulated by a relief valve integral in the oil pump. The pressurised oil is directed through the various galleries and

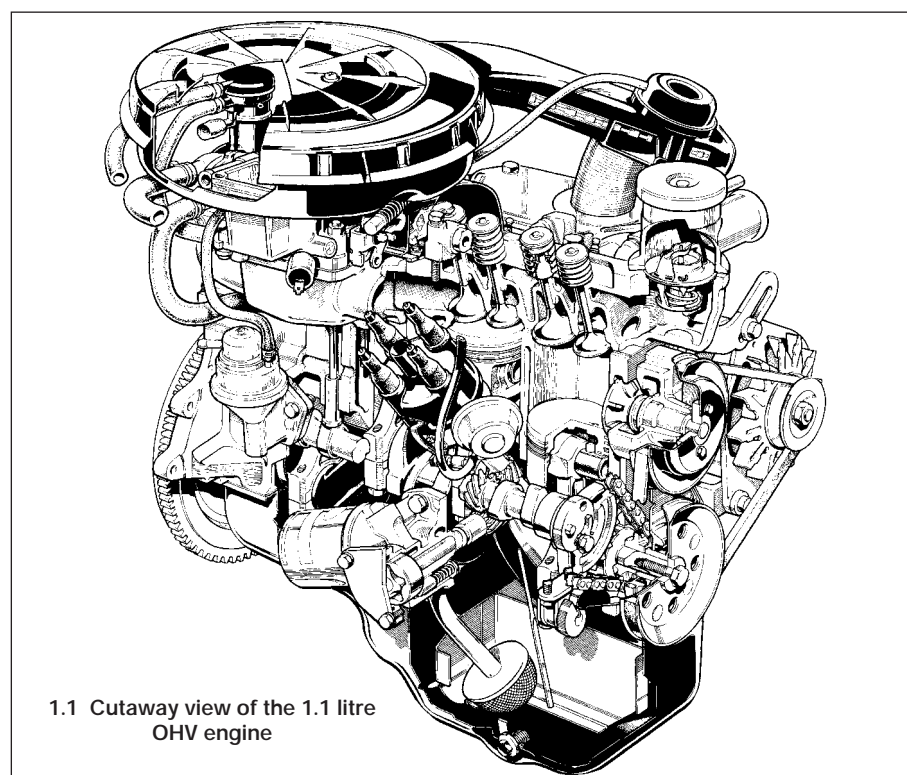
passages to all bearing surfaces. A drilling in the big-end provides lubrication for the gudgeon pins and cylinder bores. The timing chain and sprockets are lubricated by an oil ejection nozzle.

**HCS engines**

The 1.1 and 1.3 litre High Compression Swirl (HCS) engines were introduced at the beginning of 1989 and fitted to certain 1.1 Escort models and all 1.3 Escort models, including the Van and Combi, replacing the previous OHV engine.

A further development of the Ford "lean burn" principle, the HCS engine is basically similar to the previous OHV engine, being of four cylinder, in-line OHV construction, but nearly every aspect of the engine has been re-designed. The major differences are in the cylinder head, where the inlet valve ports and combustion chambers are designed to impart a high level of "swirl" to the incoming fuel/air mixture. The valve arrangement is also different, being of "mirror" design, where the inlet valves of the centre cylinders are next to each other. Combined with the DIS fully

2A



1.1 Cutaway view of the 1.1 litre OHV engine

## 2A•6 OHV and HCS engines

electronic ignition system which has no moving parts, the result is an economical engine with cleaner exhaust emissions which can run on leaded or unleaded fuel without adjustment to the ignition system.

Although most components of the HCS engine have been redesigned, for the most part the servicing and overhaul procedures remain unchanged, unless otherwise stated.

### 2 Major operations possible with the engine in the car

The following work can be carried out without having to remove the engine:

- a) *Cylinder head - removal and refitting.*
- b) *Valve clearances - adjustment (see Chapter 1).*
- c) *Sump - removal and refitting.*
- d) *Rocker gear - overhaul.*
- e) *Crankshaft front oil seal - renewal.*
- f) *Pistons/connecting rods - removal and refitting.*
- g) *Engine mountings - renewal.*
- h) *Oil filter - removal and refitting.*
- i) *Oil pump - removal and refitting.*

### 3 Major operations requiring engine removal

The following work can only be carried out after removal of the engine from the car:

- a) *Crankshaft main bearings - renewal.*
- b) *Crankshaft - removal and refitting.*
- c) *Flywheel - removal and refitting.*
- d) *Crankshaft rear oil seal - renewal.*
- e) *Camshaft - removal and refitting.*
- f) *Timing gears and chain - removal and refitting.*

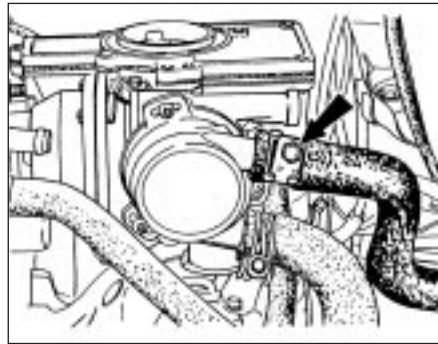
### 4 Cylinder head - removal and refitting

#### Removal

**Note:** *On HCS engines, cylinder head bolts may be used a total of three times (including initial fit) and must be suitably marked to indicate each removal operation. A new cylinder head gasket must be used on refitting.*

1 If the engine is in the car carry out the preliminary operations described in paragraphs 2 to 16.

- 2 Disconnect the battery negative terminal.
- 3 Remove the air cleaner (Chapter 4, Part A).
- 4 Drain the cooling system (Chapter 1).
- 5 Disconnect the hoses from the thermostat housing.
- 6 Disconnect the heater hose from the upper connection on the automatic choke housing, or inlet manifold as applicable (see illustrations).
- 7 Release the throttle cable from the carburettor operating lever by moving the spring clip and removing the bracket fixing bolt (see illustration).



4.6a Heater hose connection on choke housing

8 On manual choke models disconnect the choke cable from the linkage lever and support bracket.

9 Disconnect the fuel and vacuum pipes from the carburettor.

10 Disconnect the breather hose from the inlet manifold.

11 On vehicles with servo-assisted brakes, disconnect the vacuum hose from the inlet manifold.

12 Disconnect the HT leads from the spark plugs.

13 Disconnect the electrical leads from the temperature sender unit, the anti-run-on solenoid valve at the carburettor, and the radiator fan thermal switch.

14 Unbolt and remove the hot air box from the exhaust manifold.

15 Disconnect the exhaust downpipe from the manifold by unbolting the connecting flanges. Support the exhaust system at the front end.

16 Remove the oil filler cap with breather hose.

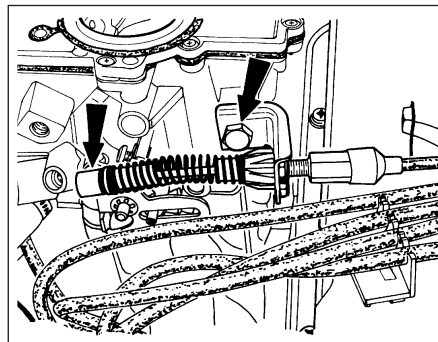
17 Extract the four screws and remove the rocker cover.

18 Unscrew and remove the four fixing bolts and lift away the rocker shaft assembly from the cylinder head.

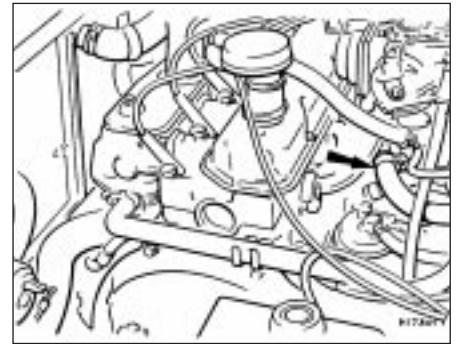
19 Withdraw the pushrods, keeping them in their originally fitted sequence. A simple way to do this is to punch holes in a piece of card and number them 1 to 8 from the thermostat housing end of the cylinder head.

20 Remove the spark plugs.

21 Unscrew the cylinder head bolts



4.7 Throttle cable disconnection points



4.6b Heater hose connection at inlet manifold

progressively in the reverse order to that given for tightening (see illustration 4.27). Remove the cylinder head.

22 To dismantle the cylinder head, refer to Section 13.

#### Refitting

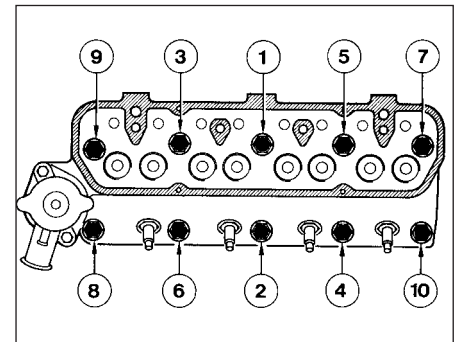
23 Before refitting the cylinder head, remove every particle of carbon, old gasket and dirt from the mating surfaces of the cylinder head and block. Do not let the removed material drop into the cylinder bores or waterways, if it does, remove it. Normally, when a cylinder head is removed, the head is decarbonised and the valves ground in as described in Section 14 to remove all trace of carbon. Clean the threads of the cylinder head bolts and mop out oil from the bolt holes in the cylinder block. In extreme cases, screwing a bolt into an oil-filled hole can cause the block to fracture due to hydraulic pressure.

24 If there is any doubt about the condition of the inlet or exhaust gaskets, unbolt the manifolds and fit new ones to perfectly clean mating surfaces.

25 Locate a new cylinder head gasket on the cylinder block, making quite sure that the bolt holes, coolant passages and lubrication holes are correctly aligned.

26 Lower the cylinder head carefully into position on the block.

27 Screw in all the bolts finger tight and then tighten them in the stages given (see Specifications), and in the sequence shown to the specified torque (see illustration). Note that



4.27 Cylinder head bolt tightening sequence

on all except HCS engines with M11 necked-shank (a reduced diameter section between the bolt head and the threaded portion) cylinder head bolts there are four tightening stages. On HCS engines with M11 necked-shank cylinder head bolts there are three tightening stages.

