

# Chapter 2

## Engine, clutch and transmission

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### Degrees of difficulty

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

#### General

Capacity	
600 cc engine (J, K, M models) . . . . .	583 cc
650 cc engine (P, S, T models) . . . . .	647 cc
Bore	
600 cc engine (J, K, M models) . . . . .	75.0 mm
650 cc engine (P, S, T models) . . . . .	79.0 mm
Stroke . . . . .	<b>66.0 mm</b>
Compression ratio . . . . .	9.2 to 1
Cylinder compression . . . . .	192 ± 28 psi (13.25 ± 1.9 Bar)

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### Camshafts, rockers and cam chain

Cam chain tensioner projection (max) .....	6 mm
Camshaft	
Intake lobe height	
Standard .....	38.189 mm
Service limit .....	38.17 mm
Exhaust lobe height	
Standard .....	38.123 mm
Service limit .....	38.19 mm
Journal diameter	
Standard .....	21.959 to 21.980 mm
Service limit .....	21.95 mm
Camshaft bearing oil clearance	
Standard .....	0.040 to 0.093 mm
Service limit .....	0.11 mm
Camshaft runout	
Standard .....	0.03 mm
Service limit .....	0.05 mm
Rocker shaft diameter	
Standard .....	11.966 to 11.984 mm
Service limit .....	11.96 mm
Rocker arm internal diameter	
Standard .....	12.000 to 12.018 mm
Service limit .....	12.03 mm

### Cylinder head

Warpage (max) .....	0.10 mm
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### Valves, guides and springs

Intake valve	
Stem diameter	
Standard .....	5.475 to 5.490 mm
Service limit .....	5.47 mm
Guide bore diameter	
Standard .....	5.500 to 5.512 mm
Service limit .....	5.53 mm
Stem-to-guide clearance	
Standard .....	0.010 to 0.037 mm
Service limit .....	0.07 mm
Seat width	
Standard .....	0.9 to 1.1 mm
Service limit .....	1.5 mm
Spring free lengths	
Inner spring .....	36.47 mm
Outer spring .....	40.58 mm
Guide projection height .....	19.4 to 19.6 mm
Exhaust valve	
Stem diameter	
Standard .....	6.555 to 6.570 mm
Service limit .....	6.55 mm
Guide bore diameter	
Standard .....	6.600 to 6.615 mm
Service limit .....	6.66 mm
Stem-to-guide clearance	
Standard .....	0.030 to 0.060 mm
Service limit .....	0.11 mm
Seat width	
Standard .....	0.9 to 1.1 mm
Service limit .....	1.5 mm
Spring free lengths	
Inner spring .....	37.51 mm
Outer spring .....	41.25 mm
Guide projection height .....	17.9 to 18.1 mm
Valve clearances .....	see Chapter 1

**Cylinder block**

Bore diameter	
600 cc engine	
Standard	75.00 to 75.015 mm
Wear limit	75.10 mm
650 cc engine	
Standard	79.00 to 79.015 mm
Wear limit	79.05 mm
Taper (max)	0.06 mm
Ovality (max)	0.06 mm
Warpage (max)	0.10 mm

**Pistons**

Piston diameter (measured 10.0 mm up from skirt, at 90° to piston pin axis)	
600 cc engine	
Standard	74.965 to 74.990 mm
Service limit	74.90 mm
650 cc engine	
Standard	78.970 to 78.990 mm
Service limit	78.92 mm
• 1 st oversize	+0.25 mm
2nd oversize	+0.50 mm
Piston-to-bore clearance	
Standard	0.010 to 0.035 mm
Service limit	0.13 mm
Piston pin diameter	
600 cc engine	
Standard	17.994 to 18.000 mm
Service limit	17.98 mm
650 cc engine	
Standard	19.994 to 20.000 mm
Service limit	19.98 mm
Piston pin bore	
600 cc engine	
Standard	18.002 to 18.008 mm
Service limit	18.05 mm
650 cc engine	
Standard	20.002 to 20.008 mm
service limit	20.02 mm
Piston pin-to-bore clearance	
Standard	0.002 to 0.014 mm
Service limit	0.034 mm
Connecting rod small-end internal diameter	
600 cc engine	
Standard	18.016 to 18.034 mm
Service limit	18.07 mm
650 cc engine	
Standard	20.016 to 20.034 mm
Service limit	20.04 mm
Piston pin-to-connecting rod small-end clearance	
Standard	0.016 to 0.040 mm
Service limit	0.060 mm

**Piston rings**

Ring-to-groove clearance	
Top ring	
Standard	0.025 to 0.055 mm
Service limit	0.11 mm
2nd ring	
Standard	0.015 to 0.045 mm
Service limit	0.10 mm

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### Piston rings (continued)

#### End gap (installed)

Top ring	
Standard	0.20 to 0.35 mm
Service limit	0.65 mm
2nd ring	
Standard	0.35 to 0.50 mm
Service limit	0.65 mm
Oil ring	
Standard	0.2 to 0.8 mm
Service limit	0.95 mm

### Connecting rods

#### Side clearance

Standard	0.05 to 0.20 mm
Service limit	0.3 mm

#### Bearing oil clearance

Standard	0.028 to 0.052 mm
Service limit	0.08 mm

#### Big-end internal diameter

Size code 1	39.000 to 39.006 mm
Size code 2	39.006 to 39.012 mm

#### Crankpin diameter

Size code A	35.994 to 36.000 mm
Size code B	35.988 to 35.994 mm

For connecting rod small-end specifications see under "Pistons".

### Crankshaft and bearings

#### Main bearing oil clearance

Standard	0.025 to 0.041 mm
Service limit	0.06 mm
Runout (max)	0.05 mm

### Clutch

#### Friction plate (see Section 17 for identification)

##### Type A

Quantity	1
Thickness	2.92 to 3.08 mm
Service limit	2.6 mm

##### Type B

Quantity	6
Thickness	2.62 to 2.78 mm
Service limit	2.3 mm

##### Type C

Quantity	1
Thickness	2.62 to 2.78 mm
Service limit	2.3 mm

#### Plain plate

Quantity	7
Warpage (max)	0.3 mm

#### Springs

Free length	44.4 mm
Service limit	42.8 mm

#### Mainshaft diameter at clutch housing guide

Standard	21.967 to 21.980 mm
Service limit	21.92 mm

#### Clutch housing guide

##### Internal diameter

Standard	21.991 to 22.016 mm
Service limit	22.09 mm

##### External diameter

Standard	31.959 to 31.975 mm
Service limit	31.92 mm

#### Clutch housing internal diameter

Standard	32.000 to 32.025 mm
Service limit	32.10 mm

#### Oil pump drive sprocket internal diameter

Standard	32.000 to 32.025 mm
Service limit	32.10 mm

**Starter clutch**

Starter driven gear hub external diameter	
Standard	57.749 to 57.768 mm
Service limit	57.60 mm

**Transmission**

Type	
Gearbox	5 speed, constant mesh
Final drive	Shaft
Gear ratios (No. of teeth)	
Primary reduction	
600 cc engine	1.888 to 1 (68/36T)
650 cc engine	1.763 to 1 (67/38T)
Secondary reduction	0.882 to 1 (30/34T)
Tertiary reduction	1.058 to 1 (18/17T)
Final drive	2.909 to 1 (32/11T)
1st gear	2.571 to 1 (36/14T)
2nd gear	1.882 to 1 (32/17T)
3rd gear	1.500 to 1 (30/20T)
4th gear	1.240 to 1 (31/25T)
5th gear	1.074 to 1 (29/27T)
Gear ID	
Mainshaft 4th and 5th gears	
Standard	28.000 to 28.021 mm
Service limit	28.03 mm
Countershaft 1st gear	
Standard	24.000 to 24.021 mm
Service limit	24.03 mm
Countershaft 2nd and 3rd gears	
Standard	28.000 to 28.021 mm
Service limit	28.03 mm
Output drive shaft driven gear	
Standard	24.000 to 24.021 mm
Service limit	24.10 mm
Gear bushing OD	
Mainshaft 4th and 5th gears	
Standard	27.959 to 27.980 mm
Service limit	27.95 mm
Countershaft 1st gear	
Standard	23.959 to 23.980 mm
Service limit	23.95 mm
Countershaft 2nd and 3rd gears	
Standard	27.959 to 27.980 mm
Service limit	27.95 mm
Output drive shaft driven gear	
Standard	23.959 to 23.980 mm
Service limit	23.70 mm
Gear bushing ID	
Mainshaft 4th gear	
Standard	25.000 to 25.021 mm
Service limit	25.03 mm
Countershaft 1st gear	
Standard	20.016 to 20.037 mm
Service limit	20.05 mm
Countershaft 2nd and 3rd gears	
Standard	25.000 to 25.021 mm
Service limit	25.03 mm
Output drive shaft driven gear	
Standard	20.020 to 20.041 mm
Service limit	20.10 mm
Gear-to-bushing clearance	
Mainshaft 4th and 5th gear	
Standard	0.020 to 0.062 mm
Service limit	0.08 mm
Countershaft 1st, 2nd and 3rd gear	
Standard	0.020 to 0.062 mm
Service limit	0.08 mm

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### Transmission (continued)

Mainshaft OD at 4th gear bushing point	
Standard	24.959 to 24.980 mm
Service limit	24.95 mm
Countershaft OD	
1st gear bushing point	
Standard	19.980 to 19.993 mm
Service limit	19.97 mm
2nd gear bushing point	
Standard	24.972 to 24.990 mm
Service limit	24.96 mm
3rd gear bushing point	
Standard	24.959 to 24.980 mm
Service limit	24.95 mm
Shaft-to-bushing clearance	
Mainshaft 4th gear	
Standard	0.020 to 0.062 mm
Service limit	0.08 mm
Countershaft 2nd gear	
Standard	0.010 to 0.049 mm
Service limit	0.07 mm
Countershaft 3rd gear	
Standard	0.020 to 0.062 mm
Service limit	0.08 mm
Output drive shaft OD	
Standard	19.979 to 20.000 mm
Service limit	19.97 mm
Damper spring free length	
J model	
Standard	58.40 mm
Service limit	56.00 mm
All other models	
Standard	62.30 mm
Service limit	59.70 mm
Output shaft backlash	
Standard	0.40 mm
Maximum difference between measurements	0.10 mm

### Selector drum and forks

Selector fork end thickness	
Standard	5.93 to 6.00 mm
Service limit	5.83 mm
Selector fork bore ID	
Standard	13.000 to 13.018 mm
Service limit	13.03 mm
Selector fork shaft OD	
Standard	12.966 to 12.984 mm
Service limit	12.96 mm
Selector drum OD at the left-hand journal	
Standard	11.966 to 11.984 mm
Service limit	11.96 mm

### Lubrication system

Oil pressure	64 psi @ 6000 rpm
Oil pump rotor tip-to-outer rotor clearance	
Standard	0.15 mm
Service limit	0.20 mm
Oil pump outer rotor-to-body clearance	
Standard	0.15 to 0.22 mm
Service limit	0.35 mm
Oil pump rotor end float	
Standard	0.02 to 0.07 mm
Service limit	0.10 mm

## Torque settings

Engine mounting bolts	
Front	40 Nm
Frame cross-member to engine bolts	25 Nm
Rear upper	40 Nm
Rear lower	40 Nm
Rear mounting bracket bolts	22 Nm
Gearchange linkage arm pinch bolt	12 Nm
Valve cover bolts	10 Nm
Crankshaft end cap	15Nm
Timing mark inspection cap	10Nm
Camshaft main holder bolts and nut	23 Nm
Camshaft end holder bolts	10 Nm
Camshaft sprocket bolts	23 Nm
Cam chain tensioner mounting bolts	10 Nm
Ignition timing rotor/primary drive gear bolt	90 Nm
Cylinder head nuts	
Domed nuts	43 Nm
Plain nut	23 Nm
Long bolts	23 Nm
Short bolt	10 Nm
External oil pipe (J and K models only)	
Upper bolts	10Nm
Lower bolt	23 Nm
Clutch nut	130 Nm
Gear selector drum stopper plate bolt	26 Nm
Starter clutch bolts	30 Nm
Output driveshaft bolt	50 Nm
Crankcase bolts	
8 mm bolts	23 Nm
6 mm bolts	12 Nm
Cylinder studs	
8 mm stud	20 to 30 Nm
10 mm studs	30 to 50 Nm
Oil pump driven sprocket bolt	18 Nm
Output shaft housing assembly bolts	32 Nm
Output drive shaft bearing housing bolts	32 Nm
Output driven shaft bearing housing bolts	32 Nm
Crankcase cover bolts (left-hand side)	10 Nm
Crankcase cover bolts (right-hand side)	10 Nm
Connecting rod nuts	34 Nm

## 1 General information

The engine/transmission unit is a water-cooled 52° V-twin, fitted parallel with the frame. The engine has three valves per cylinder, two for the intake and one for the exhaust, operated by a single overhead camshaft via rocker arms. The camshafts are chain driven off the crankshaft.

The engine/transmission unit is constructed in aluminium alloy with the crankcase being divided vertically. The crankcase incorporates a wet sump, pressure fed lubrication system, and houses a chain driven oil pump. The one-piece forged crankshaft runs in two main bearings. The left-hand end of the crankshaft carries the alternator rotor, whilst the right-hand end carries the ignition rotor and pulse generator coils.

The clutch is of the wet multi-plate type and is gear driven off the crankshaft. The transmission is of the five-speed constant mesh type. Drive is then turned through 90° by the output drive and driven shafts, then transmitted to the rear wheel by shaft.

### Operations possible with the engine in the frame

The components and assemblies listed below can be removed without having to remove the engine/transmission assembly from the frame. If however, a number of areas require attention at the same time, removal of the engine is recommended.

*Valve covers*  
*Cam chain tensioners*  
*Camshafts and rockers*  
*Cylinder heads*  
*Cylinder blocks, pistons and piston rings*  
*Water pump*

*Ignition rotor and pulse generator coils*  
*Clutch*  
*Gearchange mechanism*  
*(external components)*  
*Starter motor*  
*Alternator*  
*Starter clutch and idle gear*

### 3 Operations requiring engine removal

It is necessary to remove the engine/transmission assembly from the frame and separate the crankcase halves to gain access to the following components.

*Transmission shafts*  
*Crankshaft and bearings*  
*Connecting rod big-ends and bearings*  
*Selector drum and forks (gearchange mechanism internal components)*  
*Oil pump*

## 2•8 Engine, clutch and transmission

### 4 Major engine repair - general note

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

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

3 Exhaust smoke and excessive oil consumption are both indications that piston rings and/or valve guides are in need of attention, although make sure that the fault is not due to oil leakage.

4 If the engine is making obvious knocking or rumbling noises, the connecting rod and/or main bearings are probably at fault.

5 Loss of power, rough running, excessive valve train noise and high fuel consumption rates may also point to the need for an overhaul, especially if they are all present at the same time. If a complete tune-up does not remedy the situation, major mechanical work is the only solution.

6 An engine overhaul generally involves restoring the internal parts to the specifications of a new engine. The piston rings and main and connecting rod bearings are usually replaced and the cylinder walls honed or, if necessary, re-bored during a major overhaul. Generally the valve seats are reground, since they are usually in less than perfect condition at this point. The end result should be a like new engine that will give as many trouble-free miles as the original.

7 Before beginning the engine overhaul, read through the related procedures to familiarise yourself with the scope and requirements of the job. Overhauling an engine is not all that difficult, but it is time consuming. Plan on the motorcycle being tied up for a minimum of

two weeks. Check on the availability of parts and make sure that any necessary special tools, equipment and supplies are obtained in advance.

8 Most work can be done with typical workshop hand tools, although a number of precision measuring tools are required for inspecting parts to determine if they must be replaced. Often a dealer will handle the inspection of parts and offer advice concerning reconditioning and replacement. As a general rule, time is the primary cost of an overhaul so it does not pay to install worn or substandard parts.

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

### 5 Engine - removal and installation



**Note:** *The engine is very heavy. Engine removal and installation should be carried out with the aid of at least one assistant; personal injury or damage could occur if the engine falls or is dropped. A hydraulic or mechanical floor jack should be used to support and lower or raise the engine if possible.*

#### Removal

1 Position the bike on its centre stand or support it securely in an upright position using an auxiliary stand. Work can be made easier by

raising the machine to a suitable working height on a hydraulic ramp or a suitable platform.

2 If the engine is dirty, particularly around its mountings, wash it thoroughly before starting any major dismantling work. This will make work much easier and rule out the possibility of caked on lumps of dirt falling into some vital component.

3 Drain the engine oil and remove the oil filter (see Chapter 1).

4 Drain the coolant (see Chapter 1).

5 Remove the seat and the side panels (see Chapter 8) and disconnect the battery negative (-ve) lead (see Chapter 9).

6 Remove the fuel tank (see Chapter 4).

7 Remove the air filter housing (see Chapter 4).

8 Remove the carburettors (see Chapter 4). Plug the engine intake manifolds with clean rag.

9 Remove the radiator (see Chapter 3).

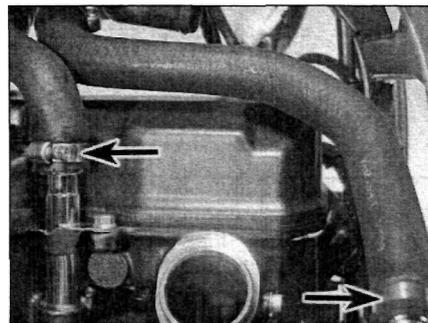
10 Unscrew the clamps securing the coolant hoses to the cylinder head pipes and detach the hoses (**see illustration**). Release the clamp securing the overflow hose to the filler neck and secure the hose clear of the engine (**see illustration**).