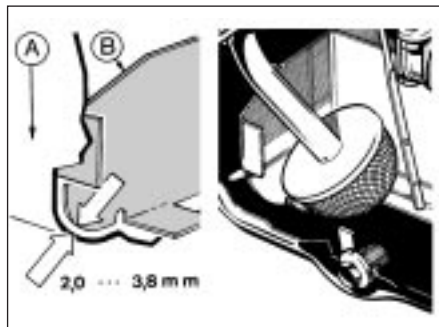
- 28 Refit the pushrods in their original order.
- 29 Lower the rocker shaft assembly into position, making sure that the rocker adjusting screws engage in the sockets at the ends of the pushrods.
- 30 Screw in the rocker pedestal bolts finger tight. At this stage, some of the rocker arms will be applying pressure to the ends of the valve stems and some of the rocker pedestals will not be in contact with the cylinder head. The pedestals will be pulled down however when the bolts are tightened to the specified torque, which should now be done.
- 31 Adjust the valve clearances as described in Chapter 1.
- 32 Refit the rocker cover, using a new gasket. Do not exceed the specified torque for the securing screws; this may result in oil leaks at the rocker cover/cylinder head mating face.
- 33 Fit the oil filler cap and breather hose and the spark plugs. Tighten these to the specified torque. They are of tapered seat type, no sealing washers being used.
- 34 Connect the exhaust downpipe and fit the hot air box.
- 35 Reconnect all electrical leads, vacuum and coolant hoses.
- 36 Reconnect the throttle and choke cables as described in Chapter 4, Part A.
- 37 Refit the air cleaner as described in Chapter 4, Part A and fill the cooling system as described in Chapter 1.
- 38 Reconnect the battery negative terminal.

## 5 Sump - removal and refitting

**Note:** New gaskets and sealing strips must be used on refitting.

### Removal

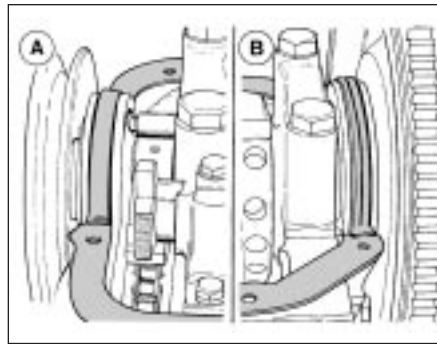
- 1 Disconnect the battery negative lead and drain the engine oil (see Chapter 1).



5.7 Sump and oil baffle clearance details

A Sump

B Baffle

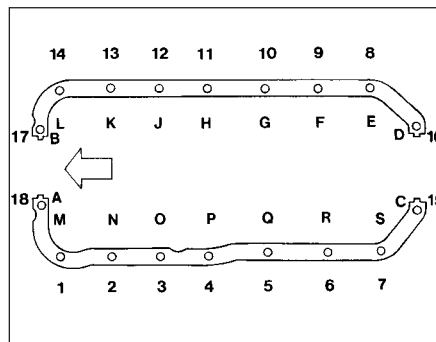


5.6a Sump gasket fitting details at timing cover end (A) and flywheel end (B)

- 2 Refer to Chapter 5, Part A and remove the starter motor.
- 3 Unbolt and remove the clutch cover plate.
- 4 Extract the sump securing bolts and remove the sump. If it is stuck, prise it gently with a screwdriver but do not use excessive leverage. If it is very tight, cut round the gasket joint using a sharp knife.

### Refitting

- 5 Before refitting the sump, remove the front and rear sealing strips and gaskets. Clean the mating surfaces of the sump and cylinder block.
- 6 Stick new gaskets into position on the block using thick grease to retain them, then install new sealing strips into their grooves so that they overlap the gaskets (see illustrations).
- 7 Before offering up the sump, check that the gap between the sump and the oil baffle is between 2.0 and 3.8 mm (see illustration).
- 8 Screw in the sump bolts and tighten in three stages to the specified torque in the sequence shown (see illustration).
  - a) Stage 1 - in alphabetical order
  - b) Stage 2 - in numerical order
  - c) Stage 3 - in alphabetical order
- 9 It is important to follow this procedure in order to provide positive sealing against oil leakage.
- 10 Refit the clutch cover plate and the starter motor and reconnect the battery.
- 11 Refill the engine with the correct grade and quantity of oil.



5.8 Sump bolt tightening sequence



5.6b Fitting the sump gasket sealing strips to overlap the tabs on the gasket

## 6 Rocker gear - dismantling and reassembly

### Dismantling

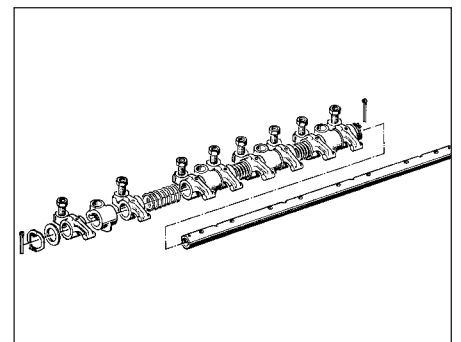
- 1 With the rocker assembly removed as described in Section 4, extract the split pin from one end of the rocker shaft (see illustration).
- 2 Take off the spring and plain washers from the end of the shaft.
- 3 Slide off the rocker arms, support pedestals and coil springs, keeping them in their originally fitted order. Clean out the oil holes in the shaft.

### Reassembly

- 4 Apply engine oil to the rocker shaft before reassembling and make sure that the flat on the end of the shaft is to the same side as the rocker arm adjuster screws. This is essential for proper lubrication of the components.

## 7 Crankshaft front oil seal - renewal

- 1 Disconnect the battery negative lead.
- 2 Slacken the alternator mounting and adjuster bolts and after pushing the alternator in towards the engine, slip off the drivebelt.
- 3 Unscrew and remove the crankshaft pulley bolt. To prevent the crankshaft turning while the bolt is being released, jam the teeth of the



6.1 Rocker shaft assembly components

starter ring gear on the flywheel after removing the clutch cover plate or starter motor (Chapter 5, Part A) for access.

4 Remove the crankshaft pulley. This should come out using the hands but if it is tight, prise it carefully with two levers placed at opposite sides under the pulley flange.

5 Using a suitable claw tool, prise out the defective seal and wipe out the seat.

6 Install the new seal using a suitable distance piece, the pulley and its bolt to draw it into position. If it is tapped into position, the seal may be distorted or the timing cover fractured.

7 When the seal is fully seated, remove the pulley and bolt, apply grease to the seal rubbing surface of the pulley, install it and tighten the securing bolt to the specified torque.

8 Refit the clutch cover or starter motor.

9 Fit and tension the drivebelt as described in Chapter 1, and reconnect the battery.

### 8 Piston/connecting rod assemblies - removal and refitting



**Note:** A piston ring compressor tool will be required for this operation.

#### Removal

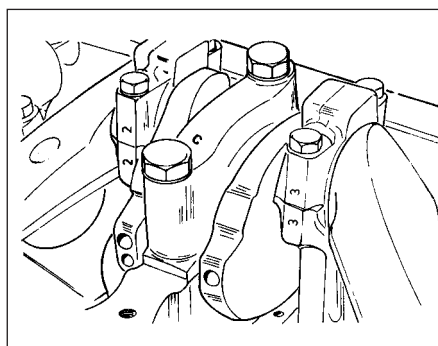
1 Remove the cylinder head and the sump as described in Sections 4 and 5 respectively. Do not remove the oil pick-up filter or pipe, which is an interference fit.

2 Note the location numbers stamped on the connecting rod big-ends and caps, and to which side they face. No 1 assembly is nearest the timing cover and the assembly numbers are towards the camshaft side of the engine (see illustration).

3 Turn the crankshaft by means of the pulley bolt until the big-end cap bolts for No 1 connecting rod are in their most accessible position. Unscrew and remove the bolts and the big-end cap complete with bearing shell. If the cap is difficult to remove, tap it off with a plastic-faced hammer.

4 If the bearing shells are to be used again (Section 13), keep the shell taped to its cap.

5 Feel the top of the cylinder bore for a wear ridge. If one is detected, it should be scraped



8.2 Connecting rod and big-end cap identification numbers

off before the piston/rod is pushed out of the top of the cylinder block. Take care when doing this not to score the cylinder bore surfaces.

6 Push the piston/connecting rod out of the block, retaining the bearing shell with the rod if it is to be used again.

7 Dismantling the piston/rod is covered in Section 13.

8 Repeat the operations on the remaining piston/rod assemblies.

#### Refitting

9 To install a piston/rod assembly, have the piston ring gaps staggered as shown, oil the rings and apply a piston ring compressor (see illustration). Compress the piston rings.

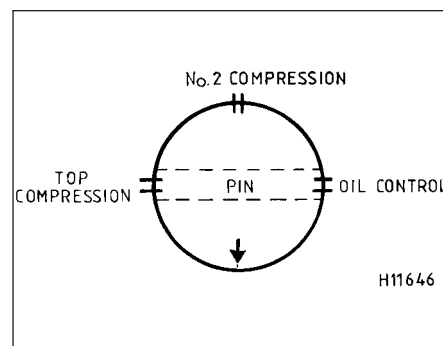
10 Oil the cylinder bores.

11 Wipe out the bearing shell seat in the connecting rod and insert the shell.

12 Lower the piston/rod assembly into the cylinder bore until the base of the piston ring compressor stands squarely on the top of the block (see illustration).

13 Check that the directional arrow on the piston crown faces towards the timing cover end of the engine and then apply the wooden handle of a hammer to the piston crown (see illustrations). Strike the head of the hammer sharply to drive the piston into the cylinder bore.

14 Oil the crankpin and draw the connecting rod down to engage with the crankshaft. Check that the bearing shell is still in position in the connecting rod.



8.9 Piston ring end gap positioning diagram

15 Wipe the bearing shell seat in the big-end cap clean and insert the bearing shell.

16 Fit the cap, screw in the bolts and tighten to the specified torque.

17 Repeat the operations on the remaining pistons/connecting rods.

18 Refit the sump (Section 5) and the cylinder head (Section 4). Refill with oil and coolant.

### 9 Engine/transmission mountings - removal and refitting



#### Pre-1986 models

1 The engine mountings can be removed if the weight of the engine/transmission is first taken by one of the three following methods.

2 Either support the engine under the sump using a jack and a block of wood, or attach a hoist to the engine lifting lugs. A third method is to make up a bar with end pieces which will engage in the water channels at the sides of the bonnet lid aperture. Using an adjustable hook and chain connected to the engine lifting lugs, the weight of the engine can be taken off the mountings.

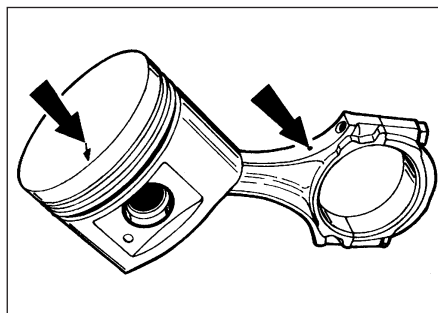
#### Rear mountings

##### Removal

3 Unbolt the mounting, according to type from the body member or panel, also from the engine or transmission. With the mounting withdrawn, the centre bolt can be unscrewed and the flexible component detached (see illustrations).



8.12 Fitting a piston/connecting rod assembly with ring compressor in position

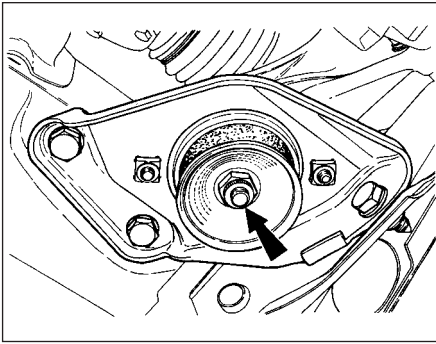


8.13a Relative positions of piston directional arrow and oil squirt hole in connecting rod



8.13b Arrow on piston crown must face the timing cover when installed





9.3a Transmission left-hand rear mounting-to-bracket attachment - pre-1986 models

#### Refitting

4 Refitting is a reversal of removal. Make sure that the original sequence of assembly of washers and plates is maintained.

#### Front left-hand mounting

##### Removal

5 Removal of the front mounting on the transmission requires a different removal procedure. Remove the centre bolt from the mounting and then using one of the methods described, raise the transmission just enough to be able to unbolt and remove the two insulator bolts and withdraw the insulator (see illustration).

##### Refitting

6 Refitting is a reversal of removal. Make sure that the original sequence of assembly of washers and plates is maintained.

#### 1986 models onwards

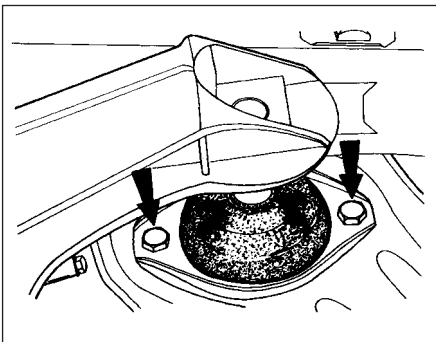
##### Removal

7 From 1986 onwards a longitudinal crossmember is mounted beneath the transmission, and the front and rear left-hand mountings are attached to it. Removal of the rear right-hand mounting is as previously described, but removal of the front and rear left-hand mountings is as follows.

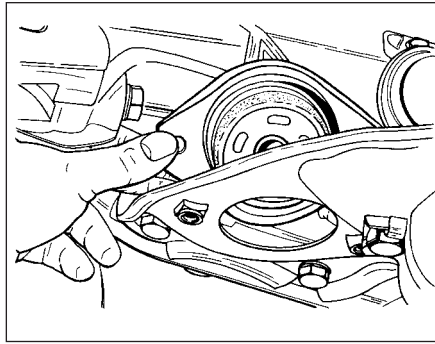
8 Support the engine; see paragraphs 1 and 2.

9 Undo the nuts securing the mountings to the transmission support crossmember and to the brackets on the transmission.

10 Unbolt the transmission support



9.5 Transmission left-hand front mounting attachments - pre-1986 models



9.3b Removing transmission left-hand rear mounting - pre-1986 models

crossmember at the front and rear and remove it from under the car. Remove the relevant mounting.

#### Refitting

11 Refitting is the reversal of removal. Make sure that the original sequence of assembly of washers and plates is maintained.

#### 10 Oil pump - removal and refitting

**Note:** A new gasket must be used on refitting.

##### Removal

1 The oil pump is externally mounted on the rear facing side of the crankcase.

2 Using a strap wrench or similar, unscrew and remove the oil filter cartridge and discard it.

3 Unscrew the three mounting bolts and withdraw the oil pump from the engine (see illustration).

4 Clean away the old gasket.

##### Refitting

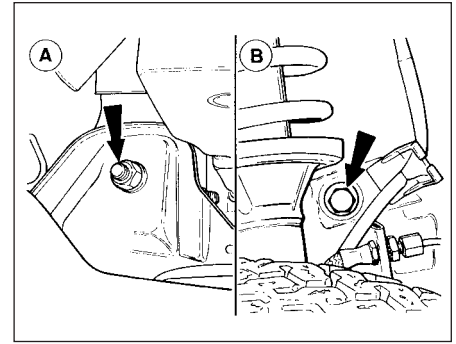
5 If a new pump is being fitted, it should be primed with engine oil before installation. Do this by turning its shaft while filling it with clean engine oil.

6 Locate a new gasket on the pump mounting flange, insert the pump shaft and bolt the pump into position.

7 Grease the rubber sealing ring of a new filter and screw it into position on the pump, using hand pressure only, not the removal tool.



10.3 Removing the oil pump



9.3c Right-hand rear engine mounting attachments - pre-1986 models

A Mounting to side member

B Mounting to inner wheel arch

8 Top-up the engine oil to replenish any lost during the operations.

#### 11 Engine/transmission - removal and separation

**Note:** Suitable lifting tackle will be required for this operation.

#### OHV engines

##### Removal

1 The engine is removed complete with the transmission in a downward direction and then withdrawn from under the front of the car.

2 Disconnect the battery negative lead.

3 Place the transmission in fourth gear on four-speed versions, or reverse gear on the five-speed unit to aid adjustment of the gearchange linkage when refitting. On models produced from February 1987 onwards, place the transmission in second gear on four-speed versions, or fourth gear on five-speed versions.

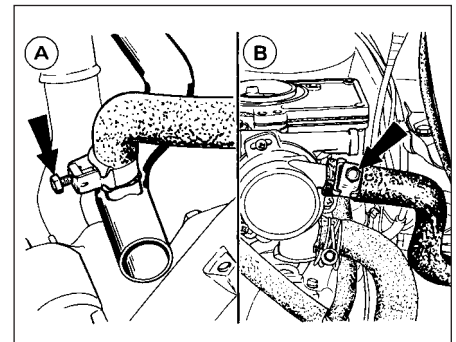
4 Remove the bonnet (Chapter 11).

5 Remove the air cleaner (Chapter 4, Part A).

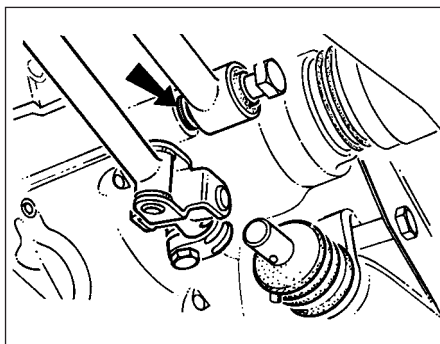
6 Drain the cooling system (Chapter 1).

7 Disconnect both the radiator hoses and the expansion tank hose at the thermostat housing.

8 Disconnect the heater hoses from the stub on the lateral coolant pipe, automatic choke housing or inlet manifold as applicable (see illustration).



11.8 Heater hose attachments at lateral coolant pipe (A) and choke housing (B)



**11.22** Gearchange rod and stabiliser disconnection points - washer fitted behind stabiliser arrowed

**9** Disconnect the choke cable (where fitted) and the throttle cable from the carburettor throttle lever. Unbolt the cable support bracket and tie the cable assembly to one side of the engine compartment.

**10** Disconnect the fuel pipe from the fuel pump and plug the pipe.

**11** On vehicles equipped with power-assisted brakes, disconnect the vacuum pipe from the inlet manifold.

**12** Disconnect the leads from the following electrical components:

- a) Alternator and electric fan temperature switch.
- b) Oil pressure sender.
- c) Coolant temperature sender.
- d) Reversing lamp switch.
- e) Anti-run on solenoid valve.

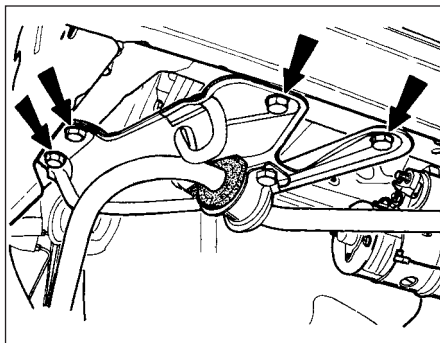
**13** Disconnect the HT and LT (distributor) wires from the coil terminals.

**14** Unscrew the speedometer drive cable from the transmission and release the breather hose.

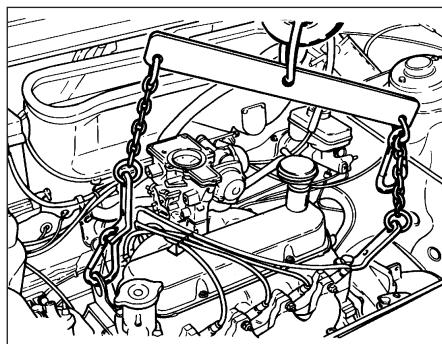
**15** Disconnect the clutch cable from the release lever and from its transmission support.

**16** Unbolt and remove the hot air box from the exhaust manifold.

**17** Disconnect the exhaust downpipe from the manifold by extracting the two flange bolts. Support the exhaust pipe to avoid straining it.