11 Pull out the clips securing the heat guard and remove the guard (**see illustration**).

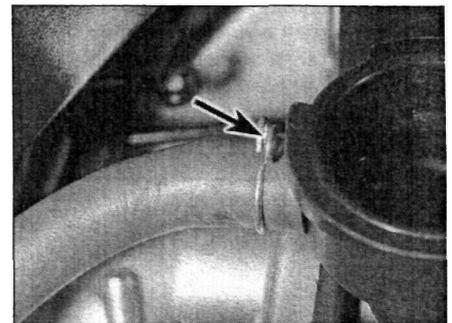
12 Remove the exhaust system (Chapter 4).

13 Pull back the rubber boot on the starter motor, then unscrew the nut securing the lead to the motor (**see illustration**). Also unscrew the front starter motor mounting bolt to release the earth cable (**see illustration**).

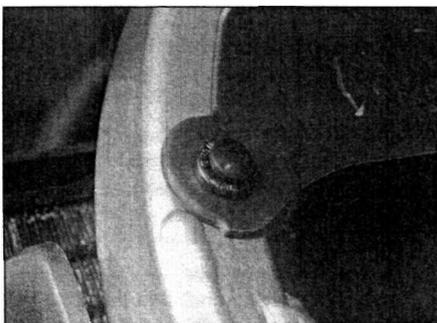
14 Detach the clutch cable from the clutch housing (see Section 18). Release the cable



5.10a Release the clamps (arrows) and detach the coolant hoses from the cylinder heads



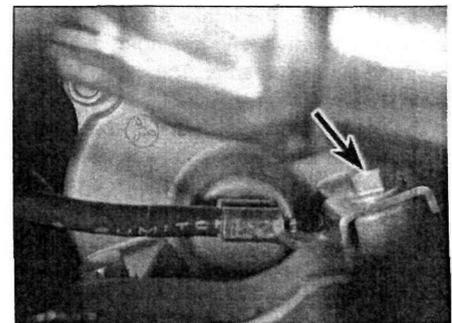
5.10b Release the overflow hose clamp (arrow) and detach the hose from the filler neck



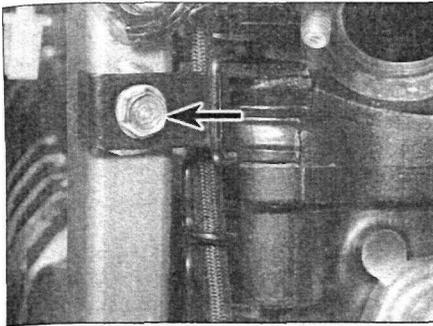
5.11 The heat guard is secured by three trim clips



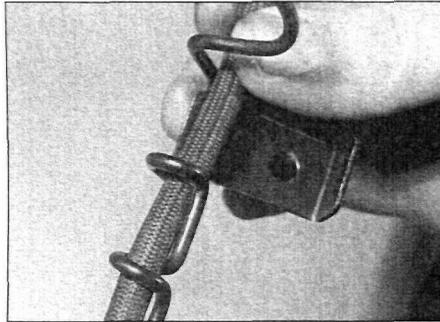
5.13a Pull back the rubber boot (arrow) to expose the starter motor lead securing nut



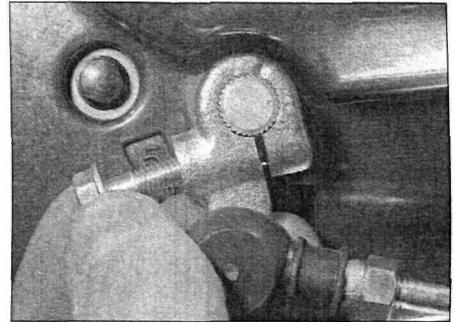
5.13b Unscrew the starter motor front bolt to release the earth lead (arrow)



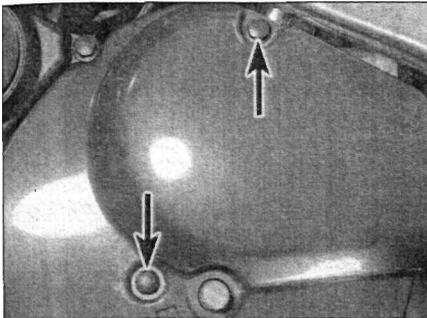
5.15a Unscrew the wiring guide bolt (arrow) . . .



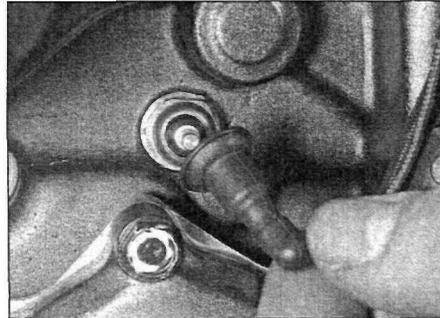
5.15b . . . and release the wiring from the guide



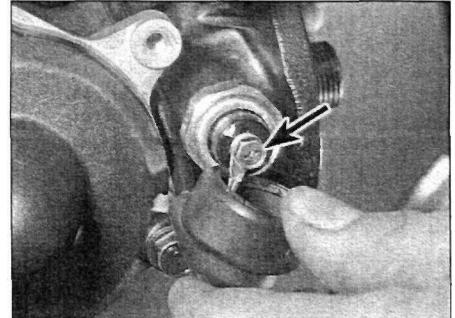
5.16 Remove the pinch bolt and slide the gearchange linkage off the shaft



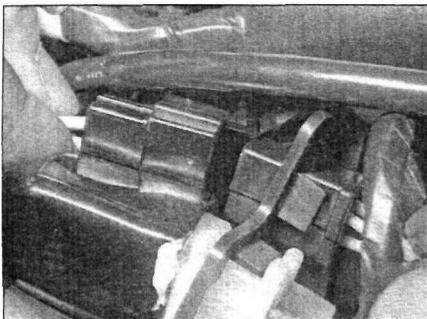
5.17a Left-hand side crankcase rear cover bolts (arrows)



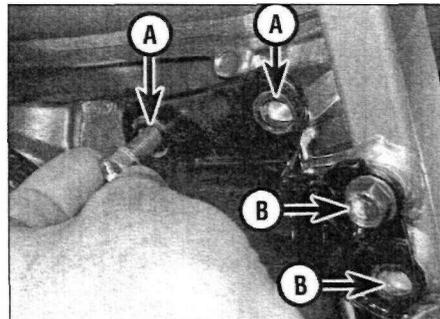
5.17b Pull off the neutral switch wiring connector



5.17c Unscrew the oil pressure switch wiring connector (arrow)



5.18 The alternator wiring connector is behind the right-hand side panel



5.23 The cross-member is secured to the engine by two bolts (A) and to each frame downtube by two bolts (B)

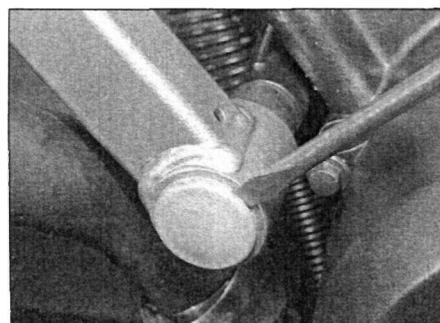
from the guide on the right-hand side frame downtube and secure it clear of the engine.

15 Trace the ignition pulse generator wiring and disconnect it at the connector. Unscrew the wiring guide bolt from the frame and release the wiring from the guide, noting how it fits (see illustrations). Coil the wiring between the cylinders so it does not impede engine removal.

16 Unscrew the gearchange linkage arm pinch bolt and remove the linkage arm from the shaft (see illustration). Note the punch marks on the arm and the shaft which must be aligned on installation.

17 Unscrew the bolts securing the left-hand side crankcase rear cover and remove the cover (see illustration). Pull off the neutral switch wiring connector (see illustration). Pull back the rubber boot on the oil pressure switch, then unscrew the screw securing the wiring connector to the switch (see illustration). Secure the wiring clear of the engine.

18 Trace the alternator wiring and disconnect it at the connector behind the right-hand side panel, then coil the wiring in between the cylinders so that it does not impede engine removal (see illustration).



5.24a Prise off the front engine mounting bolt caps using a flat-bladed screwdriver

19 Disconnect the spark plug leads from the plugs and secure them clear of the engine.

20 Remove the rear wheel (see Chapter 7).

21 Remove the final drive housing along with the driveshaft and universal joint as an assembly (see Chapter 6).

22 At this point, position an hydraulic or mechanical jack under the engine with a block of wood between the jack head and sump. Make sure the jack is centrally positioned so the engine will not topple in any direction when the last mounting bolt is removed. Take the weight of the engine on the jack.

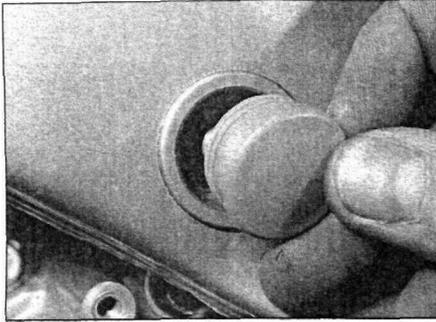
23 Unscrew the bolts securing the frame cross-member to the engine, then unscrew the bolts securing the frame cross-member to the frame downtubes and remove the cross-member (see illustration).

24 Remove the cap from each end of the front engine mounting bolt, then unscrew the nut and withdraw the bolt (see illustrations). Note

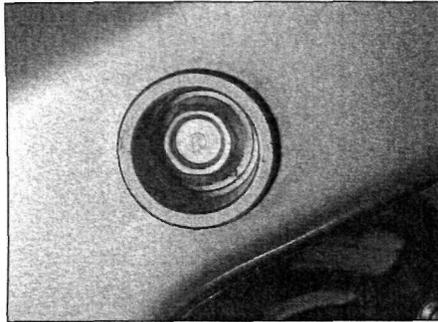


5.24b Unscrew the nut and withdraw the bolt

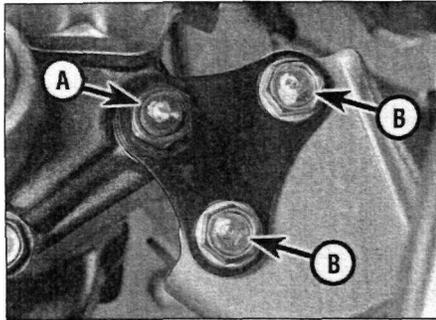
## 2•10 Engine, clutch and transmission



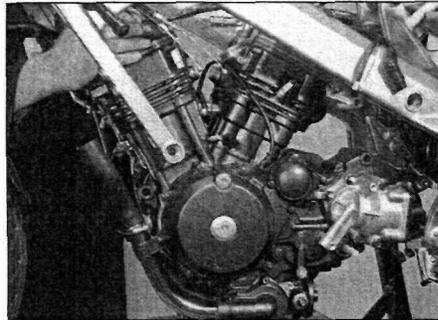
5.25a Prise off the rear upper engine mounting bolt caps



5.25b Rear upper engine mounting bolt



5.26 Rear lower engine mounting bolt nut (A) and bracket bolts (B)



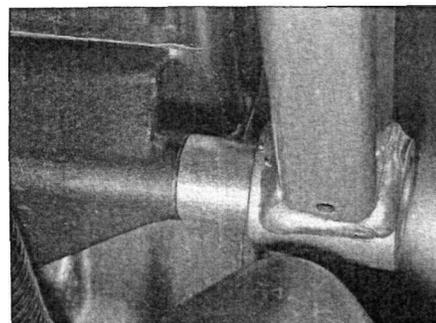
5.27 Removing the engine from the frame

how the spacers fit in between the frame downtubes and the engine, and that the longer spacer fits on the left-hand side.

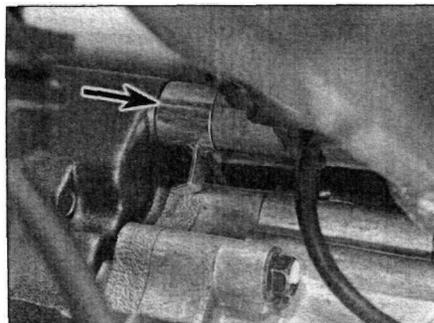
25 Remove the cap from each end of the rear upper engine mounting bolt, then unscrew the nut and withdraw the bolt (**see illustrations**). Note how the spacer fits in between the frame and the engine.

26 Make sure the engine is properly supported on the jack, then unscrew the rear lower engine mounting bolt nut and withdraw the bolt (**see illustration**). Unscrew the bolts securing the mounting bolt bracket to the frame and remove the bracket.

27 The engine can now be removed from the frame. Check that all wiring, cables and hoses are well clear, then lower the jack and manoeuvre the engine out (**see illustration**).



5.28a The longer spacer for the front engine mounting bolt fits on the left-hand side



5.28b Rear upper engine mounting bolt spacer (arrow)

- e) Do not tighten any of the engine mounting bolts until they have all been installed. Make sure the spacers are correctly positioned.
- f) Tighten the engine mounting bolts and any other bolts to the torque settings specified at the beginning of the Chapter.
- g) Use new gaskets at all exhaust pipe connections.
- h) Align the punch marks on the gearchange linkage arm and shaft when installing the arm on the shaft, and tighten the pinch bolt to the specified torque setting (**see illustration**).
- i) Make sure all wires, cables and hoses are correctly routed and connected, and secured by any clips or ties.
- j) Refill the engine with oil (**see Chapter 1**).
- k) Refill the cooling system with coolant (**see Chapter 1**).
- l) Adjust the throttle and clutch freeplay (**see Chapter 1**).

## 6 Engine disassembly and reassembly - general information

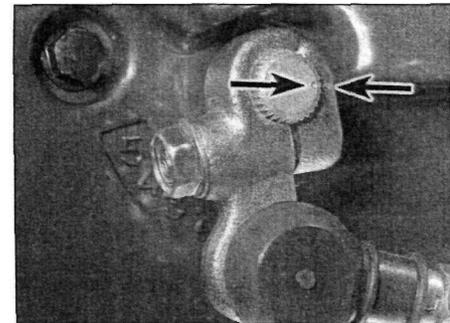
**Note:** Refer to "Maintenance techniques, tools and working facilities" in the Reference section of this manual for further information.

### Disassembly

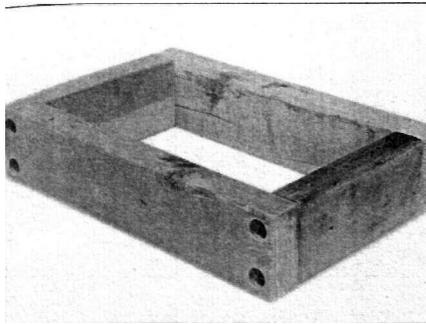
1 Before disassembling the engine, the external surfaces of the unit should be thoroughly cleaned and degreased. This will prevent contamination of the engine internals, and will also make working a lot easier and cleaner. A high flash-point solvent, such as paraffin can be used, or better still, a proprietary engine degreaser. Use old paintbrushes and toothbrushes to work the solvent into the various recesses of the engine casings. Take care to exclude solvent or water from the electrical components and intake and exhaust ports.



**Warning:** The use of petrol as a cleaning agent should be avoided because of the risk of fire.



5.28c Align the punch mark on the gearchange linkage arm with that on the shaft (arrows)



**6.4 An engine support made from pieces of 2 x 4 inch wood**

2 When clean and dry, arrange the unit on the workbench, leaving suitable clear area for working. Gather a selection of small containers and plastic bags so that parts can be grouped together in an easily identifiable manner. Some paper and a pen should be on hand to permit notes to be made and labels attached where necessary. A supply of clean rag is also required.

3 Before commencing work, read through the appropriate section so that some idea of the necessary procedure can be gained. When removing various engine components it should be noted that great force is seldom required, unless specified. In many cases, a component's reluctance to be removed is indicative of an incorrect approach or removal method. If in any doubt, re-check with the text.

4 An engine support stand made from short lengths of 2 x 4 inch wood bolted together into a rectangle will help support the engine (see illustration). The perimeter of the mount should be just big enough to accommodate the sump within it so that the engine rests on its crankcase.

5 When disassembling the engine, keep "mated" parts together (including gears, cylinders, pistons, connecting rods, valves, etc. that have been in contact with each other during engine operation). These "mated" parts must be re-used or replaced as an assembly.

6 Engine/transmission disassembly should be done in the following general order with reference to the appropriate Sections.

- Remove the valve covers
- Remove the camshafts and cam chain tensioners
- Remove the cylinder heads
- Remove the cylinder blocks
- Remove the pistons
- Remove the water pump (see Chapter 3)
- Remove the ignition rotor and pulse generator coils (see Chapter 5)
- Remove the clutch
- Remove the gearchange mechanism external components
- Remove the starter motor (see Chapter 9)
- Remove the alternator (see Chapter 9)
- Remove the starter clutch and idle gear
- Separate the crankcase halves

- Remove the oil pump
- Remove the transmission shafts/gears
- Remove the selector drum and forks
- Remove the crankshaft and the connecting rods

**Reassembly**

7 Reassembly is accomplished by reversing the general disassembly sequence.

**7 Valve covers - removal and installation**



**Note:** The valve covers can be removed with the engine in the frame. If the engine has been removed, ignore the steps which do not apply.