**11.27** Remove the anti-roll bar support plates on both sides - pre-1986 models



**11.24** Typical lifting gear connection to engine

**18** The vehicle should now be jacked up and safety stands fitted to provide sufficient clearance beneath it to be able to remove the engine/transmission from below. A distance of 686 mm (27.0 in) is recommended between the floor and the bottom edge of the front panel.

**19** Disconnect the exhaust system from its flexible mountings and remove the system complete.

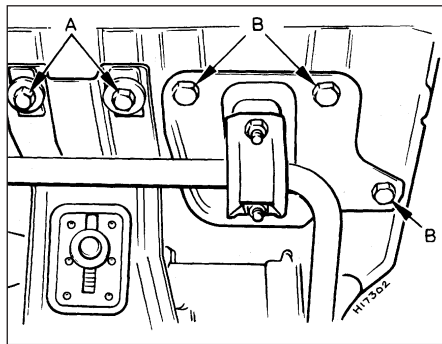
**20** Disconnect the starter motor leads and the engine earth strap.

**21** Disconnect the gearchange rod from the transmission selector shaft by releasing the clamp bolt and withdrawing the rod. Tie the rod to the stabiliser and then where fitted, unhook the tension spring.

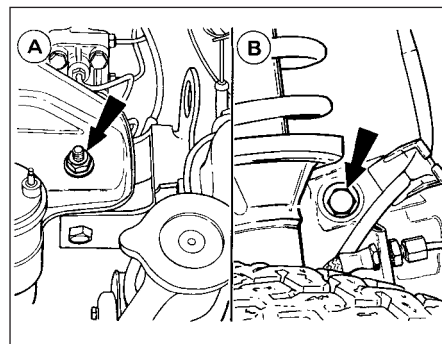
**22** Unscrew the single bolt and disconnect the stabiliser from the transmission housing, noting the washer fitted between the stabiliser trunnion and the transmission (see illustration).

**23** Remove the driveshafts from the transmission using the procedure described in the manual transmission removal procedure in Chapter 7, Part A. Note that on pre-1986 models equipped with an anti-roll bar the right-hand mounting clamp should also be undone and the bar lowered together with the suspension arms.

**24** Connect a suitable hoist to the engine using chains and brackets (see illustration).



**11.28a** Transmission support crossmember front mounting bolts (A) and anti-roll bar support plate bolts (B) - 1986 models onwards



**11.26** Engine right-hand mounting attachment at side member (A) and inner wing panel (B)

**25** Just take the weight of the engine/transmission assembly so that the tension is relieved from the mountings.

**26** Unbolt the rear right-hand engine mounting (complete with coolant hose support on early models) from the side member and from the inner wing panel (see illustration).

**27** On pre-1986 models unbolt the front and rear transmission mountings from their brackets, and remove the front mounting and anti-roll bar support plates from the body on both sides (see illustration).

**28** On 1986 models onwards undo the nuts and bolts securing the transmission support crossmember to the body (see illustrations). The crossmember is removed with the engine/transmission assembly.

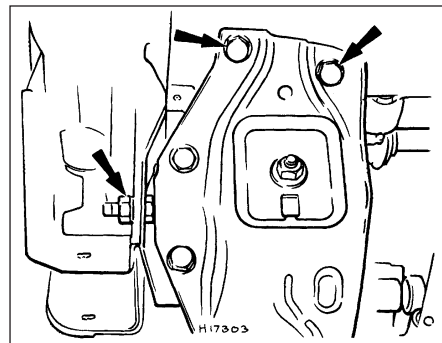
**29** Carefully lower the engine/transmission and withdraw it from under the car.

**HAYNES HINT** To ease the withdrawal operation, lower the engine/transmission onto a crawler board or a sheet of substantial chipboard placed on rollers or lengths of pipe.

### Separation

**30** Unscrew and remove the starter motor bolts and remove the starter.

**31** Unbolt and remove the clutch cover plate from the lower part of the clutch bellhousing.



**11.28b** Transmission support crossmember rear mounting bolts - 1986 models onwards



11.35 A locally made-up lifting eye - HCS engine

32 Unscrew and remove the bolts from the clutch bellhousing-to-engine mating flange.

33 Withdraw the transmission from the engine. Support its weight so that the clutch assembly is not distorted while the input shaft is still in engagement with the splined hub of the clutch driven plate.

### HCS engines

#### Removal

34 The engine can be lifted from the engine bay provided the radiator and certain other ancillary components are removed first to give room for manoeuvring. These are detailed in the removal procedure.

35 Before commencing work it will be necessary to make up two lifting eyes from 1/4"



11.41a Radiator lower mounting bolt . . .

mild steel bar, approximately 3" long and 1 1/2" wide, with two 1/2" holes drilled in them (see illustration).

36 Remove the bonnet (Chapter 11).

37 Disconnect the battery negative lead.

38 Remove the air cleaner (Chapter 4, Part A).

39 Drain the engine oil (Chapter 1).

40 Drain the coolant (Chapter 1).

41 Remove the radiator (Chapter 3) (see illustrations).

42 Disconnect the heater hoses from the inlet manifold and the water pump.

43 Disconnect the lead at the anti-run-on valve solenoid on the carburettor.

44 Disconnect the throttle cable (Chapter 4, Part A).

45 Disconnect the choke cable (Chapter 4, Part A).



11.41b . . . and upper locating peg - HCS engine

46 Disconnect the fuel inlet (blue clip) and outlet (green clip) pipes from the fuel pump (see Chapter 4, Part A).

47 Disconnect the brake servo vacuum hose from the inlet manifold. On later models depress the flanged collar towards the manifold, and pull out the hose (see illustration). Do not pull the hose at an angle, or use excessive force, or the hose may lock in position.

48 Disconnect the earth lead from the inlet manifold.

49 Disconnect the following electrical connections:

a) Cooling fan thermal switch on thermostat housing (see illustration).

b) Coolant temperature sender (see illustration).

c) Alternator.

d) Ignition (DIS) coil (Chapter 5, Part B).

e) Oil pressure switch.

f) Engine coolant temperature sensor (Chapter 5, Part B).

g) Engine speed sensor (Chapter 5, Part B).

h) Reversing light switch (Chapter 7, Part A).

i) Transmission housing earth lead.

50 Disconnect the speedometer cable (see illustration).

51 Disconnect the exhaust downpipe from the exhaust manifold flange. The nuts are easier to reach from underneath the vehicle. Once undone, support the exhaust on wire.

52 Disconnect the starter motor and engine earth lead which is under one of the starter motor bolts (Chapter 5, Part A).



11.41c Lifting out the radiator - HCS engine



11.47 Disconnecting the brake vacuum servo hose - HCS engine



11.49a Disconnecting the cooling fan thermal switch . . .



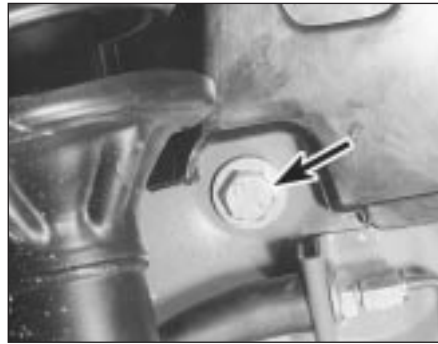
11.49b . . . and coolant temperature sender - HCS engine



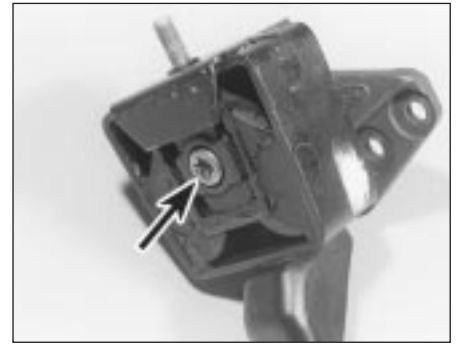
11.50 Disconnecting the speedometer cable - HCS engine



11.57a Right-hand engine mounting nuts/bolts (arrowed) - HCS engine



11.57b One bolt (arrowed) is accessible from within the wheelarch - HCS engine



11.58 Torx headed bolt (arrowed) securing the mounting to the bracket - HCS engine

53 Remove the starter lead support bracket from the transmission housing.

54 Disconnect the gearchange mechanism (Chapter 7, Part A).

55 Remove the driveshafts (Chapter 8). **Note:** On removal of the driveshafts, push a length of wooden dowel into the hole vacated by the driveshaft in the transmission housing to prevent the sun gears of the differential becoming misaligned. A piece of broom handle is ideal, but will have to be turned down somewhat.

56 Support the right-hand side of the engine on a trolley jack; just take the weight of the engine.

57 Remove the right-hand engine mounting by undoing the top nut on the wing panel, removing the bolt accessible from inside the wheelarch, and the three bolts securing the mounting bracket to the engine (see illustrations).

58 Once removed, undo the Torx headed bolt securing the mounting to the bracket (see illustration).

59 Refit the bracket to the cylinder block and bolt one of the made-up lifting eyes to the bracket using one of the spare bolts (see illustration).

60 Fit the other lifting eye to the transmission housing (see illustration).

61 Secure suitable lifting gear to the engine and just begin to take the weight. **Note:** If the carburettor is likely to be damaged because of the angle of the lifting sling/chain, remove the carburettor as described in Chapter 4, Part A.

62 Remove the alternator (Chapter 5, Part A) to give more room for manoeuvring the engine out.

63 Pull the transmission breather hose from inside the wing panel.

64 Remove the nut from the left-hand front engine mounting.

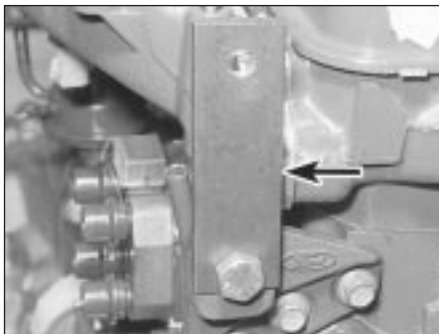
65 Remove the nut from the left-hand rear mounting. Remove the nuts securing the mounting bracket to the transmission housing and remove the bracket (see illustrations).

66 Commence lifting the engine slowly, checking all round that everything has been disconnected and that the engine does not foul other components as it is lifted. Swing the engine and tilt it as necessary to clear obstacles (see illustrations).

67 Once out of the engine bay, swing the engine clear and lower it onto a suitable work surface.

### Separation

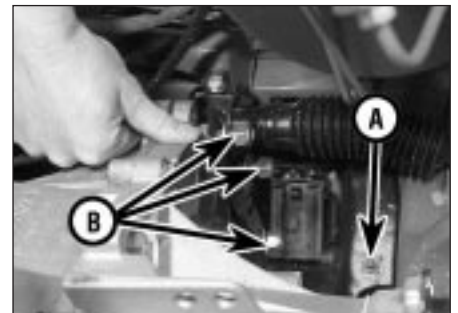
68 Proceed as described previously in this Section for OHV engines



11.59 Lifting eye (arrowed) bolted to right-hand mounting position on cylinder block ...



11.60 ... and on transmission housing - HCS engine



11.65a Mounting nut location (A) and bracket-to-transmission housing nuts (B) - HCS engine



11.65b Removing the mounting bracket - HCS engine



11.66a Lifting the engine and transmission upwards ...



11.66b ... and out of the engine compartment



12.13 Keep the pushrods in strict order after removal



12.28 Removing the timing chain tensioner



12.31 Camshaft thrust plate removal

## 12 Engine - complete dismantling



### OHV engines

1 The need for dismantling will have been dictated by wear or noise in most cases. Although there is no reason why only partial dismantling cannot be carried out to renew such items as the timing chain or crankshaft rear oil seal, when the main bearings or big-end bearings have been knocking and especially if the vehicle has covered a high mileage, then it is recommended that a complete strip down is carried out and every engine component examined (Section 13).

2 Position the engine so that it is upright on a bench or other convenient working surface. If the exterior is very dirty it should be cleaned before dismantling using paraffin and a stiff brush or a water-soluble solvent.

3 Remove the coolant pipe from the side of the engine by disconnecting the hose clips and the securing bolt.

4 If not already done, drain the engine oil.

5 Remove the dipstick and unscrew and discard the oil filter.

6 Disconnect the HT leads from the spark plugs, release the distributor cap and lift it away complete with leads.

7 Unscrew and remove the spark plugs.

8 Disconnect the breather hose from the inlet manifold and remove it with the oil filler cap.

9 Disconnect the fuel and vacuum pipes from the carburettor and unbolt and remove the carburettor (refer to Chapter 4, Part A).

10 Unbolt the thermostat housing cover and remove it together with the thermostat (refer to Chapter 3).

11 Remove the rocker cover.

12 Remove the rocker shaft assembly (four bolts).

13 Withdraw the pushrods, keeping them in their originally fitted order (see illustration).

14 Remove the cylinder head complete with manifolds as described in Section 4.

15 Remove the distributor as described in Chapter 5, Part B.

16 Unbolt and remove the fuel pump.

17 Remove the oil pump (Section 10).

18 Pinch the two runs of the water pump drivebelt together at the pump pulley to prevent the pulley rotating and release the pulley bolts.

19 Release the alternator mounting and adjuster link bolts, push the alternator in towards the engine and remove the drivebelt.

20 Unbolt the alternator bracket and remove the alternator.

21 Unbolt and remove the water pump.

22 Unscrew the crankshaft pulley bolt. To do this, the flywheel starter ring gear will have to be jammed to prevent the crankshaft from turning.

23 Remove the crankshaft pulley. If this does not pull off by hand, carefully use two levers behind it placed at opposite points.

24 Place the engine on its side and remove the sump. Do not invert the engine at this stage, or sludge and swarf may enter the oilways.

25 Unbolt and remove the timing chain cover.

26 Take off the oil slinger from the front face

of the crankshaft sprocket.

27 Slide the chain tensioner arm from its pivot pin on the front main bearing cap.

28 Unbolt and remove the chain tensioner (see illustration).

29 Bend back the lockplate tabs from the camshaft sprocket bolts and unscrew and remove the bolts.

30 Withdraw the sprocket complete with timing chain.

31 Unbolt and remove the camshaft thrust plate (see illustration).

32 Rotate the camshaft until each cam follower (tappet) has been pushed fully into its hole by its cam lobe.

33 Withdraw the camshaft, taking care not to damage the camshaft bearings (see illustration).

34 Withdraw each of the cam followers, keeping them in their originally fitted sequence by marking them with a piece of numbered tape or using a box with divisions (see illustration).

35 From the front end of the crankshaft, draw off the sprocket using a two-legged extractor.

36 Check that the main bearing caps are marked F (Front), C (Centre) and R (Rear). The caps are also marked with an arrow which indicates the timing cover end of the engine, a point to remember when refitting the caps.

37 Check that the big-end caps and connecting rods have adjacent matching numbers facing towards the camshaft side of the engine. Number 1 assembly is nearest the timing chain end of the engine. If any markings are missing or indistinct, make some of your own with quick-drying paint (see illustration).



12.33 Withdrawing the camshaft from the front of the engine



12.34 Using a valve grinding tool suction cup to withdraw the cam followers



12.37 Connecting rod and big-end cap markings

38 Unbolt and remove the big-end bearing caps. If the bearing shell is to be used again, tape the shell to the cap.

39 Now check the top of the cylinder bore for a wear ring. If one can be felt, it should be removed with a scraper before the piston/rod is pushed out of the cylinder.

40 Remove the piston/rod by pushing it out of the top of the block. Tape the bearing shell to the connecting rod.

41 Remove the remaining three piston/rod assemblies in a similar way.

42 Unbolt the clutch pressure plate cover from the flywheel. Unscrew the bolts evenly and progressively until spring pressure is relieved, before removing the bolts. Be prepared to catch the clutch friction plate as the cover is withdrawn.

43 Unbolt and remove the flywheel. It is heavy, do not drop it. If necessary, the starter ring gear can be jammed to prevent the flywheel rotating. There is no need to mark the fitted position of the flywheel to its mounting flange as it can only be fitted one way. Take off the adapter plate (engine backplate).

44 Unbolt and remove the crankshaft rear oil seal retainer.

45 Unbolt the main bearing caps. Remove the caps, tapping them off if necessary with a plastic-faced hammer. Retain the bearing shells with their respective caps if the shells are to be used again, although unless the engine is of low mileage this is not recommended (see Section 13). To improve access to the No 2 main bearing bolt on 1.3 litre engines the oil pick-up tube can be removed by drifting it out. A new pick-up tube must be obtained for reassembly together with suitable adhesive to secure it in position.

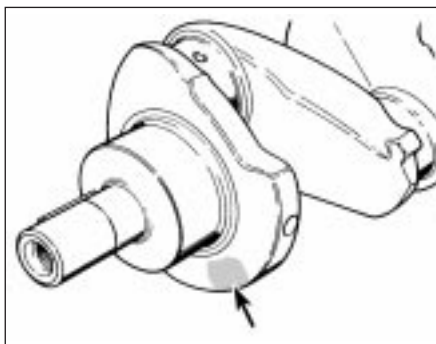
46 Lift the crankshaft from the crankcase and lift out the upper bearing shells, noting the thrustwashers either side of the centre bearing. Keep these shells with their respective caps, identifying them for refitting to the crankcase if they are to be used again.

47 With the engine now completely dismantled, each component should be examined as described in Section 13 before reassembling.

### HCS engines

48 The procedure is as described previously in this Section for OHV engines, noting the following differences.

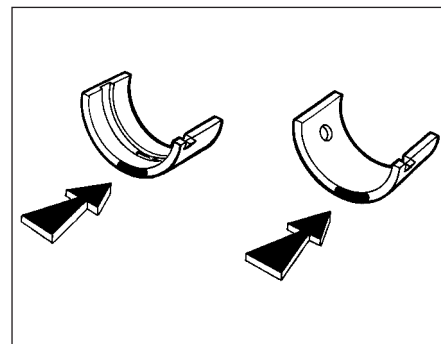
- There is no coolant transfer pipe along the front of the engine.
- Disconnect and remove the HT leads with reference to Chapter 5, Part B.
- There is no distributor to remove. The procedure for removal of the DIS coil is given in Chapter 5, Part B.
- big-end cap bolts are Torx type bolts.
- Remove the engine speed sensor as described in Chapter 5, Part B before removing the flywheel to prevent damage to the sensor.
- There are three main bearings on 1.1 engines and five on 1.3 engines. From the



13.7a Crankshaft main bearing journal size identification mark on balance web (arrowed)

*timing chain end, the main bearing caps are numbered 1 to 3 or 1 to 5 as applicable, and have an arrow on them which must point towards the timing chain end of the engine.*

- The crankshaft thrust bearings are still fitted either side of the centre main bearing.
- rear oil seal carrier is secured in place by Torx type bolts.



13.7b Bearing shell colour identification markings (arrowed)

## 13 Examination and renovation

1 Clean all components using paraffin and a stiff brush, except the crankshaft, which should be wiped clean and the oil passages cleaned out with a length of wire.

2 Never assume that a component is unworn simply because it looks all right. After all the effort which has gone into dismantling the engine, refitting worn components will make the overhaul a waste of time and money. Depending on the degree of wear, the overhauler's budget and the anticipated life of the vehicle, components which are only slightly worn may be refitted, but if in doubt it is always best to renew.

### Crankshaft, main and big-end bearings

3 The need to renew the main bearing shells or to have the crankshaft reground will usually have been determined during the last few miles of operation when perhaps a heavy knocking has developed from within the crankcase or the oil pressure warning lamp has stayed on denoting a low oil pressure probably caused by excessive wear in the bearings.

4 Even without these symptoms, the journals and crankpins on a high mileage engine should be checked for out-of-round (ovality) and taper. For this a micrometer will be needed to check the diameter of the journals and crankpins at several different points around them. A motor factor or engineer can do this for you. If the average of the readings shows that either out-of-round or taper is outside permitted tolerance (see

Specifications), then the crankshaft should be reground by your dealer or engine reconditioning company to accept the undersize main and big-end shell bearings which are available. Normally, the company doing the regrounding will supply the necessary undersize shells.