**Removal**

- 1 Remove the seat and the side panels (see Chapter 8) and disconnect the battery negative (-ve) lead.
- 2 Remove the fuel tank and the air filter housing (see Chapter 4).
- 3 Remove the radiator and the thermostat housing (not necessary if only removing the rear valve cover) (see Chapter 3). Unscrew the clamps securing the coolant hoses to the cylinder head pipes and detach the hoses (not necessary if only removing the rear valve cover) (see illustration 5.10a).
- 4 Remove the three clips securing the heat guard and remove the guard (not necessary if

only removing the rear valve cover) (see illustration 5.11).

5 Disconnect the spark plug leads from the plugs and secure them clear of the engine.

6 Unscrew the valve cover bolts, then remove them with their rubber washers and seals (see illustration).

7 Lift the valve cover off the cylinder head. If it is stuck, do not try to lever it off with a screwdriver. Tap it gently around the sides with a rubber hammer to dislodge it. Remove the front cylinder valve cover through the front of the frame.

**Installation**

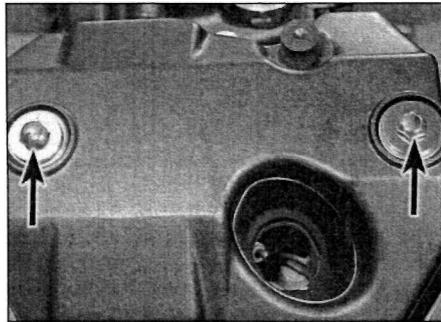
8 Examine the valve cover gasket for signs of damage or deterioration and replace it if necessary (see illustration). Also check the cover bolt washers and seals and replace them if necessary.

9 Clean the mating surfaces of the cylinder head and the valve cover with lacquer thinner, acetone or brake system cleaner.

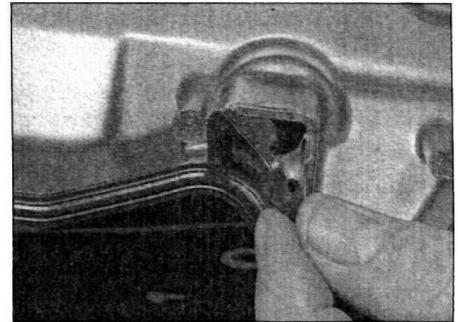
10 Install the rubber gasket into the valve cover, making sure it fits correctly into the groove.

11 Position the cover on the cylinder head, making sure the gasket stays in place (see illustration). Install the cover bolts with their seals and washers and tighten them to the torque setting specified at the beginning of the Chapter (see illustration).

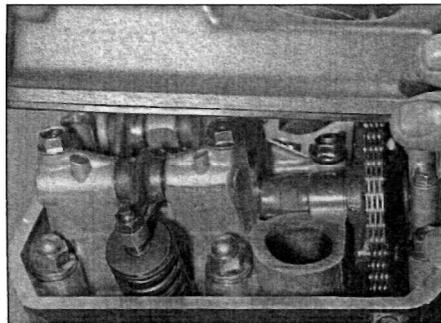
12 Install the remaining components in the reverse order of removal.



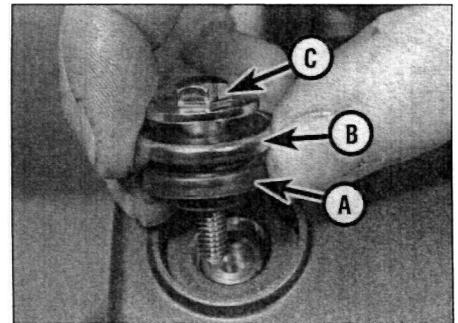
**7.6 Each valve cover is secured by two bolts (arrows)**



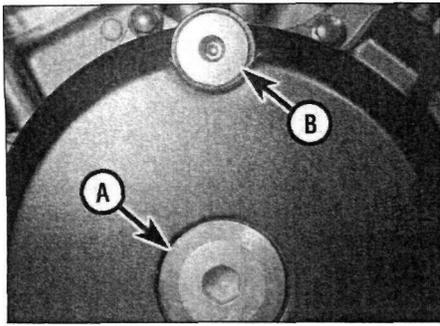
**7.8 Make sure the gasket is in good condition before re-using it**



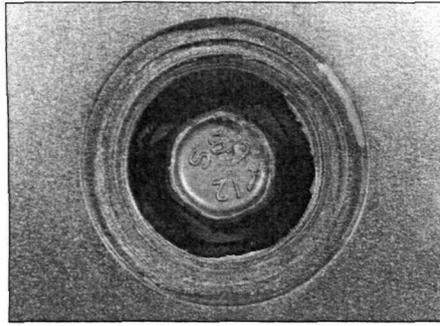
**7.11a Install the valve cover .**



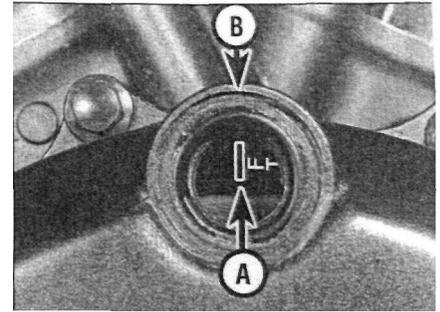
**7.11b ... and secure it with its bolts, making sure the seal (A) and washer (B) are installed with the bolt (C)**



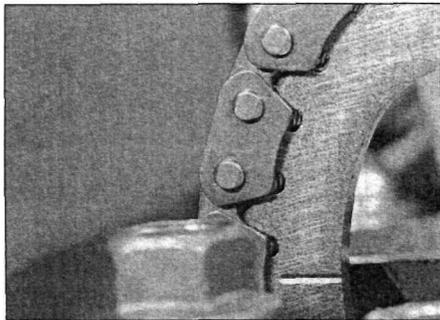
8.2a Crankshaft end cap (A) and timing mark inspection cap (B)



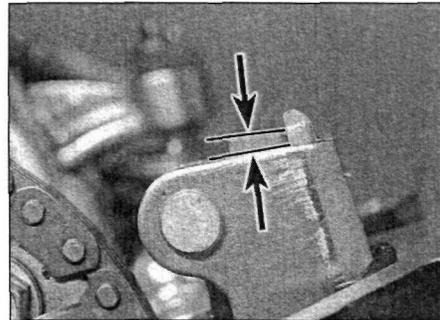
8.2b Use a socket on the flywheel bolt behind the crankshaft end cap to rotate the engine



8.2c Align the "FT" or "RT" mark (A) with the notch (B) in the inspection hole



8.2d The index lines on the sprocket (arrow) should align with the surface of the cylinder head



8.3a Measure the amount of projection of the front wedge on top of the cam chain tensioner



8.3b Pull up the rear wedge and insert a suitable pin or nail through its hole to secure it in the raised position

## 8 Camshafts and rockers - removal, inspection and installation



**Note:** The camshafts and rockers can be removed with the engine in the frame.

### Removal

- 1 Remove the valve cover (see Section 7).
- 2 Unscrew the crankshaft end cap and the timing mark inspection cap from the left-hand side crankcase cover (see illustration). Using a suitable socket on the alternator rotor bolt (see illustration), rotate the engine anti-clockwise so that it is at TDC (Top Dead Centre) on the compression stroke of the cylinder being worked on. At this point the "FT" mark (if removing the front camshaft) or

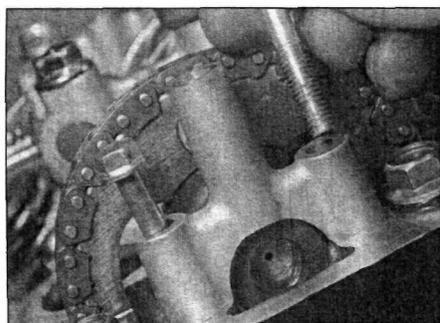
the "RT" mark (if removing the rear camshaft) should align with the notch in the inspection hole (see illustration), the index lines on the camshaft sprocket should align with the top of the cylinder head mating surface (see illustration), and both camshaft lobes should face down. If necessary to ease reassembly, make your own alignment marks on the sprockets, chain and camshafts with a felt pen.

- 3 At this point, measure the amount of projection of the front wedge on the top of the cam chain tensioner (see illustration). If the amount of projection exceeds the limit specified at the beginning of the Chapter, the cam chain must be replaced (see Section 9). Having taken the measurement, pull the rear wedge straight up using a pair of pliers and secure it in position using a 2 mm pin inserted

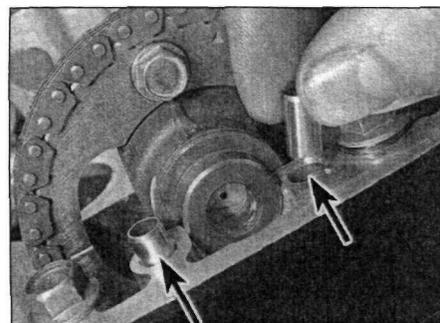
through the whole in the wedge (see illustration). Slacken, but do not remove, the lower cam chain tensioner bolt (see illustration 10.4a).

- 4 Unscrew the two bolts securing the end camshaft holder adjacent to the cam chain sprocket and remove the holder, noting which way round it fits (see illustration). Remove the two dowels if they are loose (see illustration).

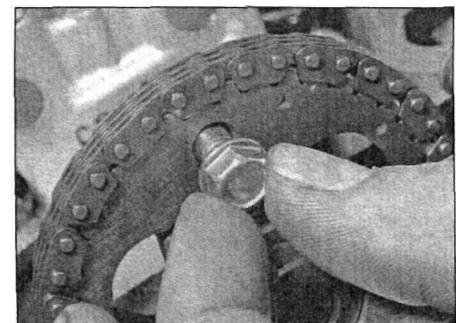
- 5 Rotate the engine to reveal the lower sprocket bolt and remove it, then return the engine to TDC on the compression stroke and remove the other sprocket bolt (see illustration). Use the socket on the alternator rotor bolt to stop the engine rotating while unscrewing the bolts. Slip the sprocket from its boss on the camshaft. **Caution:** Do not rotate the camshaft after the cam chain has



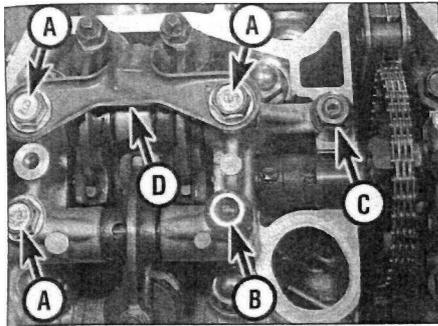
8.4a Camshaft end holder bolts (arrows)



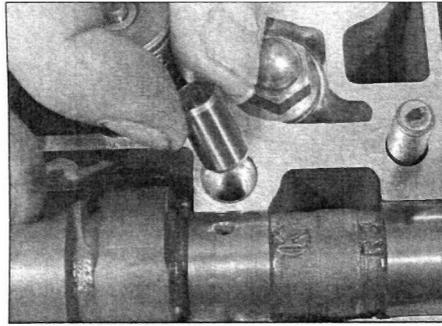
8.4b Remove the dowels (arrows) if they are loose



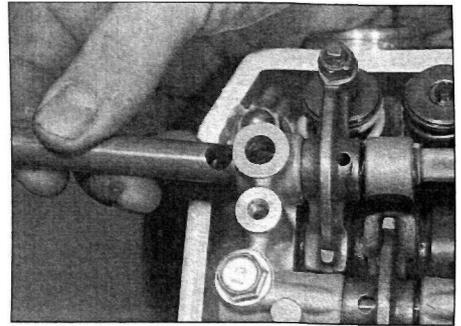
8.5 Remove the two sprocket bolts



8.6a Main camshaft holder has 3 bolts (A) and a nut (B) on J & K models, or 3 bolts (A) and 2 nuts (B) and (C) on M, P, S & T models. Note how oil guide plate (D) fits



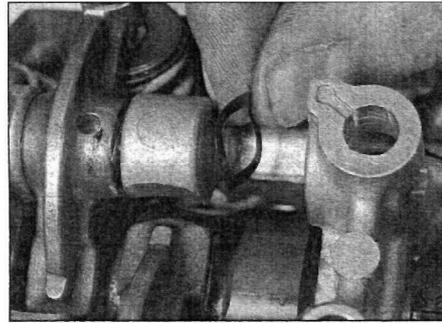
8.6b Remove the dowels if they are loose



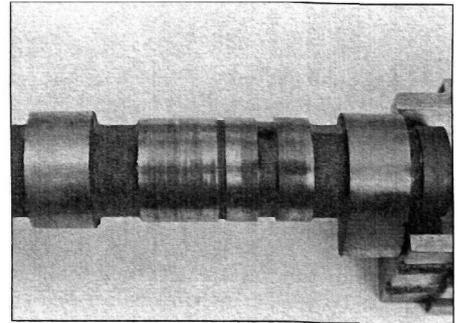
8.8a Withdraw the rocker arm shafts . . .



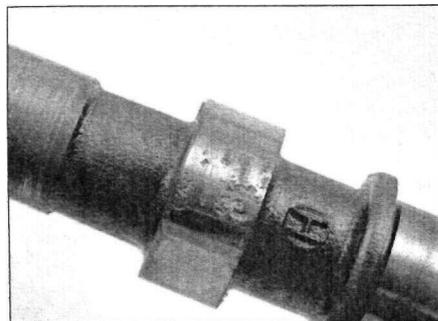
8.8b . . . then remove each rocker arm . . .



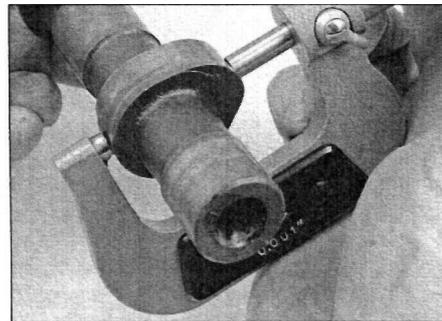
8.8c along with its wave washer



8.9a Check the journal surfaces of the camshaft for scratches or wear



8.9b Check the lobes of the camshaft for wear - damage like this will require replacement (or repair) of the camshaft



8.9c Measure the height of the camshaft lobes with a micrometer

### Inspection

**Note:** Before replacing the camshafts or the cylinder head and camshaft holders because of damage, check with local machine shops specialising in motorcycle engineering work. In the case of the camshafts, it may be possible for cam lobes to be welded, reground and hardened, at a cost far lower than that of a new camshaft. If the bearing surfaces in the cylinder head are damaged, it may be possible for them to be bored out to accept bearing inserts. Due to the cost of a new cylinder head, it is recommended that all options be explored.

9 Inspect the cam bearing surfaces of the head and the holder. Look for score marks, deep scratches and evidence of spalling (a pitted appearance). Check the camshaft lobes for heat discoloration (blue appearance), score marks, chipped areas, flat spots and spalling (**see illustrations**). Measure the height of each lobe with a micrometer and compare the reading with the specifications at the beginning of the Chapter (**see illustration**). If wear is excessive the amount of valve lift is reduced which results in poor engine performance. The camshaft must be replaced, but first refer to the **Note** preceding this Step.

10 Camshaft runout can be checked by supporting each end of the camshaft on V-blocks, and measuring any runout using a dial gauge. If the runout exceeds the specified limit the camshaft must be replaced.

11 The camshaft bearing oil clearance should then be checked using a product known as Plastigauge.

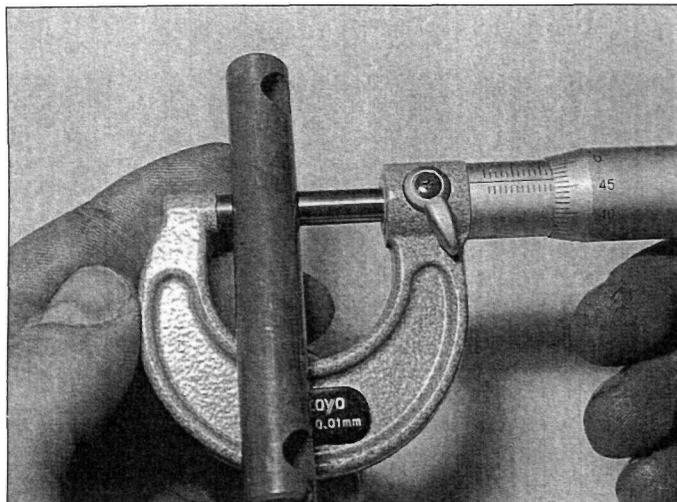
been disengaged as damage may occur if a valve contacts a piston. The crankshaft can be rotated as long as the valves are closed or if the camshaft has been removed.

6 Unscrew the three bolts and the two nuts (one nut only on J and K models) securing the main camshaft holder (**see illustration**). Slacken them evenly in a criss-cross pattern, then remove the holder along with the oil guide plate, noting how the assembly fits. Retrieve the two dowels if they are loose (**see illustration**). Mark each holder according to its cylinder (ie front or rear).