5 If the crankshaft is in good condition, it is wise to renew the bearing shells as it is almost certain that the original ones will have worn. This is often indicated by scoring of the bearing surface or by the top layer of the bearing metal having worn through to expose the metal underneath.

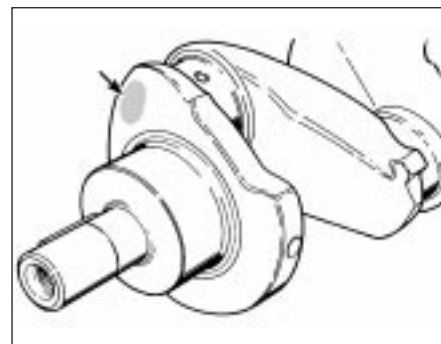
6 Each shell is marked on its back with the part number. Undersize shells will have the undersize stamped additionally on their backs.

7 Standard size crankshafts having main bearing journal diameters at the lower end of the tolerance range are marked with a yellow spot on the front balance weight. You will find that with this type of crankshaft, a standard shell is fitted to the seat in the crankcase but a yellow colour-coded shell to the main bearing cap (see illustrations).

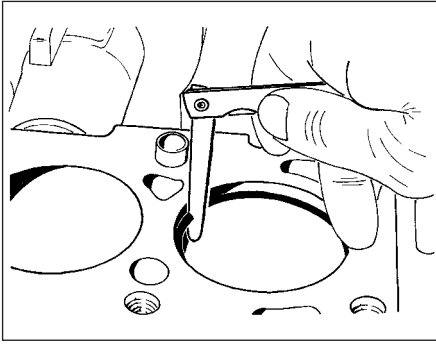
8 If a green spot is seen on the crankshaft then this indicates that 0.25 mm (0.0098 in) undersize big-end bearings are used (see illustration).

### Cylinder bores, pistons, rings and connecting rods

9 Cylinder bore wear will usually have been evident from the smoke emitted from the



13.8 Crankshaft big-end journal size identification mark on crank throw web



13.14 Checking piston ring end gap

exhaust during recent operation of the vehicle on the road, coupled with excessive oil consumption and fouling of spark plugs.

10 Engine life can be extended by fitting special oil control rings to the pistons. These are widely advertised and will give many more thousands of useful mileage without the need for a rebore, although this will be inevitable eventually. If this remedy is decided upon, remove the piston/connecting rods (Section 8) and fit the proprietary rings in accordance with the manufacturer's instructions.

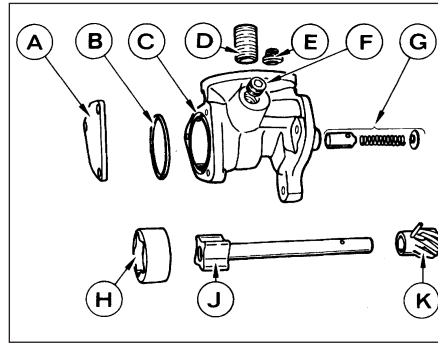
11 Where a more permanent solution is decided upon, the cylinder block can be rebored by your dealer or engineering works, or by one of the mobile workshops which now undertake such work. The cylinder bore will be measured both for out-of-round and for taper to decide how much the bores should be bored out. A set of matching pistons will be supplied in a suitable oversize to suit the new bores.

12 Due to the need for special heating and installing equipment for removal and refitting of the interference type gudgeon pin, the removal and refitting of pistons to the connecting rods is definitely a specialist job, preferably for your Ford dealer.

13 The removal and refitting of piston rings is however well within the scope of the home mechanic. Do this by sliding two or three old feeler blades round behind the top compression ring so that they are at equidistant points. The ring can now be slid up the blades and removed. Repeat the removal operations on the second compression ring and then the oil control ring. This method will not only prevent the rings dropping onto empty grooves as they are withdrawn, but it will also avoid ring breakage.

14 Even when new piston rings have been supplied to match the pistons, always check that they are not tight in their grooves and also check their end gaps by pushing them squarely down their particular cylinder bore and measuring with a feeler blade (see illustration). Adjustment of the end gap can be made by careful grinding to bring it within the specified tolerance.

15 If new rings are being fitted to an old piston, always remove any carbon from the grooves beforehand. The best tool for this job is the end of a broken piston ring. Take care



13.24a Exploded view of the oil pump

A Pump cover	F Blind plug
B O-ring	G Oil pressure relief valve
C Pump body	H Outer rotor
D Oil filter	J Inner rotor
E Filter relief valve	K Drive gear

not to cut your fingers, piston rings are sharp. The cylinder bores should be roughened with fine glass paper to assist the bedding-in of the new rings.

### Timing sprockets and chain

16 The teeth on the timing sprockets rarely wear, but still check for broken or hooked teeth.

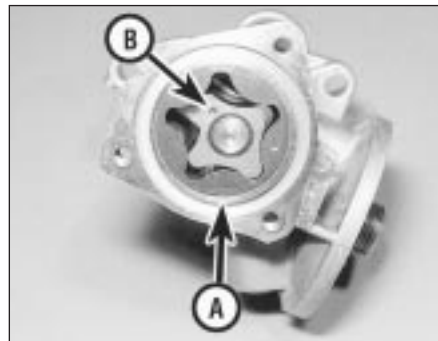
17 The timing chain should always be renewed at time of major engine overhaul. A worn chain is evident if when supported horizontally at both ends it takes on a deeply bowed appearance.

18 Finally check the rubber cushion on the tensioner spring leaf. If grooved or chewed up, renew it.

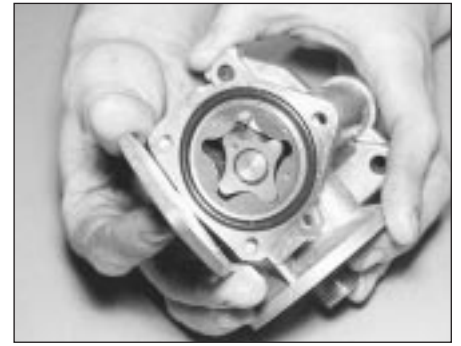
### Flywheel

19 Inspect the starter ring gear on the flywheel for wear or broken teeth. If evident, the ring gear should be renewed in the following way. Drill the ring gear with two holes, approximately 7 or 8 mm (0.3 in) diameter and offset slightly. Make sure that you do not drill too deeply or you will damage the flywheel.

20 Tap the ring gear downward off its register and remove it.



13.25 Check the oil pump rotor-to-body clearance (A) and the inner-to-outer rotor clearance (B)



13.24b Lift off the oil pump cover and remove the O-ring

21 Place the flywheel in the household refrigerator for about an hour and then heat the new ring gear to between 260 and 280°C (500 and 536°F) in a domestic oven. Do not heat it above 290°C (554°F) or its hardness will be lost.

22 Slip the ring onto the flywheel and gently tap it into position against its register. Allow it to cool without quenching.

23 The clutch friction surface on the flywheel should be checked for grooving or tiny hair cracks, the latter being caused by overheating. If these conditions are evident, it may be possible to surface grind the flywheel provided its balance is not upset. Otherwise, a new flywheel will have to be fitted consult your dealer about this.

### Oil pump

24 The oil pump should be checked for wear by unbolting and removing the cover plate and O-ring and checking the following tolerances (see illustrations):

- Outer rotor to pump body gap.
- Inner rotor to outer rotor gap.
- Rotor endfloat (use a feeler blade and straight-edge across pump body).

25 Use feeler blades to check the tolerances and if they are outside the specified values, renew the pump (see illustration).

### Oil seals and gaskets

26 Renew the oil seals on the timing cover and the crankshaft rear retainer as a matter of routine at time of major overhaul. Oil seals are cheap, oil is not! Use a piece of tubing as a removal and installing tool. Apply some grease to the oil seal lips and check that the small tensioner spring in the oil seal has not been displaced by the vibration caused during fitting of the seal.

27 Renew all the gaskets by purchasing the appropriate "de-coke", short or full engine set. Oil seals may be included in the gasket sets.

### Crankcase

28 Clean out the oilways with a length of wire or by using compressed air. Similarly clean the coolant passages. This is best done by flushing through with a cold water hose. Examine the crankcase and block for stripped threads in bolt holes; if evident, thread inserts can be fitted.



13.38 Compress the valve spring to remove the collets



13.39 Remove the valve spring retainer and spring . . .



13.40 . . . followed by the valve

29 Renew any core plugs which appear to be leaking or which are excessively rusty.

30 Cracks in the casting may be rectified by specialist welding, or by one of the cold metal key interlocking processes available.

### Camshaft and bearings

31 Examine the camshaft gear and lobes for damage or wear. If evident a new camshaft must be purchased, or one which has been "built-up" such as are advertised by firms specialising in exchange components.

32 The bearing internal diameters should be checked against the specifications if a suitable gauge is available; otherwise, check for movement between the camshaft journal and the bearing. Worn bearings should be renewed by your dealer.

33 Check the camshaft endfloat by temporarily refitting the camshaft and the thrust plate. If the endfloat exceeds the specified tolerance, renew the thrust plate.

### Cam followers

34 It is seldom that the cam followers wear in their bores, but it is likely that after a high mileage, the cam lobe contact surface will show signs of a depression or grooving.

35 Where this condition is evident, renew the cam followers. Grinding out the wear marks will only reduce the thickness of the hardened metal of the cam follower and accelerate further wear.

### Cylinder head and rocker gear

36 The usual reason for dismantling the cylinder head is to de-carbonise and to grind in the valves. Reference should therefore be made to Section 14, in addition to the dismantling operations described here. First remove the manifolds.

37 Using a standard valve spring compressor, compress the spring on No 1 valve (valve nearest the timing cover). Do not over compress the spring or the valve stem may bend. If it is found that when screwing down the compressor tool, the spring retainer does not release from the collets, remove the compressor and place a piece of tubing on the retainer so that it does not impinge on the collets and strike the end of the tubing a sharp

blow with a hammer. Refit the compressor and compress the spring.

38 Extract the split collets and then gently release the compressor and remove it (see illustration).

39 Remove the valve spring retainer, the spring and the oil seal (see illustration).

40 Withdraw the valve (see illustration).

41 Repeat the removal operations on the remaining seven valves. Keep the valves in their originally fitted sequence by placing them in a piece of card which has holes punched in it and numbered 1 to 8 (from the timing cover end).

42 Place each valve in turn in its guide so that approximately one third of its length enters the guide. Rock the valve from side to side. If there is any more than an imperceptible movement, the guides will have to be reamed (working from the valve seat end) and oversize stemmed valves fitted. If you do not have the necessary reamer (tool No 21-242), leave this work to your Ford dealer.

43 Examine the valve seats. Normally, the seats do not deteriorate but the valve heads are more likely to burn away in which case, new valves can be ground in as described in the next Section. If the seats require recutting, use a standard cutter available from most accessory or tool stores or consult your motor engineering works.

44 Renewal of any valve seat which is cracked or beyond recutting is definitely a job for your dealer or motor engineering works.

45 If the cylinder head mating surface is suspected of being distorted due to persistent leakage of coolant at the gasket joint, then it can be checked and surface ground by your dealer or motor engineering works. Distortion is unlikely under normal circumstances with a cast iron head.

46 Check the rocker shaft and rocker arms pads which bear on the valve stem end faces for wear or scoring, also for any broken coil springs. Renew components as necessary after dismantling as described in Section 6. If the springs have been in use for 50 000 miles (80 000 km) or more, they should be renewed.

47 Reassemble the cylinder head by fitting new valve stem oil seals. Install No 1 valve (lubricated) into its guide and fit the valve

spring with the closer coils to the cylinder head, followed by the spring retainer. Compress the spring and engage the split collets in the cutout in the valve stem. Hold them in position while the compressor is gently released and removed.

48 Repeat the operations on the remaining valves, making sure that each valve is returned to its original guide or if new valves have been fitted, into the seat into which it was ground.

49 On completion, support the ends of the cylinder head on two wooden blocks and strike the end of the valve stem with a plastic or copper-faced hammer, just a light blow to settle the components.

## 14 Cylinder head and pistons - decarbonising

### OHV engines

1 With the cylinder head removed (Section 4), the carbon deposits should be removed from the combustion spaces using a scraper and a wire brush fitted into an electric drill. Take care not to damage the valve heads, otherwise no special precautions need be taken as the cylinder head is of cast iron construction.

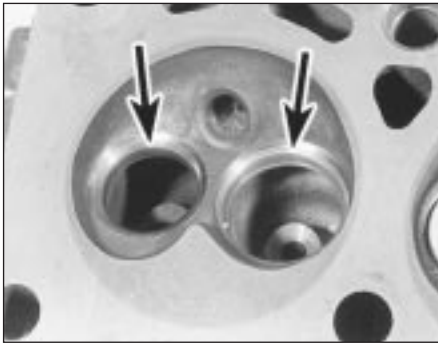
2 Where a more thorough job is to be carried out, the cylinder head should be dismantled (Section 13), so that the valves may be ground in and the ports and combustion spaces cleaned, brushed and blown out after the manifolds have been removed.

3 Before grinding in a valve, remove the carbon and deposits completely from its head and stem. With an inlet valve, this is usually quite easy, simply scraping off the soft carbon with a blunt knife and finishing with a wire brush. With an exhaust valve the deposits are much harder and those on the head may need a rub on coarse emery cloth to remove them.

**HAYNES** An old woodworking chisel is a useful tool to remove the worst of the head deposits.

4 Ensure that the valve heads are really clean, otherwise the suction cup of the grinding tool will not stick during the grinding-in operations.





14.14a View of the swirl chamber in the cylinder head showing the valve seats (arrowed) - HCS engine

5 Before starting to grind in a valve, support the cylinder head so that there is sufficient clearance under for the valve stem to project fully without being obstructed.

6 Take the first valve and apply a little coarse grinding paste to the bevelled edge of the valve head. Insert the valve into its guide and apply the suction grinding tool to its head. Rotate the tool between the palms of the hands in a back-and-forth rotary movement until the gritty action of the grinding-in process disappears. Repeat the operation with fine paste and then wipe away all traces of grinding paste and examine the seat and bevelled edge of the valve. A matt silver mating band should be observed on both components, without any sign of black spots. If some spots do remain, repeat the grinding-in-process until they have disappeared. A drop or two of paraffin applied to the contact surfaces will increase the speed of grinding-in, but do not allow any paste to run down into the valve guide. On completion, wipe away every trace of grinding paste using a paraffin-moistened cloth.

7 Repeat the operations on the remaining valves, taking care not to mix up their originally fitted sequence.

8 The valves are refitted as described in Section 13.

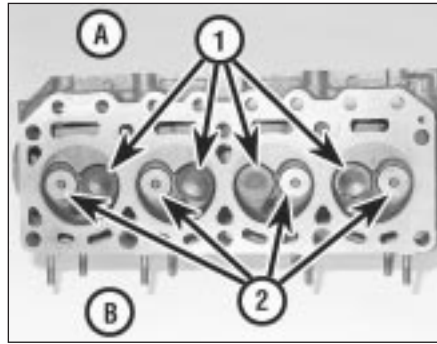
9 An important part of the decarbonising operation is to remove the carbon deposits from the piston crowns. To do this, turn the crankshaft so that two pistons are at the top of their stroke and press some grease between these pistons and the cylinder walls. This will prevent carbon particles falling down into the piston ring grooves. Stuff rags into the other two bores.

10 Cover the oilways and coolant passages with masking tape and then using a blunt scraper remove all the carbon from the piston crowns. Take care not to score the soft alloy of the crown or the surface of the cylinder bore.

11 Rotate the crankshaft to bring the other two pistons to TDC and repeat the operations.

12 Wipe away the circle of grease and carbon from the cylinder bores.

13 Clean the top surface of the cylinder block by careful scraping.



14.14b View of the cylinder head with valves fitted - HCS engine

A Inlet side                    1 Inlet valves  
B Exhaust side                2 Exhaust valves

### HCS engines

14 The procedure is as described previously in this Section for OHV engines, noting the following.

- When cleaning out the swirl ports, great care must be exercised not to damage the valve seats, especially if using power tools (see illustration).
- The valve arrangement is different, being of mirror effect, where the inlet valves for number 2 and 3 cylinders are next to each other (see illustration).
- When refitting the valve stem oil seals, tape the end of the stem to prevent damage to the seal as it is fitted, and use a long reach socket or length of tube to push the seals fully down (see illustrations). Remove the tape on completion.
- The valve seats cannot be re-worked using conventional tools.

### 15 Engine - reassembly

**Note:** Ensure that all necessary new oil seals and gaskets have been obtained before starting the reassembly procedure.

#### OHV engines

1 With everything clean, commence reassembly by oiling the bores for the cam



15.3 Secure the camshaft thrust plate bolts with the locktabs



14.14c Tape the end of the valve stem before fitting the valve stem seal - HCS engine



14.14d Using a long reach socket to push the seal fully home - HCS engine

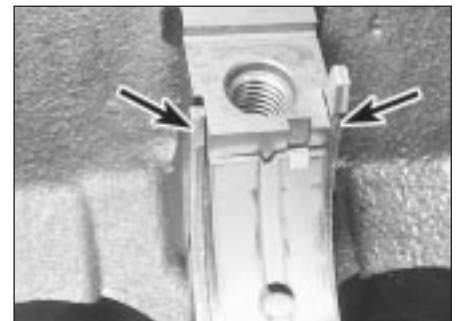
followers and inserting them fully in their original sequence.

2 Lubricate the camshaft bearings and insert the camshaft from the timing cover end of the engine.

3 Fit the thrust plate and tighten the fixing bolts to the specified torque. The endfloat will already have been checked as described in Section 13. Secure the bolts with the locktabs (see illustration).

4 Wipe clean the main bearing shell seats in the crankcase and fit the shells. Using a little grease, stick the semi-circular thrustwashers on either side of the centre bearing so that the oil grooves are visible when the washers are installed (see illustration).

5 Check that the Woodruff key is in position on the front end of the crankshaft and tap the



15.4 Fit the upper main bearing shell and thrustwashers (arrowed) to the centre bearing



**15.9 Using feeler blades to check crankshaft endfloat**

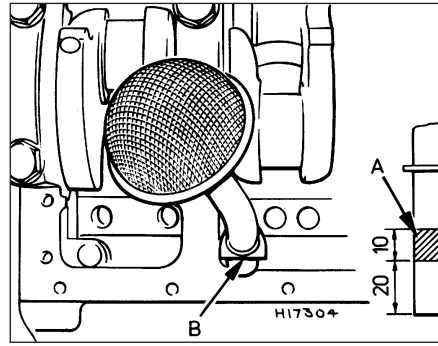
crankshaft sprocket into place using a piece of tubing.

**6** Oil the bearing shells and lower the crankshaft into the crankcase.

**7** Wipe the seats in the main bearing caps and fit the bearing shells into them. Install the caps so that their markings are correctly positioned as explained at dismantling in Section 12.

**8** Screw in the cap bolts and tighten evenly to the specified torque.

**9** Now check the crankshaft endfloat. Ideally a dial gauge should be used, but feeler blades are an alternative if inserted between the face of the thrustwasher and the machined surface of the crankshaft balance weight after having prised the crankshaft first in one direction and then the other (see illustration). Provided the thrustwashers at the centre bearing have been



**15.10 Oil pick-up tube details - 1.3 litre engine**

*A Area for application of adhesive  
B Edge must be parallel with engine longitudinal axis*

renewed, the endfloat should be within the specified tolerance. If it is not, oversize thrustwashers are available (see Specifications).

**10** If the oil pick-up tube was previously removed on 1.3 litre engines a new tube should now be fitted. Apply a suitable adhesive (available from Ford dealers) to the area shown, and fit the tube with the flat edge of the mounting flange parallel with the longitudinal axis of the engine (see illustration).

**11** Rotate the crankshaft so that the timing mark on its sprocket is directly in line with the centre of the camshaft sprocket mounting flange.