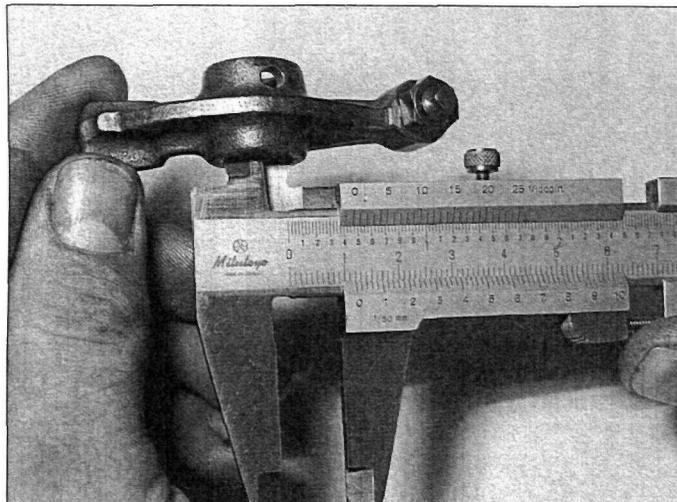
7 Slip the cam chain off the sprocket and withdraw the camshaft and sprocket. Tie the cam chain up to prevent it from dropping down into the crankcase, and do not allow it to go slack as it could bind between the crankshaft sprocket and the crankcase. Cover

the top of the cylinder head with a rag to prevent anything falling into the engine. Mark each camshaft and sprocket according to its cylinder (ie front or rear). The camshafts come with their cylinder identity already marked on their end ("F" or "R"). Check that it is visible and make your own mark if necessary). Note the "IN" mark on the sprocket which must face inwards on installation.

8 Remove the rocker arm shafts from the camshaft holder, using a soft-faced mallet if necessary to drift them out (**see illustration**). If the shafts are difficult to remove, carefully drift them out. Remove the rocker arms and their wave washers, noting how they fit. Mark each shaft and rocker arm according to its position (ie front or rear cylinder, intake or exhaust valve), and/or install each rocker arm back onto its shaft in its original position.



8.21a Measure the diameter of the rocker arm shaft . . .



8.21b . . . and the internal diameter of the rocker arm bore

12 Clean the camshaft, the bearing surfaces in the cylinder head and the holders with a clean, lint-free cloth, then lay the camshaft in place in the cylinder head.

13 Cut strips of Plastigauge and lay one piece on each bearing journal parallel with the camshaft centreline, making sure none is placed over the oil hole. Make sure the camshaft holder dowels are installed and fit the holders. Ensuring the camshafts are not rotated at all, tighten the holder bolts and nut(s) evenly, a little at a time, in a criss-cross sequence, until the specified torque setting is reached.

14 Now unscrew the bolts and nut(s) evenly, a little at a time, in a criss-cross sequence and carefully lift off the holders, again making sure the camshaft is not rotated.

15 To determine the oil clearance, compare the crushed Plastigauge (at its widest point) on each journal to the scale printed on the Plastigauge container.

16 Compare the results to this Chapter's Specifications. If the oil clearance is greater than specified, measure the diameter of the camshaft bearing journal with a micrometer. If it is within specifications, replace the cylinder head and cam holders with new components. If the journal diameter is less than the specified limit, replace the camshaft with a new one and recheck the clearance. If the clearance is still too great, also replace the cylinder head and cam holders. Before replacing any worn parts with new ones, bear in mind the information in the Note preceding Step 9.

17 Except in cases of oil starvation, the cam chain wears very little. If the chain has stretched excessively, which makes it difficult to maintain proper tension, it must be replaced (see Section 9).

18 Check the sprocket for cracks and other damage, replacing it if necessary. Note that if a new sprocket is installed, a new cam chain must also be installed. If the sprockets are

worn, the cam chain is also worn, and also the sprocket on the crankshaft (which can only be remedied by replacing the crankshaft). If wear this severe is apparent, the entire engine should be disassembled for inspection.

19 If available, blow through the oil passages in the rocker arms and camshaft holder with compressed air. Inspect the rocker arm contact points for pitting, spalling, score marks, cracks and rough spots. If the rocker arms are damaged they must be replaced along with the shafts as a set.

20 Check the condition of the wave washers and replace them if they are damaged or deteriorated.

21 Measure the diameter of the rocker arm shafts in the area of contact with the rocker arms (see illustration). Also measure the internal diameter of the rocker arm bores (see illustration). Compare the measurements to the specifications listed at the beginning of the Chapter. If any components are worn beyond their limits, replace all the shafts and arms as a set.

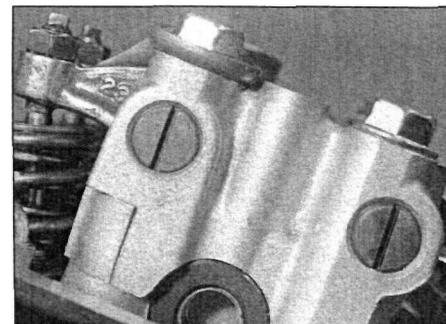
### Installation

22 Apply a smear of molybdenum disulphide grease to the contact faces of each rocker arm, then install the arms and their wave washers into the camshaft holder, making sure they are returned to their original positions (see illustrations 8.8c and 8.8b). The wave washers fit on the inside of the intake rocker arms, on the left-hand side of the front cylinder exhaust rocker arm, and on the right-hand side of the rear cylinder exhaust arm.

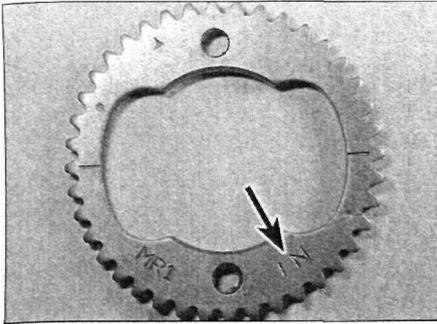
23 Apply a smear of molybdenum disulphide grease to the rocker arm shafts, then slide the shafts into the camshaft holder, making sure they are installed in their original positions, and that they pass through the rocker arms and wave washers (see illustration 8.8a). Position the shafts so that the grooves in the ends of the shafts are vertical and the holes in

the shafts align with the bolt holes in the camshaft holder (see illustration). Check that the arms move freely on the shafts.

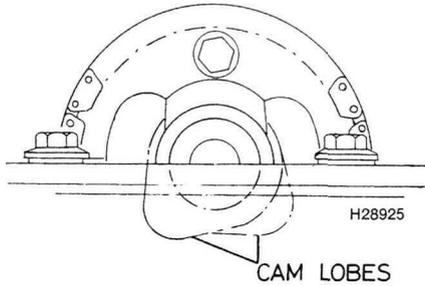
24 If only the front camshaft has been removed, position the crankshaft at TDC on the compression stroke for the rear cylinder (see Step 2), then rotate the crankshaft anticlockwise 488° (at which point the "FT" mark on the rotor will align with the notch in the inspection hole). This positions the front cylinder at TDC on the compression stroke, and the front camshaft can be installed. If only the rear camshaft has been removed, position the crankshaft at TDC for the front cylinder (see Step 2), then rotate the crankshaft anticlockwise 232° (at which point the "RT" mark on the rotor will align with the notch in the inspection hole). This positions the rear cylinder at TDC on the compression stroke, and the rear camshaft can be installed. If both camshafts have been removed, install the front one first, with the crankshaft positioned so that the "FT" mark on the rotor aligns with the notch in the inspection hole, then rotate the crankshaft anti-clockwise 232° (at which point the "RT" mark on the rotor will align with the notch in the inspection hole). This positions the rear cylinder at TDC on the compression stroke, and the rear camshaft can be installed.



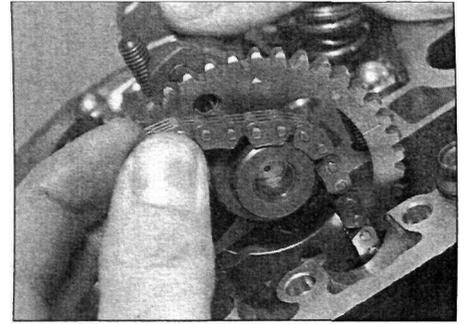
8.23 Position the shafts so that the grooves in the shaft ends are as shown



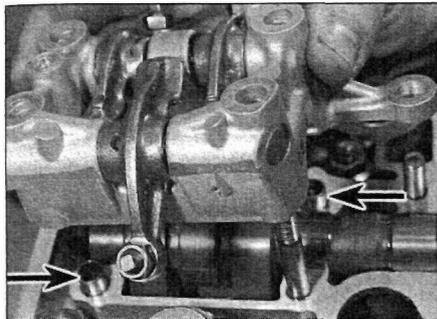
8.25a The "IN" mark (arrow) must face inwards



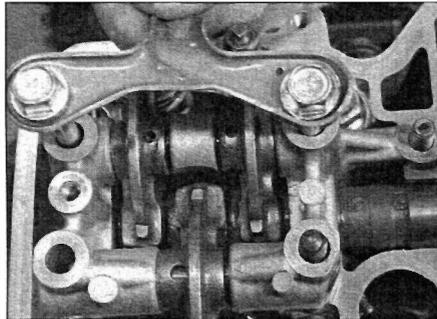
8.25b Position the camshaft so that the lobes face down as shown



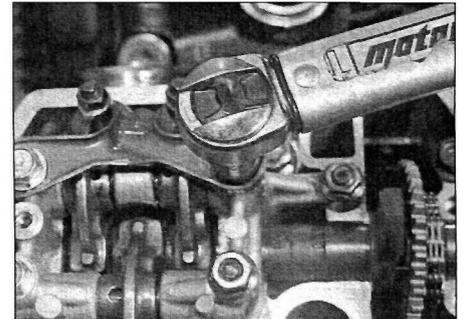
8.25c Fit the camchain onto the sprocket



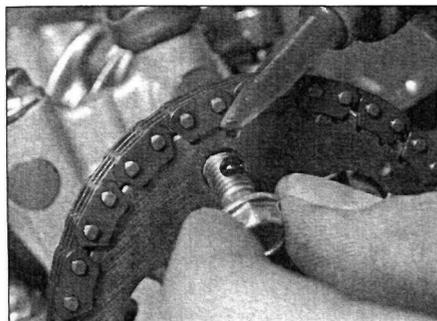
8.27a Make sure the dowels are in place (arrows) before installing the main holder



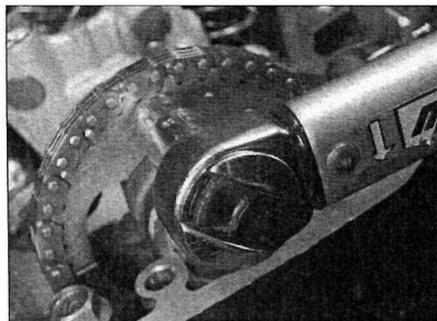
8.27b Install the oil guide plate



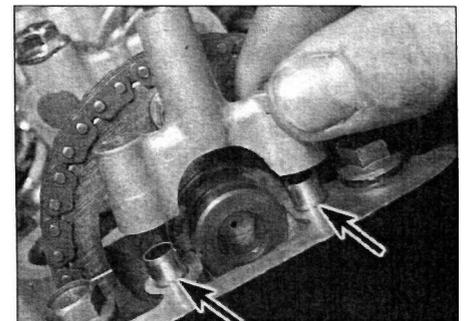
8.27c Tighten the bolts and nut(s) to the specified torque setting



8.28a Apply thread locking compound to the sprocket bolt threads . . .



8.28b . . . and tighten them to the specified torque setting



8.29a Install the end holder onto its two dowels (arrows) . . .

25 Check that the cam chain is engaged around the lower sprocket teeth on the crankshaft and that the crankshaft is positioned as described in Step 24. Apply a smear of molybdenum disulphide grease to the camshaft journals and install the correct camshaft for the cylinder being worked on (the one marked "F" for the front cylinder, the one marked "R" for the rear), with its sprocket loose on the shaft and with the sprocket's "IN" mark facing inwards, through the cam chain and position it so that the cam lobes are facing down (**see illustrations**). Keeping the front run of the chain taut engage the chain on the sprocket teeth with the sprocket positioned loose on the camshaft but so that the index lines on the sprocket align with the cylinder head mating surface and its mounting holes align with those on the camshaft (**see illustration**). With the chain engaged on the sprocket, mount the sprocket onto its boss on

the camshaft, and install the top sprocket bolt finger-tight only. Check that the chain is tight at the front of the engine so that there is no slack between the crankshaft sprocket and the camshaft sprocket. If any slack is evident, move the chain around the sprocket so that the slack is taken up. Any slack in the chain must lie in the portion of the chain in the back of the cylinder so that it is then taken up by the tensioner.

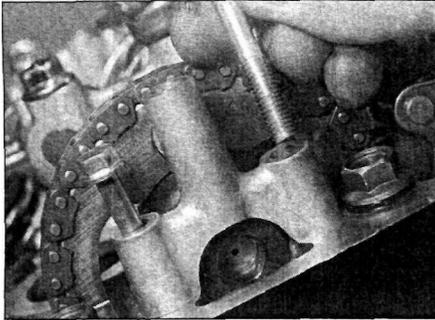
26 Before proceeding further, check that everything aligns as described in Step 2. If it doesn't, the valve timing will be inaccurate and the valves will contact the piston when the engine is turned over.

27 If removed, install the main camshaft holder dowels into the cylinder head, then install the holder, making sure it is the right way round and seats correctly onto the dowels (**see illustration**). Install the oil guide plate onto the holder with its guide facing the intake

valves (**see illustration**), then install the holder bolts and nuts (one only on J and K models) and tighten them evenly in a criss-cross pattern to the torque setting specified at the beginning of the Chapter (**see illustration**).

28 Apply a suitable non-permanent thread locking compound to the camshaft sprocket bolt threads, then tighten the top bolt to the specified torque setting, using a socket on the alternator rotor bolt to stop the engine from rotating if necessary (**see illustrations**). Rotate the crankshaft anti-clockwise to reveal the lower sprocket bolt and tighten that to the specified torque setting, then return the engine to TDC on the compression stroke for the cylinder being worked on.

29 If removed, install the end camshaft holder dowels into the cylinder head, then install the holder, making sure its flat surface faces inwards and it seats correctly onto the dowels (**see illustration**). Install the holder



8.29b . . . and secure it with its bolts

bolts and tighten them evenly to the specified torque setting (see illustration).

30 With both holders tightened down, check that the valve timing marks still align (see Step 2). Check that each camshaft is not pinched by turning it a few degrees in each direction using a suitable socket on the alternator rotor bolt. Lubricate the camshaft lobes with a mixture of engine oil and molybdenum disulphide grease.

31 Tighten the lower cam chain tensioner bolt to the specified torque setting (see illustration 10.4a). Remove the 2 mm pin securing the bottom wedge on the cam chain tensioner.

32 Rotate the engine anti-clockwise through 720° degrees and re-check that the valve timing for both cylinders is correct (see Step 2).

33 Check the valve clearances (Chapter 1) and adjust if necessary.

34 Apply a smear of molybdenum disulphide grease to the threads of the crankshaft end cap and the timing mark inspection cap, and install them into the left-hand side crankcase cover and tighten them to the specified torque setting.

35 Install the valve cover (see Section 7).

36 Check the engine oil level and top up if necessary (see Chapter 1).

## 9 Cam chains - removal and installation



**Note:** The cam chains can be removed with the engine in the frame.

### Front cylinder cam chain

#### Removal

- 1 Drain the engine oil (see Chapter 1).
- 2 Remove the camshaft (see Section 8).
- 3 Remove the alternator rotor/starter clutch and starter driven gear (see Section 20).
- 4 Unscrew the bolt securing the cam chain tensioner set plate to the crankcase and remove the plate, noting how it fits (see illustration).
- 5 Hook a piece of wire to the top of the cam chain, then drop the chain down through its tunnel. Detach the wire and remove the cam chain from the end of the crankshaft.

#### Installation

- 6 Hook the new cam chain to the piece of wire and draw the chain up through its tunnel, making sure its bottom end engages around the sprocket on the crankshaft (see illustration). Secure the chain at the top to prevent it falling back down the tunnel.
- 7 Install the cam chain tensioner set plate and tighten its bolt securely (see illustration).
- 8 Install the starter driven gear and alternator/starter clutch (see Section 20).
- 9 Install the camshaft (see Section 8). Replenish the engine oil (see Chapter 1).

### Rear cylinder cam chain

#### Removal

- 10 Drain the engine oil (see Chapter 1).
- 11 Remove the camshaft (see Section 8).

12 Remove the ignition pulse generator coil assembly (see Chapter 5).

13 The crankshaft must be locked so that the timing rotor bolt can be slackened. Honda provide a special tool (Pt. No. 07724-0010100) which locks the primary drive gear and the clutch. Alternatively, if the engine is in the frame, select a gear and have an assistant apply the rear brake. If the engine has been removed, install the universal joint onto the output driven shaft and engage 5th gear, then fit a suitable spanner onto the flats of the universal joint and secure it against the work surface (see illustration 17.8a). With the crankshaft locked, unscrew the timing rotor bolt and remove the rotor (see illustration).

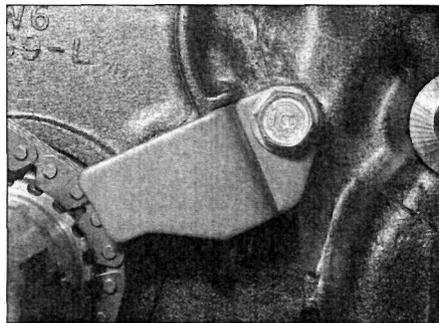
14 Remove the clutch (see Section 17).

15 Remove the primary drive gear from the end of the crankshaft. Note the "OUT" mark on the gear which must face outwards.

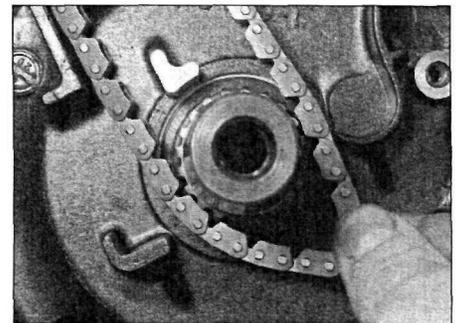
16 Hook a piece of wire to the top of the cam chain, then drop the chain down through its tunnel. Detach the wire and remove the cam chain from the end of the crankshaft. Slide the cam chain sprocket off the end of the crankshaft and check it for wear or damage to both the outer teeth and the inner splines (see illustration).

#### Installation

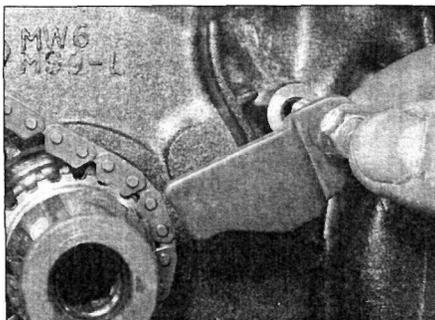
17 Align the extra wide spline on the crankshaft with that on the sprocket, then slide the sprocket onto the crankshaft. Hook the new cam chain to the piece of wire and



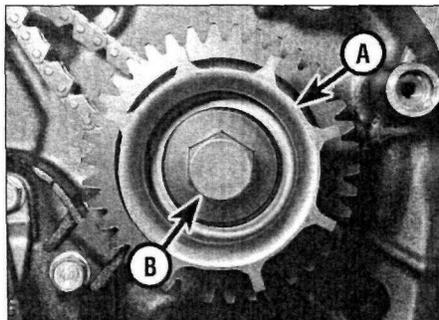
9.4 The cam chain tensioner set plate is secured by a single bolt (shown with tensioner removed)



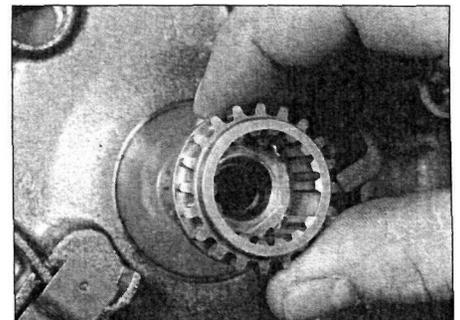
9.6 Make sure the cam chain engages properly on the crankshaft sprocket



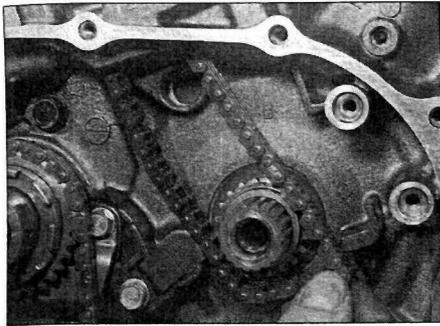
9.7 Install the cam chain tensioner set plate (shown with tensioner removed)



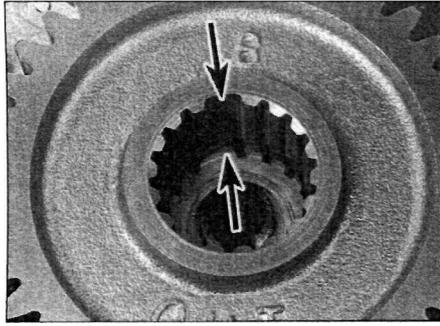
9.13 Ignition timing rotor (A) and its bolt (B)



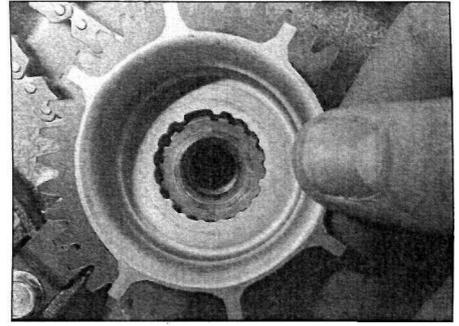
9.16 Check the cam chain sprocket for wear or damage



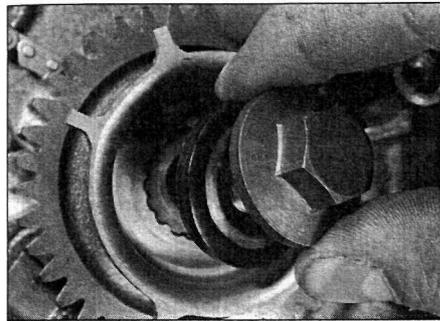
9.17 Make sure the cam chain engages properly on the sprocket



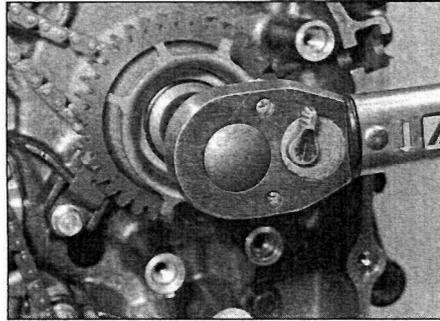
9.18 Align the wide splines (arrows) and make sure the "OUT" mark faces outwards



9.20a Install the timing rotor onto the crankshaft



9.20b Install the rotor bolt with its washer . . .



9.20c . . . and tighten it to the specified torque setting

draw the chain up through its tunnel, making sure its bottom end engages around the sprocket (see illustration). Secure the chain at the top to prevent it falling back down the tunnel.

18 Align the extra wide spline on the crankshaft with that on the primary drive gear and install the gear onto the crankshaft with its "OUT" mark facing out (see illustration).

19 Install the clutch (see Section 17).

20 Align the extra wide spline on the crankshaft with that on the timing rotor, and install the rotor onto the end of the crankshaft (see illustration). Install the rotor bolt with its washer, then, using the method employed in Step 13 to lock the crankshaft, tighten the bolt to the torque setting specified at the beginning of the Chapter (see illustrations).

21 Install the camshaft (see Section 8). Replenish the engine oil (see Chapter 1).

## 10 Cam chain tensioners and guide blades - removal, inspection and installation



**Note:** The cam chain tensioners and guide blades can be removed with the engine in the frame.

### Cam chain tensioner

#### Removal

1 Remove the valve cover (see Section 7). The cam chain tensioner is located in the back of the cam chain tunnel. Note the position of the rubber cushion behind the top of the tensioner (see illustration).

2 At this point, measure the projection of the front wedge on the top of the cam chain tensioner (see illustration 8.3a). If the amount

of projection exceeds the limit specified at the beginning of the Chapter, the cam chain must be replaced (see Section 9). Having taken the measurement, pull the rear wedge straight up using a pair of pliers and secure it in position using a 2 mm pin inserted through the hole in the wedge (see illustration 8.3b). Slacken, but do not yet remove, the lower cam chain tensioner bolt (see illustration 10.4a).

3 Unscrew the crankshaft end cap and the timing mark inspection cap from the left-hand side crankcase cover (see illustration 8.2a). Using a suitable socket on the alternator rotor bolt (see illustration 8.2b), rotate the engine anti-clockwise as required to access the two cam chain sprocket mounting bolts. Unscrew each bolt as it is exposed and displace the sprocket off the camshaft. **Note:** Do not disengage the cam chain from the sprocket or the valve timing will have to be reset (see Section 8). **Caution:** Do not rotate either the camshaft or the crankshaft whilst the cam chain sprocket is displaced as damage could occur if a valve contacts a piston.

4 Unscrew the two bolts securing the cam chain tensioner and withdraw the tensioner from the cylinder head along with its rubber cushion, noting which way up the cushion fits (see illustrations).

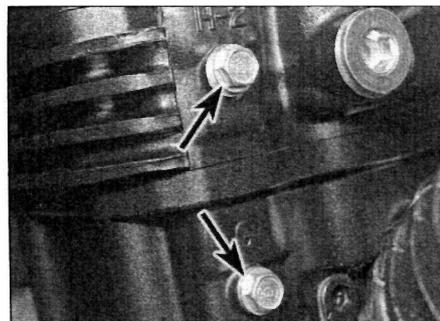
#### Inspection

5 Examine the sliding surface of the tensioner for wear or damage, and replace it if necessary.

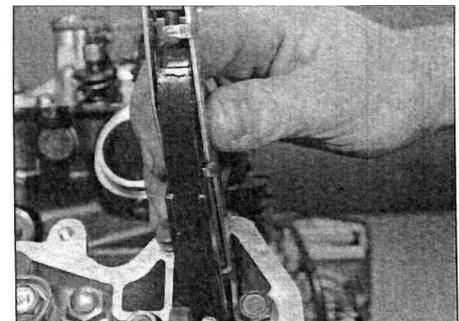
6 Check the tensioner spring for damage or a loss of tension, and replace it if necessary.



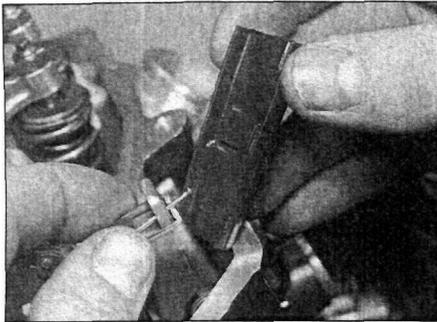
10.1 The cam chain tensioner is located behind the sprocket. Note the position of the rubber cushion (arrow)



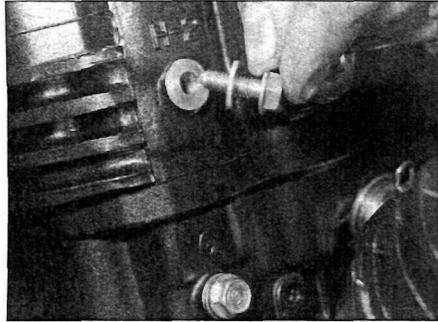
10.4a Unscrew the two cam chain tensioner mounting bolts (arrows) . .



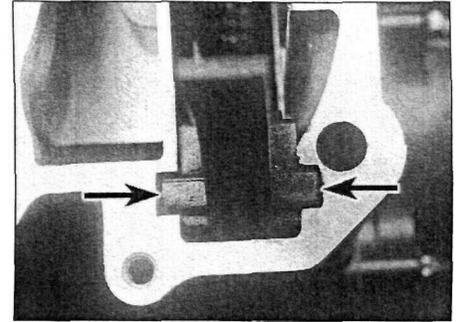
10.4b . . . and withdraw the tensioner



10.7 Make sure the rubber cushion is correctly installed



10.9 Use new sealing washers on the tensioner mounting bolts if necessary



10.15 Make sure the lugs on the guide blade fit in the slots in the head (arrows)

**Installation**

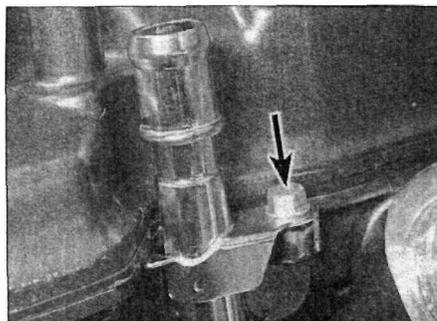
7 Install the tensioner into the back of the cam chain tunnel in the cylinder head, making sure the base of the tensioner is correctly seated in its slot. Install the rubber cushion with its widest end uppermost behind the top of the tensioner (see illustration). The top of the cushion sits flush with the top of the cylinder head (see illustration 10.1). Loosely install the lower cam chain tensioner bolt.

8 Mount the cam chain and sprocket onto its boss on the camshaft. Apply a suitable non-permanent thread locking compound to the camshaft sprocket bolt threads, then tighten the exposed bolt to the specified torque setting, using a socket on the alternator bolt to stop the engine from rotating if necessary (see illustrations 8.28a and 8.28b). Rotate the crankshaft anti-clockwise to reveal the other sprocket bolt and tighten that to the specified torque setting. Before proceeding further, check that everything aligns as described in Section 8, Step 2. If it doesn't, the valve timing will be inaccurate and the valves will contact the piston when the engine is turned over.

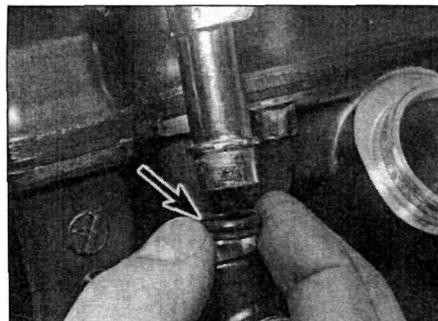
9 Make sure the sealing washers on the tensioner mounting bolts are in good condition, and replace them with new ones if necessary. Install the bolts and tighten them to the torque setting specified at the beginning of the Chapter (see illustration).

10 Remove the 2 mm pin from the wedge. The tensioner will automatically set itself to the correct tension against the cam chain.

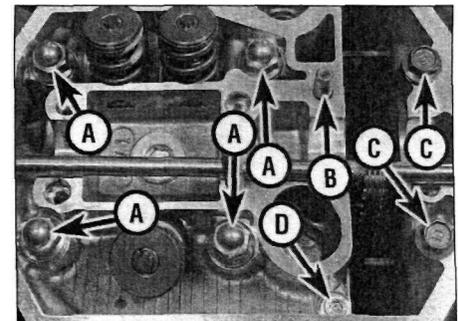
11 Install the valve cover (see Section 7).



11.9a Unscrew the water pipe bolt (arrow) . . .



11.9b . . . and withdraw the pipe and its O-ring (arrow)



11.12 The cylinder head has four domed nuts (A), one plain nut (B) (see text), two long bolts (C) and one short bolt (D)

**Cam chain guide blade**

**Removal**

12 Remove the cylinder head (Section 11).

13 Lift the cam chain guide blade out of the front of the cam chain tunnel in the cylinder block, noting how it fits.

**Inspection**

14 Examine the sliding surface of the guide blade for wear or damage, and replace it if necessary.

**Installation**

15 Install the guide blade into the front of the cam chain tunnel, making sure its lugs seat correctly in their slots (see illustration).

16 Install the cylinder head (see Section 11).

**11 Cylinder heads - removal and installation**



**Caution:** The engine must be completely cool before beginning this procedure or the cylinder head may become warped.

**Note:** The heads can be removed with the engine in the frame. If the engine has been removed, ignore the steps which don't apply.

**Removal**

**Front cylinder**

- 1 Drain the coolant (see Chapter 1).
- 2 Remove the valve cover (see Section 7).
- 3 Unscrew the bolts securing the frame

cross-member to the engine, then unscrew the bolts securing the frame cross-member to the frame downtubes and remove the cross-member (see illustration 5.23).

4 Remove the front cylinder exhaust pipe (see Chapter 4).

5 Remove the carburetors (see Chapter 4).

6 Remove the spark plugs (see Chapter 1).

7 Remove the camshaft (see Section 9).

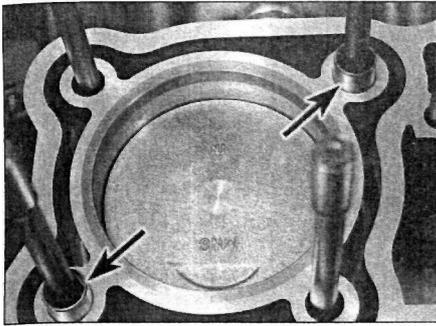
8 On J and K models unscrew the four bolts securing the external oil pipe and remove the pipe; do not bend it. Discard the pipe's sealing washers as new ones must be used.

9 Unscrew the bolt securing the coolant pipe to the back of the cylinder head (see illustration). Withdraw the pipe from its socket and remove the O-ring, noting that it fits with its thicker section uppermost (see illustration). Discard the O-ring as a new one must be used.

10 Detach the clutch cable from the clutch housing (see Section 18). Release the cable from the guide on the right-hand side frame downtube and secure it clear of the engine. Trace the ignition pulse generator wiring and disconnect it at the connector. Unscrew the bolt securing the wiring guide to the frame and release the wiring from the guide, noting how it fits (see illustrations 5.15a and 5.15b). Secure the wiring out of the way.

11 Remove the cam chain tensioner (see Section 10).

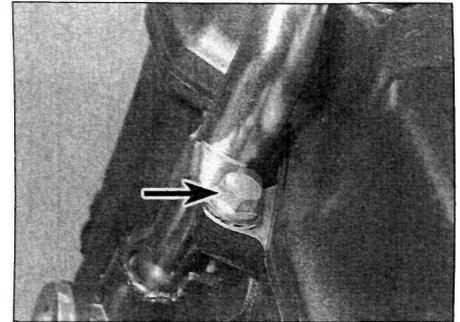
12 The cylinder head is secured by four domed nuts, one plain nut (which on all except J and K models also secures the main camshaft holder and has already been removed), two long bolts and one short bolt (see illustration). Slacken these evenly a little



11.15 Remove the two dowels if they are loose (arrows)



11.25a Detach the coolant hose from the pipe



11.25b Unscrew the coolant pipe bolt (arrow) . . .