**12** Engage the camshaft sprocket within the timing chain and then engage the chain around the teeth of the crankshaft sprocket. Push the camshaft sprocket onto its mounting flange. The camshaft sprocket bolt holes should now be in alignment with the tapped holes in the camshaft flange and both sprocket timing marks in alignment. Turn the camshaft as necessary to achieve this, also withdraw the camshaft sprocket and reposition it within the loop of the chain. This is a "trial and error" operation which must be continued until exact alignment of bolt holes and timing marks is achieved (see illustrations).

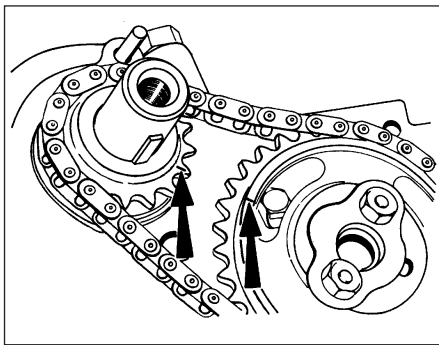
**13** Screw in the sprocket bolts to the specified torque and bend up the tabs of a new lockplate (see illustration).

**14** Bolt the timing chain tensioner into position, retract the tensioner cam spring and then slide the tensioner arm onto its pivot pin. Release the cam tensioner so that it bears upon the arm (see illustration).

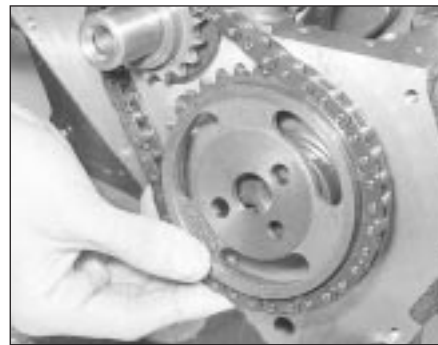
**15** Fit the oil slinger to the front of the crankshaft sprocket so that its convex side is against the sprocket (see illustration).

**16** Using a new gasket, fit the timing cover, which will already have been fitted with a new oil seal (see Section 13) (see illustration). One fixing bolt should be left out at this stage as it also holds the water pump. Grease the oil seal lips and fit the crankshaft pulley. Tighten the pulley bolt to the specified torque.

**17** Using a new gasket, bolt the crankshaft rear oil seal retainer into position. Tighten the



**15.12a Crankshaft and camshaft sprocket timing mark locations**



**15.12b Fit the timing chain and camshaft sprocket . . .**



**15.12c . . . with the sprocket timing marks aligned with the shaft centres**



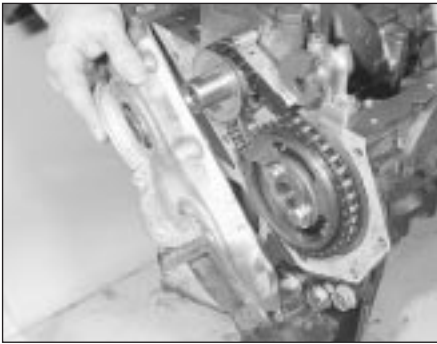
**15.13 Secure the camshaft sprocket bolts with the locktabs**



**15.14 Refit the timing chain tensioner and arm**



**15.15 Fit the oil slinger with its convex side against the sprocket**



15.16 Fitting the timing cover



15.17 Fitting the crankshaft rear oil seal retainer



15.18a Locate the engine adapter plate over the dowels (arrowed) . . .

bolts to the specified torque (see illustration).  
**18** Locate the engine adapter (back) plate on its dowels and then fit the flywheel (see illustrations).

**19** Screw in and tighten the flywheel bolts to the specified torque. To prevent the flywheel turning, the starter ring gear can be jammed or a piece of wood placed between a crankshaft balance weight and the inside of the crankcase.

**20** Install and centralise the clutch as described in Chapter 6.  
**21** The pistons/connecting rods should now be installed. Although new pistons may have been fitted to the rods by your dealer or supplier (see Section 13), it is worth checking to ensure that with the piston crown arrow pointing to the timing cover end of the engine,

the oil hole in the connecting rod is on the left (see illustration 8.13a). Oil the cylinder bores.  
**22** Install the pistons/connecting rods as described in Section 8.

**23** Fit the sump as described in Section 5.

**24** Fit the oil pressure sender unit, if removed.

**25** Turn the crankshaft until No 1 piston is at TDC (crankshaft pulley 3rd timing cover marks aligned) and fit the oil pump complete with a new gasket and a new oil filter as described in Section 10.

**26** Using a new gasket, fit the fuel pump. If the insulating block became detached from the crankcase during removal, make sure that a new gasket is fitted to each side of the block.

**27** Fit the water pump using a new gasket.

**28** Fit the cylinder head as described in Section 4.

**29** Refit the pushrods in their original sequence and the rocker shaft, also as described in Section 4.

**30** Adjust the valve clearances (Chapter 1) and refit the rocker cover using a new gasket.  
**31** Fit the inlet and exhaust manifolds using new gaskets and tightening the nuts and bolts to the specified torque (Chapter 4, Part E).

**32** Refit the carburettor using a new flange gasket and connect the fuel pipe from the pump (Chapter 4, Part A).

**33** Screw in the spark plugs and the coolant temperature switch (if removed).

**34** Refit the thermostat and the thermostat housing cover.



15.18b . . . then refit and secure the flywheel

**35** Fit the pulley to the water pump pulley flange.

**36** Fit the alternator and the drivebelt and tension the belt as described in Chapter 1.

**37** Refit the distributor as described in Chapter 5, Part B.

**38** Refit the distributor cap and reconnect the spark plug HT leads.

**39** Bolt on and connect the coolant pipe to the side of the cylinder block.

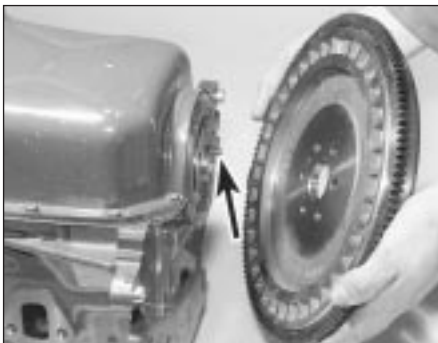
**40** Fit the breather pipe from the oil filler cap to the inlet manifold and fit the cap.

**41** Check the sump drain plug for tightness. A new seal should be fitted at regular intervals to prevent leakage. Refit the dipstick.

**42** Refilling with oil should be left until the engine is installed in the vehicle.



15.43a Line up the flange using a spanner - HCS engine



15.43b Fitting the flywheel to the crankshaft (dowel arrowed) - HCS engine



15.43c Using the correct tool . . .



15.43d . . . and using a card template to angle-tighten the big-end cap bolts - HCS engine

## HCS engines

43 The procedure is as described previously in this Section for OHV engines, noting the following points.

- a) *Tighten the main bearing cap bolts to the specified torque before fitting the oil pick-up tube.*
- b) *When fitting the oil pick-up tube, use a spanner on the flats of the flange to line it up (see illustration).*
- c) *The flywheel is dowelled to the crankshaft and cannot be fitted off-centre (see illustration).*
- d) *The big-end bearing cap bolts are angle-tightened after an initial torque load (see Specifications). Use the correct tool if it is available or make up a card template with the specified angle marked on it (see illustrations).*
- e) *Apart from lining up the camshaft and crankshaft sprocket timing marks (for valve timing), there is no ignition timing mark to worry about.*
- f) *Fit the rocker cover using a new gasket. Do not exceed the specified torque for the securing screws; this may result in oil leaks at the rocker cover/cylinder head mating face.*

### 16 Engine/transmission - reconnection and installation

1 This is a direct reversal of removal and separation from the transmission. Take care not to damage the radiator or front wings during installation.

## Reconnection

2 Reconnection of the engine and transmission is a reversal of separation, but if the clutch has been dismantled, check that the friction plate has been centralised as described in Chapter 6.

## Installation

### OHV engines

3 First check that the engine sump drain plug is tight and then, where applicable refit the selector shaft cap nut (removed to drain the transmission oil) together with its spring and interlock pin. Apply sealer to the cap nut threads when refitting (see Specifications Chapter 7, Part A).

4 Manoeuvre the engine/transmission under the vehicle and attach the lifting hoist. Raise the engine/transmission carefully until the right-hand rear mounting can be engaged. Refit the mounting nut and bolt loosely only at this stage.

5 On pre-1986 models refit the front mounting and anti-roll bar support plates, then refit the left-hand front and rear mountings loosely only.

6 On 1986 models onwards refit the transmission support crossmember.

7 Lower the hoist and let the power unit rest on its mountings. Ensure that none of the mountings are under strain, then tighten all the mounting nuts and bolts and remove the hoist.

8 The driveshafts and suspension arms should now be refitted using the procedure described in the manual transmission refitting procedure in Chapter 7, Part A.

9 Reconnect and adjust the gearchange

linkage using the procedure described in Chapter 7, Part A.

10 Fit the starter motor leads to their terminals.

11 Connect the engine earth leads.

12 Refit the exhaust system and bolt the downpipe to the manifold. Refit the hot air box which connects with the air cleaner.

13 Reconnect the clutch operating cable.

14 Reconnect the electrical leads, the fuel pipe, the brake vacuum hose and the speedometer cable.

15 Reconnect the throttle cable and the choke cable (where applicable) as described in Chapter 4, Part A.

16 Reconnect the radiator coolant hoses, and heater hoses.

17 Fill up with engine oil, transmission oil and coolant, then reconnect the battery (photo).

18 Refit the bonnet, bolting the hinges to their originally marked positions. Reconnect the screen washer pipe.

19 Fit the air cleaner and reconnect the hoses and the air cleaner inlet spout.

20 Once the engine is running, check the dwell angle, timing, idle speed and mixture adjustment as applicable (refer to Chapter 1).

21 If a number of new internal components have been installed, run the vehicle at restricted speed for the first few hundred miles to allow time for the new components to bed in. It is also recommended that with a new or rebuilt engine, the engine oil and filter are changed at the end of the running-in period.

### HCS engines

22 Refitting is a reversal of the removal procedure described in Section 11.