11.25c . . . and withdraw the pipe and its O-ring (arrow)



11.34 Install the two dowels over the studs and onto the cylinder block

at a time and in a criss-cross pattern until they are all loose. Remove all the nuts and their washers, and remove the short bolt and the front long bolt. Take great care not to drop any of the nuts or washers into the crankcase. The rear long bolt can only be fully removed once the cylinder head has been lifted off the block and brought forward to provide clearance from the frame.

13 Pull the cylinder head up off the studs. If it is stuck, tap around the joint faces of the cylinder head with a soft-faced mallet to free the head. Do not try to free the head by inserting a screwdriver between the head and cylinder block - you'll damage the sealing surfaces.

14 Lift the head off the block, and remove it from the engine via the front frame downtubes. The rear long bolt can be removed when the head is half way out of the frame. Remove the old gasket and stuff a clean rag into the cam chain tunnel to prevent any debris falling into the engine.

15 If they are loose, remove the two dowels from the cylinder block studs (see illustration). If either appears to be missing it is probably stuck in the underside of the cylinder head. Also remove the cam chain guide blade from the front of the cam chain tunnel (see Section 10).

16 Check the cylinder head gasket and the mating surfaces on the cylinder head and block for signs of leakage, which could indicate warpage. Refer to Section 13 and check the flatness of the cylinder head.

17 Clean all traces of old gasket material from the cylinder head and block. If a scraper is used, take care not to scratch or gouge the

soft aluminium. Be careful not to let any of the gasket material fall into the crankcase, the cylinder bores or the oil passages.

#### Rear cylinder

18 Drain the coolant (see Chapter 1).

19 Remove the valve cover (see Section 7).

20 Remove the rear cylinder exhaust pipe (see Chapter 4).

21 Remove the carburettors (see Chapter 4).

22 Remove the spark plugs (see Chapter 1).

23 Remove the camshaft (see Section 9).

24 On J and K models unscrew the four bolts securing the external oil pipe and remove the pipe; take care not to bend it. Discard the pipe's sealing washers as new ones must be used.

25 Slacken the coolant hose clamp and detach the coolant hose from the pipe on the front of the cylinder head (if not already done) (see illustration). Unscrew the bolt securing the coolant pipe to the cylinder head (see illustration). Withdraw the pipe from its socket and remove the O-ring, noting that it fits with its thicker section uppermost (see illustration). Discard the O-ring as a new one must be used.

26 Remove the cam chain tensioner (see Section 10).

27 The cylinder head is secured by four domed nuts, one plain nut (which on all except J and K models also secures the main camshaft holder and has already been removed), two long bolts and one short bolt (see illustration 11.12). Slacken these evenly a little at a time and in a criss-cross pattern until they are all loose, then remove them with their washers. Take great care not to drop any of the nuts or washers into the crankcase.

28 Pull the cylinder head off the studs. If it is stuck, tap around the joint faces of the cylinder head with a soft-faced mallet to free the head. Do not attempt to free the head by inserting a screwdriver between the head and cylinder block - you'll damage the sealing surfaces.

29 Lift the head off the block, and remove it from the engine. Remove the old gasket and stuff a clean rag into the cam chain tunnel to prevent any debris falling into the engine.

30 If they are loose, remove the two dowels from the cylinder block studs (see illustration 11.15). If either appears to be missing it is probably stuck in the underside of the cylinder head. Also remove the cam chain guide blade from the front of the cam chain tunnel (see Section 10).

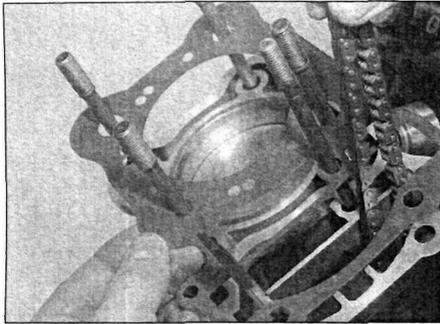
31 Check the cylinder head gasket and the mating surfaces on the cylinder head and block for signs of leakage, which could indicate warpage. Refer to Section 13 and check the flatness of the cylinder head.

32 Clean all traces of old gasket material from the cylinder head and block. If a scraper is used, take care not to scratch or gouge the soft aluminium. Be careful not to let any of the gasket material fall into the crankcase, the cylinder bores or the oil passages".

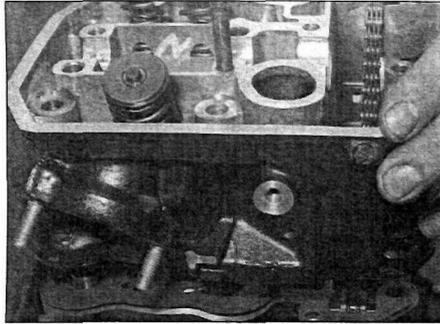
#### Installation

33 Install the cam chain guide blade into the front of the cam chain tunnel (see Section 10) (see illustration 10.15).

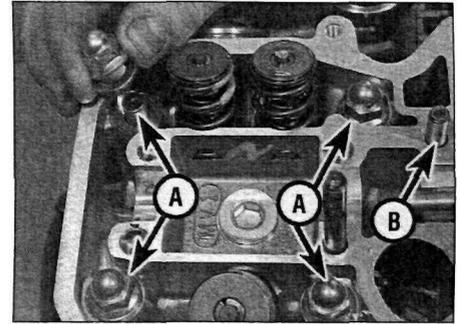
34 If removed, install the two dowels onto the cylinder block studs (see illustration). Lubricate the cylinder bores with engine oil.



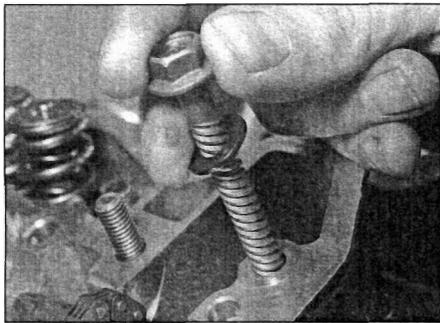
11.35 Always use a new cylinder head gasket



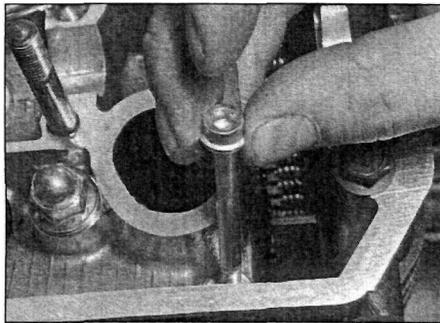
11.36 Carefully lower the cylinder head onto the block



11.37a Install the four domed nuts and washers (A), the plain nut and washer (B) (J and K models only) . . .



11.37b . . . the long bolts and washers . . .



11.37c . . . and the short bolt

35 Ensure both cylinder head and block mating surfaces are clean, then lay the new head gasket in place on the cylinder block (see illustration). The gasket can only fit one way, so if the holes do not line up properly the gasket is upside down. Never re-use the old gasket.

36 When installing the front cylinder head, install the rear long bolt into the head as the head is being manoeuvred through the front frame downtubes (unless the engine has been removed from the frame). Carefully lower the cylinder head over the studs and onto the block (see illustration). It is helpful to have an assistant to pass the cam chain up through the tunnel and slip a piece of wire through it to prevent it falling back into the engine. Keep the chain taut to prevent it becoming disengaged from the crankshaft sprocket).

37 Install the domed nuts with washers, the plain nut with washer (J and K models only), the long bolts with washers and the short bolt; tighten them finger-tight at this stage (see illustrations).

38 Tighten the cylinder head nuts and bolts evenly a little at a time and in a criss-cross pattern to the torque setting specified at the beginning of the Chapter.

39 Install all other components that have been removed in a reverse of the removal procedure, referring to the relevant sections where necessary. On J and K models (front cylinder only) blow through the external oil pipe and its bolts using compressed air if available, then install the pipe using new

sealing washers and tighten its bolts to the specified torque setting. Also tighten the frame cross-member bolts to the specified torque setting (front cylinder only).

## 12 Valves/valve seats/valve guides - servicing

1 Because of the complex nature of this job and the special tools and equipment required, most owners leave servicing of the valves, valve seats and valve guides to a professional.

2 The home mechanic can, however, remove the valves from the cylinder head, clean and check the components for wear and grind in the valves (see Section 13).

3 After the valve service has been performed, the head will be in like-new condition. When the head is returned, be sure to clean it again very thoroughly before installation on the engine to remove any metal particles or abrasive grit that may still be present from the valve service operations. Use compressed air, if available, to blow out all the holes and passages.

## 13 Cylinder head and valves - disassembly, inspection and reassembly

1 As mentioned in the previous section, valve servicing, valve seat recutting and valve guide

replacement should be left to a Honda dealer. However, disassembly, cleaning and inspection of the valves and related components can be done (if the necessary special tools are available) by the home mechanic. This way no expense is incurred if the inspection reveals that overhaul is not required at this time.

2 To disassemble the valve components without the risk of damaging them, a valve spring compressor is absolutely necessary.

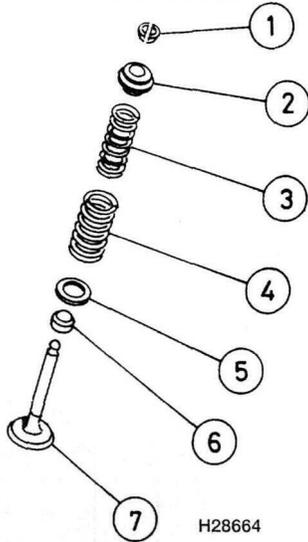
### Disassembly

3 Before proceeding, arrange to label and store the valves along with their related components in such a way that they can be returned to their original locations without getting mixed up. A good way to do this is to obtain a container which is divided into six compartments, and to label each compartment with the identity of the valve which will be stored in it (ie front or rear cylinder, intake or exhaust valve, left or right intake valve).

4 If not already done, clean all traces of old gasket material from the cylinder head. If a scraper is used, take care not to scratch or gouge the soft aluminium. Carefully scrape all carbon deposits out of the combustion chamber area. A hand-held wire brush or a piece of fine emery cloth can be used once the majority of deposits have been scraped away. Do not use a wire brush mounted in a drill motor, or one with extremely stiff bristles, as the head material is soft and may be eroded away or scratched by the wire brush.

5 Compress the valve spring on the first valve with a spring compressor, then remove the collets and the retainer from the valve assembly (see illustration). Do not compress the springs any more than is absolutely necessary. Carefully release the valve spring compressor and remove the springs and the valve from the head. If the valve binds in the guide (won't pull through), push it back into the head and deburr the area around the collet groove with a very fine file or whetstone (see illustration).

6 Repeat the procedure for the remaining valves. Remember to keep the parts for each valve together so they can be reinstalled in the same location.



13.5a Valve components

- 1 Collets
- 2 Spring retainer
- 3 Inner spring
- 4 Outer spring
- 5 Spring seat
- 6 Stem seal
- 7 Valve

7 Once the valves have been removed and labelled, pull the valve stem seals off the top of the valve guides with pliers and discard them (the old seals should never be re-used), then remove the spring seats.

8 Next, clean the cylinder head with solvent and dry it thoroughly. Compressed air will speed the drying process and ensure that all holes and recessed areas are clean.

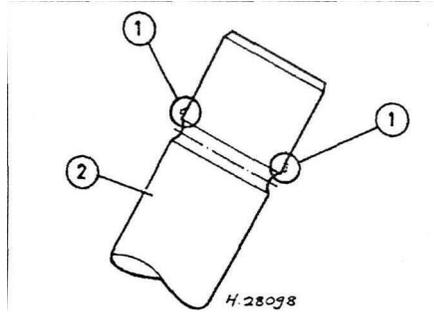
9 Clean all of the valve springs, collets, retainers and spring seats with solvent and dry them thoroughly. Do the parts from one valve at a time so that no mixing of parts between valves occurs.

10 Scrape off any deposits that may have formed on the valve, then use a motorised wire brush to remove deposits from the valve heads and stems. Again, make sure the valves do not get mixed up.

**Inspection**

11 Inspect the head very carefully for cracks and other damage. If cracks are found, a new head will be required. Check the cam bearing surfaces for wear and evidence of seizure. Check the camshafts and rockers for wear as well (see Section 8).

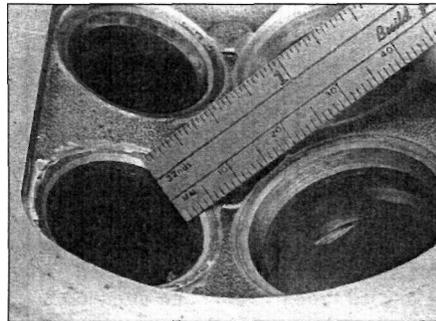
12 Using a precision straightedge and a feeler gauge of the same thickness as the warpage limit listed in the specifications at the beginning of the Chapter, check the head gasket mating surface for warpage. Lay the straightedge lengthways, across the head and diagonally, intersecting the stud holes, and try to slip the feeler gauge under it on either side of the combustion chamber (see illustration). If the feeler gauge can be inserted between the straight edge and the cylinder head, the head is warped and must be either machined or, if warpage is excessive, replaced with a new one.



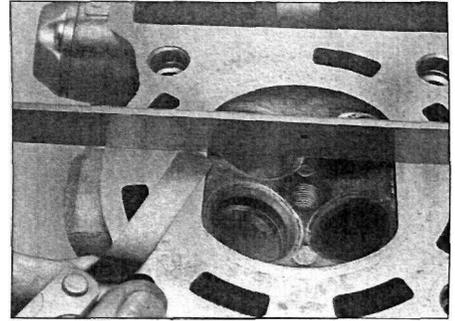
13.5b Remove any burrs (1) if the valve stem (2) won't pull through the guide

13 Examine the valve seats in the combustion chamber. If they are pitted, cracked or burned, the head will require work beyond the scope of the home mechanic. Measure the valve seat width and compare it to this Chapter's Specifications (see illustration). If it exceeds the service limit, or if it varies around its circumference, valve overhaul is required.

14 Clean the valve guides to remove any carbon build-up, then measure the inside diameters of the guides (at both ends and the centre of the guide) with a small hole gauge and micrometer (see illustrations). Record the measurements for future reference. These measurements, along with the valve stem diameter measurements, will enable you to compute the valve stem-to-



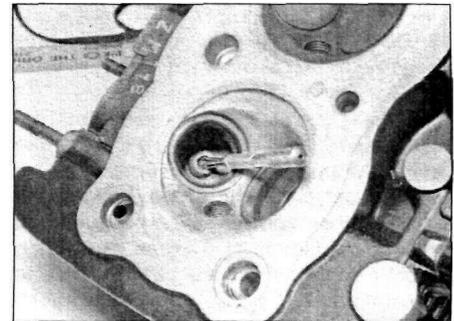
13.13 Measure the valve seat width with a ruler (or for greater precision use a vernier caliper)



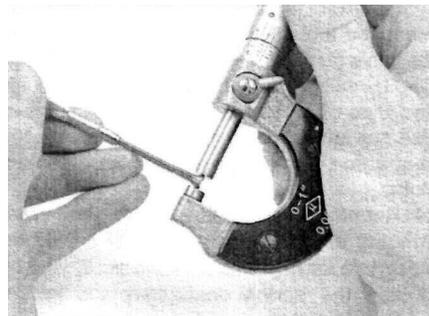
13.12 Lay a precision straightedge across the cylinder head and try to slide a feeler gauge of the specified thickness (equal to the maximum allowable warpage) under it

guide clearance. This clearance, when compared to the Specifications, will be one factor that will determine the extent of the valve service work required. The guides are measured at the ends and at the centre to determine if they are worn in a bell-mouth pattern (more wear at the ends). If the guides are worn they must be replaced.

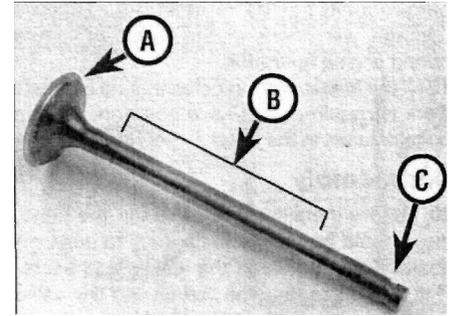
15 Carefully inspect each valve face for cracks, pits and burned spots. Check the valve stem and the collet groove area for cracks (see illustration). Rotate the valve and check for any obvious indication that it is bent. Check the end of the stem for pitting and excessive wear. The presence of any of the above conditions indicates the need for valve servicing.



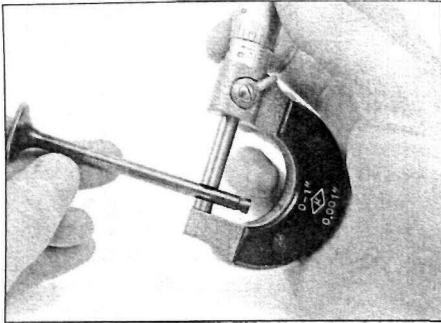
13.14a Insert a small hole gauge into the valve guide and expand it so there's a slight drag when it's pulled out



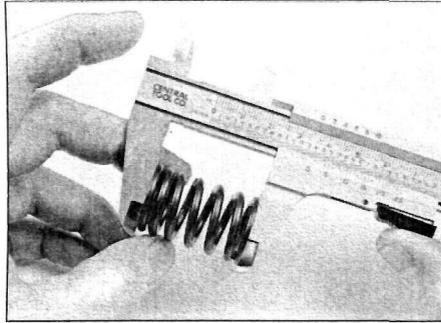
13.14b Measure the small hole gauge with a micrometer



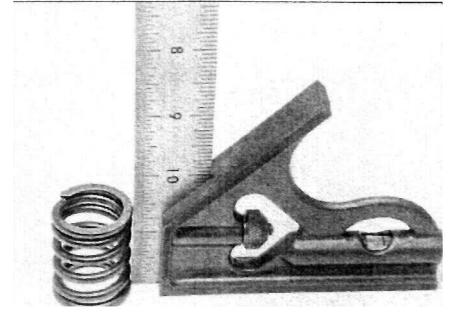
13.15 Check the valve face (A), stem (B) and collet groove (C) for wear and damage



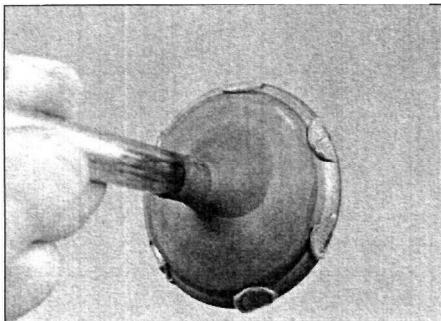
13.16 Measure the valve stem diameter with a micrometer



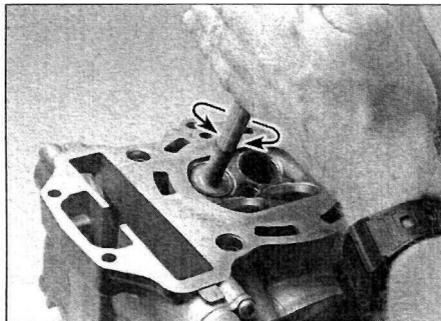
13.17a Measure the free length of the valve springs



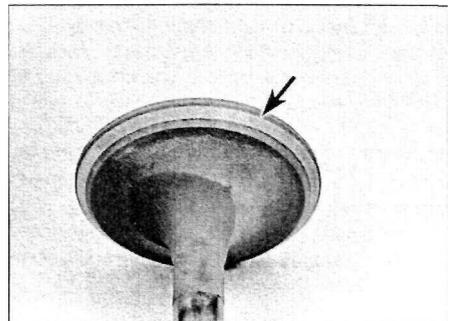
13.17b Check the valve springs for squareness



13.21 Apply the lapping compound very sparingly, in small dabs, to the valve face only



13.22a Rotate the valve grinding tool between the palms of your hands



13.22b The face should be the specified width (arrow) with a smooth, unbroken appearance

16 Measure the valve stem diameter (**see illustration**). By subtracting the stem diameter from the valve guide bore diameter, the valve stem-to-guide clearance is obtained. If the stem-to-guide clearance is greater than that listed in the specifications, the valves and guides must be replaced.

17 Check the end of each valve spring for wear and pitting. Measure the spring free length and compare it to that listed in the specifications (**see illustration**). If any spring is shorter than specified it has sagged and must be replaced. Also place the spring upright on a flat surface and check it for bend by placing a ruler against it (**see illustration**). If the bend in any spring is excessive, it must be replaced.

18 Check the spring retainers and collets for obvious wear and cracks. Any questionable parts should not be re-used, as extensive damage will occur in the event of failure during engine operation.

19 If the inspection indicates that no overhaul work is required, the valve components can be reinstalled in the head.

### Reassembly

20 Before installing the valves in the head, they should be ground in (lapped) to ensure a positive seal between the valves and seats. This procedure requires coarse and fine valve grinding compound and a valve grinding tool. If a grinding tool is not available, a piece of rubber or plastic hose can be slipped over the

valve stem (after the valve has been installed in the guide) and used to turn the valve.

21 Apply a small amount of coarse grinding compound to the valve face, then slip the valve into the guide (**see illustration**). **Note:** *Make sure each valve is installed in its correct guide and be careful not to get any grinding compound on the valve stem.*

22 Attach the grinding tool (or hose) to the valve and rotate the tool between the palms of your hands. Use a back-and-forth motion (as though rubbing your hands together) rather than a circular motion (ie so that the valve rotates alternately clockwise and anti-clockwise rather than in one direction only) (**see illustration**). Lift the valve off the seat and turn it at regular intervals to distribute the grinding compound properly. Continue the grinding procedure until the valve face and seat contact area is of uniform width and unbroken around the entire circumference of the valve face and seat (**see illustration**).

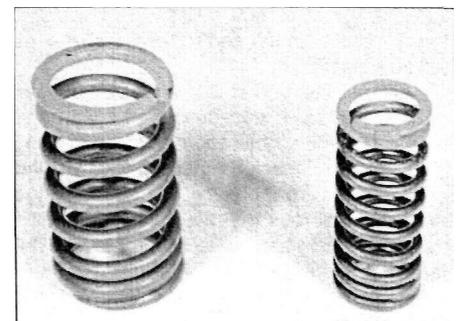
23 Carefully remove the valve from the guide and wipe off all traces of grinding compound. Use solvent to clean the valve and wipe the seat area thoroughly with a solvent soaked cloth.

24 Repeat the procedure with fine valve grinding compound, then repeat the entire procedure for the remaining valves.

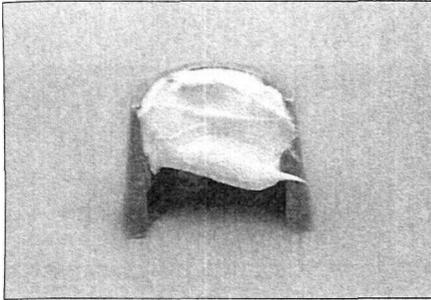
25 Lay the spring seats in place in the cylinder head, then install new valve stem seals on each of the guides. Use an appropriate size deep socket to push the

seals over the end of the valve guide until they are felt to clip into place. Don't twist or cock them, or they will not seal properly against the valve stems. Also, don't remove them again or they will be damaged.

26 Coat the valve stems with molybdenum disulphide grease, then install one of them into its guide, rotating it slowly to avoid damaging the seal. Check that the valve moves up and down freely in the guide. Next, install the springs and retainer, compress the springs and install the collets. **Note:** *Install the springs with the closely-wound coils at the bottom, towards the valve head (**see illustration**).* When compressing the springs with the valve spring compressor, depress them only as far as is absolutely necessary to slip the collets into place. Apply a small



13.26a Install the springs with their closely-wound coils down (against the cylinder head)



**13.26b** A small dab of grease will help to keep the collets in place on the valve while the spring is released

amount of grease to the collets to help hold them in place as the pressure is released from the springs (**see illustration**). Make certain that the collets are securely locked in their retaining grooves.

27 Support the cylinder head on blocks so the valves can't contact the workbench top, then very gently tap each of the valve stems with a soft-faced hammer. This will help seat the collets in their grooves.

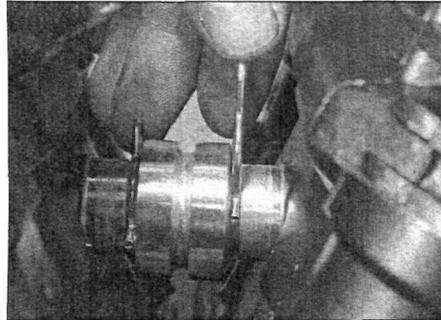
**HAYNES** **HINT** Check for proper sealing of the valves by pouring a little solvent into the valve ports. If the solvent leaks past any valve into the combustion chamber area the valve grinding operation on that valve should be repeated.

**14 Cylinder blocks - removal, inspection and installation**

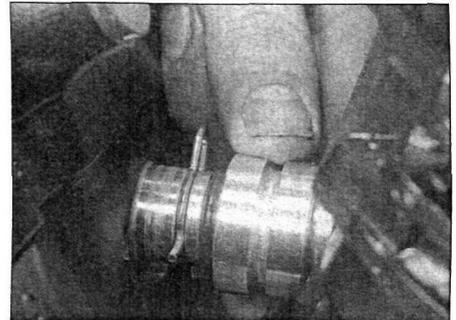
**Note:** The cylinder blocks can be removed with the engine in the frame. The procedure is the same for both front and rear cylinders.

**Removal**

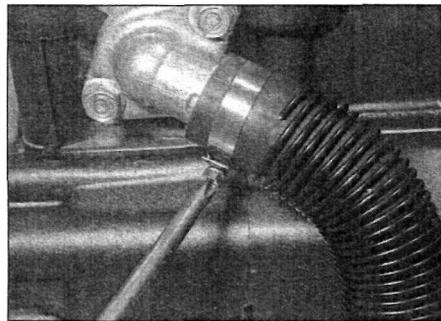
- 1 Remove the cylinder head (see Section 11).
- 2 Release one of the clips securing the coolant joint collar that connects between the two cylinder blocks (**see illustration**). Slide the collar either forwards or backwards (depending on which clip was removed) so that it is detached from the stub on one or other of the blocks (**see illustration**). Also release the clamp securing the coolant inlet hose to the union on the front of the front cylinder block and remove the hose (**see illustrations**). If necessary, unscrew the two bolts securing the hose union and remove the union. Discard the O-ring as a new one must be used.
- 3 Lift the cylinder block up to remove it from the studs. If it is stuck, tap around the joint faces of the block with a soft-faced mallet to free it from the crankcase. Don't attempt to free the block by inserting a screwdriver between it and the crankcase - you'll damage the sealing surfaces. When the block is removed, stuff clean rags around the piston to prevent anything falling into the crankcase.



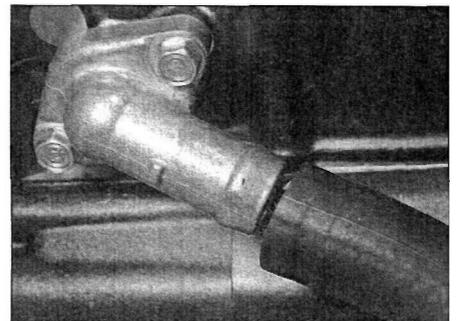
**14.2a** Remove one of the clips . . .



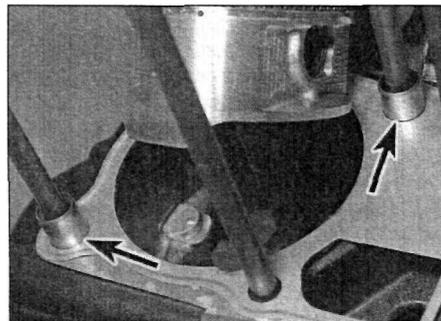
**14.2b** . . . and slide the coolant joint collar off the opposite stub



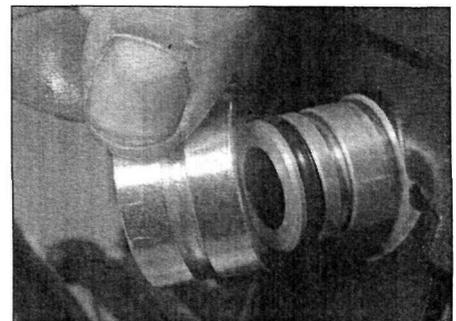
**14.2c** Slacken the hose clamp .



**14.2d** . . . and detach the coolant hose from the union



**14.4** Remove the dowels if they are loose (arrows)



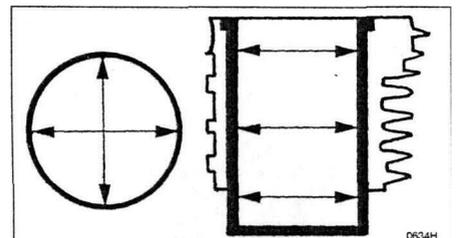
**14.5** Remove the coolant joint collar and both O-rings

- 4 Note the location of the two dowels which will be either on the bottom of the block or in the crankcase (**see illustration**). Remove them if they are loose.
- 5 Remove the coolant joint collar from whichever block it is attached to, then remove the collar O-ring from the stub on each block (**see illustration**). Discard them as new ones must be used.
- 6 Remove the gasket and clean all traces of old gasket material from the cylinder block and crankcase mating surfaces. If a scraper is used, take care not to scratch or gouge the soft aluminium. Don't let any gasket material fall into the crankcase or the oil passages.

**Inspection**

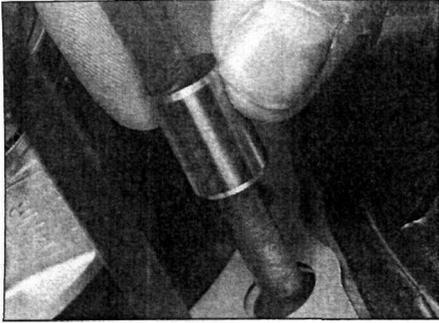
- Note:** Do not attempt to separate the cylinder liners from the cylinder block.
- 7 Check the cylinder walls carefully for scratches and score marks. A rebore will be necessary to remove any deep scores.

8 Using telescoping gauges (**see Tools and Working facilities**), check the dimensions of each cylinder to assess the amount of wear, taper and ovality. Measure near the top (but below the level of the top piston ring at TDC), centre and bottom (but above the level of the oil ring at BDC) of the bore both parallel to and across the crankshaft axis (**see illustration**). Calculate any differences between the measurements taken to

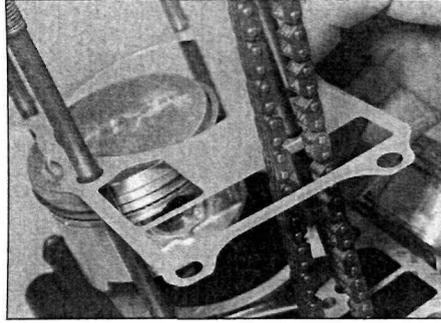


**14.8** Cylinder bore wear measurement points

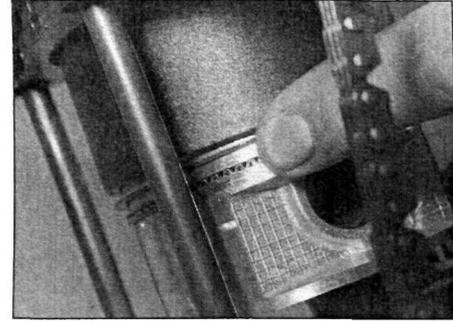
## 2•24 Engine, clutch and transmission



**14.16** Install the two dowels over the studs and into their crankcase recesses



**14.17** Always use a new base gasket



**14.20** Feed the piston rings into the bore as the block is lowered

determine any taper and ovality in the bore. Compare the results to the specifications at the beginning of the Chapter. If the cylinders are tapered, oval, or worn beyond the service limits, or badly scratched, scuffed or scored, have them rebored and honed by a Honda dealer or specialist motorcycle repair shop. If the cylinders are rebored, they will require oversize pistons and rings.

9 If the precision measuring tools are not available, take the block to a Honda dealer or specialist motorcycle repair shop for assessment and advice.

10 If the cylinders are in good condition and the piston-to-bore clearance is within specifications (see Section 15), the cylinders should be honed (de-glazed). To perform this operation you will need the proper size flexible hone with fine stones (see *Tools and Working facilities*), or a bottle-brush type hone, plenty of light oil or honing oil, some clean rags and an electric drill motor.

11 Hold the block sideways (so that the bore is horizontal rather than vertical) in a vice with soft jaws or cushioned with wooden blocks. Mount the hone in the drill motor, compress the stones and insert the hone into the cylinder. Thoroughly lubricate the cylinder, then turn on the drill and move the hone up and down in the cylinder at a pace which produces a fine cross-hatch pattern on the cylinder wall with the lines intersecting at an angle of approximately 60 degrees. Be sure to use plenty of lubricant and do not take off any more material than is necessary to produce the desired effect. Do not withdraw the hone from the cylinder while it is still turning. Switch off the drill and continue to move it up and down in the cylinder until it has stopped turning, then compress the stones and withdraw the hone. Wipe the oil from the cylinder and repeat the procedure on the other cylinder. Remember, do not take too much material from the cylinder wall.

12 Wash the cylinders thoroughly with warm soapy water to remove all traces of the abrasive grit produced during the honing operation. Be sure to run a brush through the bolt holes and flush them with running water. After rinsing, dry the cylinders thoroughly and apply a thin coat of light, rust-preventative oil to all machined surfaces.

13 If you do not have the equipment or desire to perform the honing operation, take the block to a Honda dealer or specialist motorcycle repair shop.

### Installation

14 Install a new O-ring onto the coolant joint collar stub on each cylinder block, then slide the collar as far as possible onto the stub of one of the blocks (see illustration 14.5).

15 Check that the mating surfaces of the cylinder block and crankcase are free from oil or pieces of old gasket.

16 If removed, install the dowels into their correct locations in the crankcase, and push them firmly home (see illustration).

17 Remove the rags from around the piston, and lay the new base gasket in place on the crankcase (see illustration). The gasket can only fit one way, so if the holes do not line up properly the gasket is upside down. Never reuse the old gasket.

18 If required, install a piston ring clamp onto the piston to ease its entry into the bore as the block is lowered. This is not essential as the cylinder has a good lead-in, enabling the piston rings to be hand-fed into the bore. If possible, have an assistant support the block while this is done.

19 Lubricate the cylinder bore, piston and piston rings with clean engine oil, then install the block down over the studs until the piston crown fits into the bore. At this stage feed the cam chain up through the block and secure it in place with a piece of wire to prevent it from falling back down.

20 Gently push down on the cylinder block, making sure the piston enters the bore squarely and does not get cocked sideways. If you are doing this without a piston ring clamp, carefully compress and feed each ring into the bore as the block is lowered (see illustration). If necessary, use a soft mallet to gently tap the block down, but do not use force if the block appears to be stuck as the piston and/or rings will be damaged. If clamps are used, remove them once the piston is in the bore.

21 When the piston is correctly installed in the cylinder, press the block down onto the base gasket.

22 If removed, fit a new O-ring to the coolant inlet hose union and install the union onto the front of the front cylinder block, tightening its bolts securely. Fit the coolant inlet hose onto the union and secure it with its clamp (see illustration 14.2c and 14.2d).

23 Slide the coolant joint collar across and over the O-ring so that it is central on the stubs between the cylinder blocks, then secure it in place with its clips (see illustration 14.2a).

24 Install the cylinder head (see Section 11).

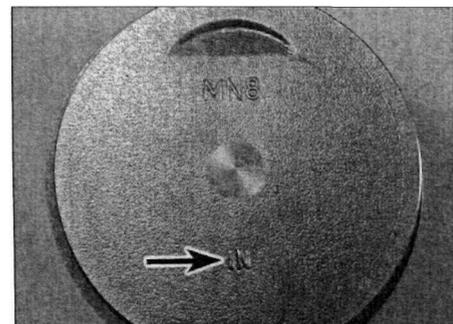
### 15 Pistons - removal, inspection and installation



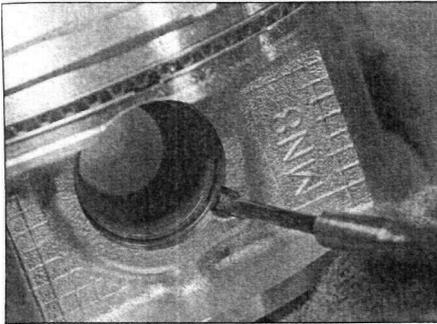
**Note:** The pistons can be removed with the engine in the frame.

#### Removal

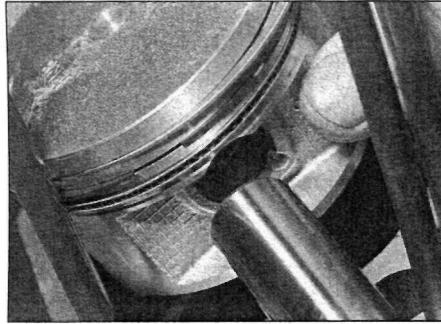
1 Remove the cylinder block (see Section 14).  
2 Before removing the piston from the connecting rod, stuff a clean rag into the hole around the rod to prevent the circlips or anything else from falling into the crankcase. Use a felt marker pen to write the cylinder identity on the crown of each piston (or on the skirt if the piston is dirty and going to be cleaned). Each piston should also have "IN" marked on its crown which should face the intake side (see illustration). If this is not visible, mark the piston accordingly so that it can be installed the correct way round.



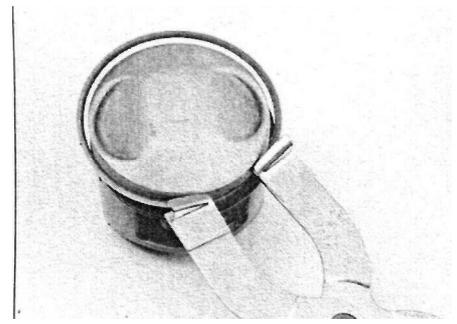
**15.2** Note the "IN" mark (arrow) on the piston which faces the intake side



15.3a Prise the piston pin circlip out from one side of the piston . . .



15.3b . . . then push the piston pin out from the other side until you can grasp it and pull it out the rest of the way



15.5 Remove the piston rings with a ring removal and installation tool

3 Prise out the circlip on one side of the piston using needle-nose pliers or a small flat-bladed screwdriver inserted into the notch (see illustration). Push the piston pin out from the other side to free the piston from the connecting rod (see illustration). Rotate the crankshaft so that the best access is obtained for each piston. Remove the other circlip and discard them as new ones must be used.



*if a piston pin is a tight fit in the piston bosses, soak a rag in boiling water then wring it out and wrap it around the piston - this will expand the alloy piston sufficiently to release its grip on the pin.*

### Inspection

4 Before the inspection process can be carried out, the piston must be cleaned and the old piston rings removed. Note that if the cylinders are being rebored, piston inspection can be overlooked as new ones will be fitted.  
5 Using your thumbs or a piston ring removal and installation tool, carefully remove the rings from the piston (see illustration). Do not nick or gouge the piston in the process. Carefully note which way up each ring fits in its groove as they must be installed in their original positions if being re-used.

6 Scrape all traces of carbon from the tops of the piston. A hand-held wire brush or a piece of fine emery cloth can be used once most of the deposits have been scraped away. Do not, under any circumstances, use a wire brush mounted in a drill motor to remove deposits from the piston; the piston material is soft and will be eroded away by the wire brush.

7 Use a piston ring groove cleaning tool to remove any carbon deposits from the ring grooves. If a tool is not available, a piece broken off an old ring will do the job. Be very careful to remove only the carbon deposits. Do not remove any metal and do not nick or gouge the sides of the ring grooves.

8 Once the deposits have been removed, clean the piston with solvent and dry it thoroughly. If the identification previously marked on the piston is cleaned off, be sure to re-mark it with the correct identity. Make sure the oil return holes below the oil ring groove are clear.

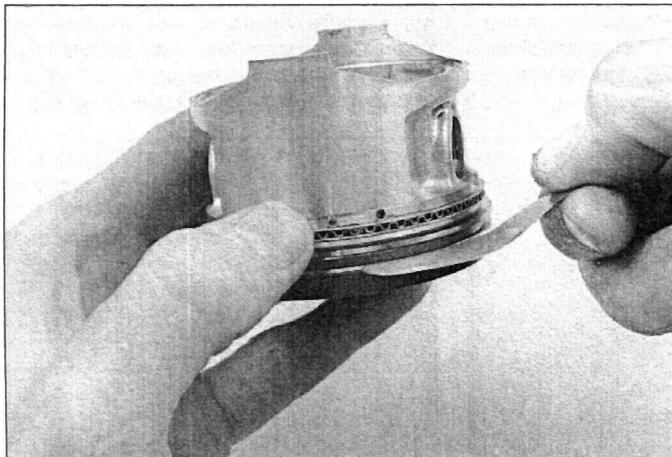
9 Carefully inspect each piston for cracks around the skirt, at the pin bosses and at the ring lands. Normal piston wear appears as even, vertical wear on the thrust surfaces of the piston and slight looseness of the top ring in its groove. If the skirt is scored or scuffed, the engine may have been suffering from overheating and/or abnormal combustion,

which caused excessively high operating temperatures. The oil pump should be checked thoroughly. Also check that the circlip grooves are not damaged.

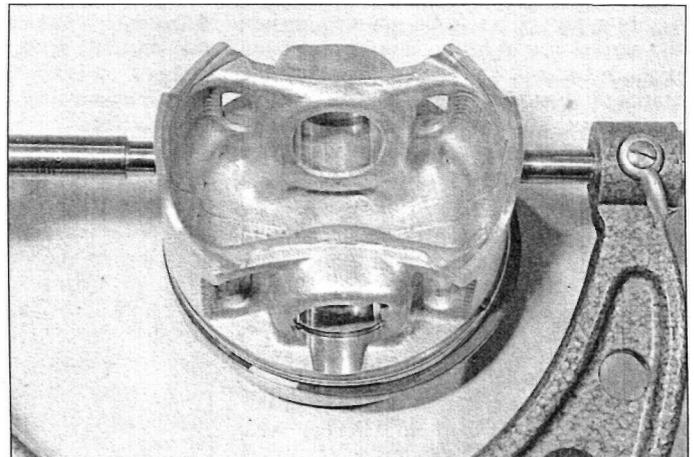
10 A hole in the piston crown, an extreme to be sure, is an indication that abnormal combustion (pre-ignition) was occurring. Burned areas at the edge of the piston crown are usually evidence of spark knock (detonation). If any of the above problems exist, the causes must be corrected or the damage will occur again.

11 Measure the piston ring-to-groove clearance by laying a new piston ring in the ring groove and slipping a feeler gauge in beside it (see illustration). Check the clearance at three or four locations around the groove. If the clearance is greater than specified, the piston is worn and must be replaced. **Note:** Make sure you have the correct ring for the groove - the two compression rings can be identified by their profile (see illustration 16.13).

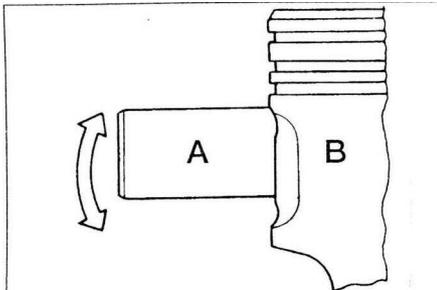
12 Check the piston-to-bore clearance by measuring the bore (see Section 14) and the piston diameter. Make sure each piston is matched to its correct cylinder. Measure the piston 10.0 mm up from the bottom of the skirt and at 90° to the piston pin axis (see illustration). Subtract the piston diameter from the bore diameter to obtain the clearance. If it



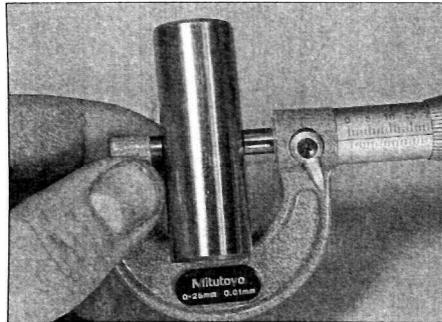
15.11 Measure the piston ring-to-groove clearance with a feeler gauge



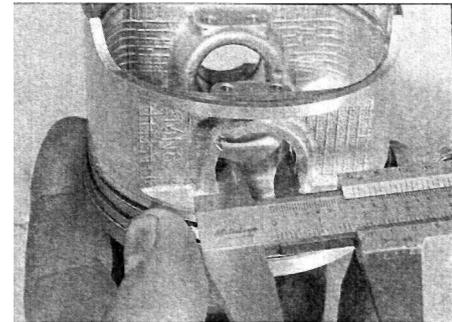
15.12 Measure piston diameter with a micrometer at the specified distance from the bottom of the skirt



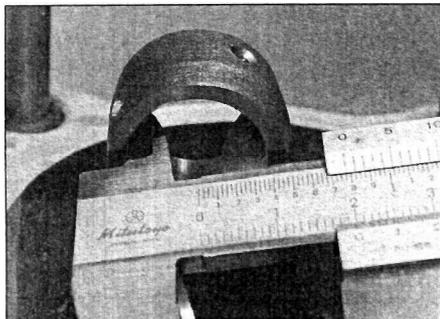
15.13a Slip the pin (A) into the piston (B) and try to rock it back and forth. If it's loose, replace the piston and pin



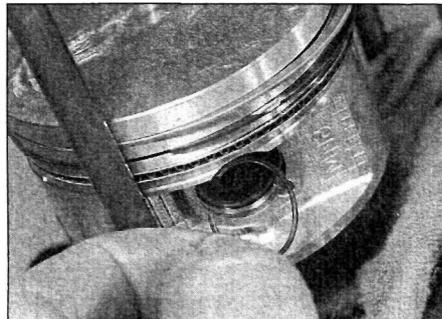
15.13b Measure the external diameter of the pin . . .



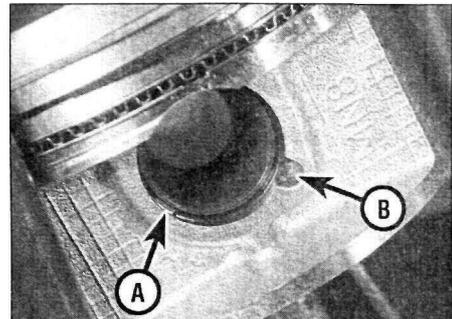
15.13c . . . the internal diameter of the bore in the piston . . .



15.13d . . . and the internal diameter of the connecting rod small-end



15.17a Secure the piston pin with new circlips



15.17b Make sure open end of the circlip (A) is away from the notch in the piston (B)

is greater than the specified figure, the piston must be replaced (assuming the bore itself is within limits, otherwise a rebore is necessary).

13 Apply clean engine oil to the piston pin, insert it into the piston and check for any freeplay between the two (see illustration). Measure the pin external diameter and the pin bore in the piston and compare the measurements to the specifications at the beginning of the Chapter (see illustrations). Calculate the difference between the measurements taken to obtain the piston pin-to-bore clearance and compare the result to the specifications. Repeat the measurements between the pin and the connecting rod small-end (see illustration). Replace components that are worn beyond the specified limits.

14 If the pistons are to be replaced, ensure the correct size of piston is ordered. Honda produce two oversize pistons as well as the standard piston. The oversize pistons available are: +0.25 mm and +0.50 mm. **Note:** Oversize pistons have their relevant size stamped on top of the piston crown, eg a 0.50 mm oversize piston will be marked 0.50.

### Installation

15 Inspect and install the piston rings (see Section 16).

16 Lubricate the piston pin and the connecting rod small-end bore with molybdenum disulphide grease.

17 Install a new circlip in one side of the piston (do not re-use old circlips) (see illustration). Line up the piston on its correct connecting rod, making sure the "IN" mark faces the intake side, and insert the piston pin

from the other side (see illustration 15.3b). Secure the pin with the other new circlip. When installing the circlips, compress them only just enough to fit them in the piston, and make sure they are properly seated in their grooves with the open end away from the removal notch (see illustration).

## 16 Piston rings - inspection and installation

1 It is good practice to replace the piston rings when an engine is being overhauled. Before installing the new piston rings, the ring end gaps must be checked.

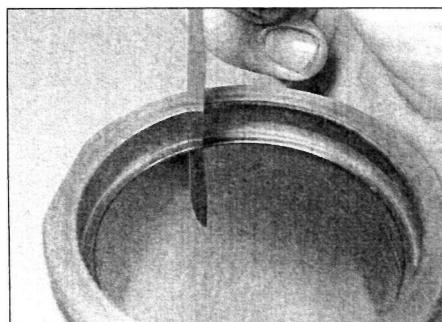
2 Lay out the pistons and the new ring sets so the rings will be matched with the same piston and cylinder during the end gap measurement procedure and engine assembly.

3 Insert the top ring into the top of the front cylinder and square it up with the cylinder walls by pushing it in with the top of the piston. The ring should be about 20 mm below the top edge of the cylinder. To measure the end gap, slip a feeler gauge between the ends of the ring and compare the measurement to the specifications at the beginning of the Chapter (see illustration).

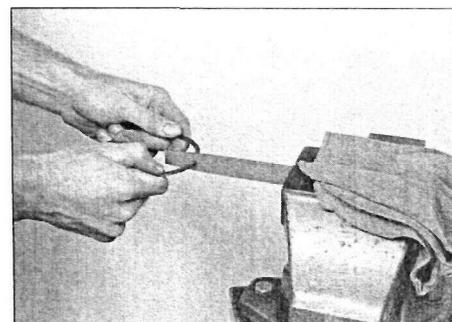
4 If the gap is larger or smaller than specified, double check to make sure that you have the correct rings before proceeding.

5 If the gap is too small, it must be enlarged or the ring ends may come in contact with each other during engine operation, which can cause serious damage. The end gap can be increased by filing the ring ends ven/ carefully with a fine file. When performing this operation, file only from the outside in (see illustration).

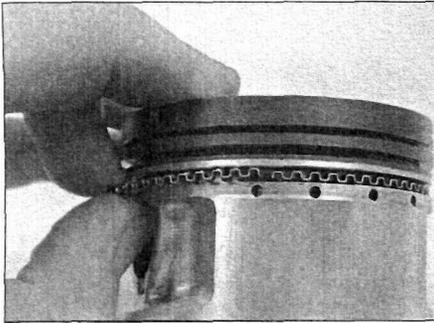
6 Excess end gap is not critical unless it is greater than 1 mm. Again, double check to



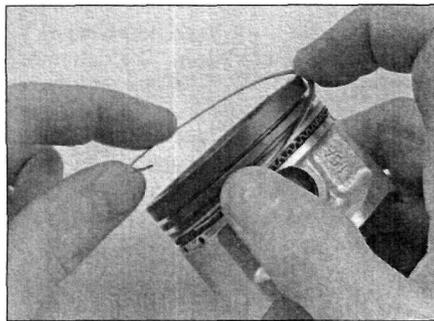
16.3 Measuring piston ring end gap



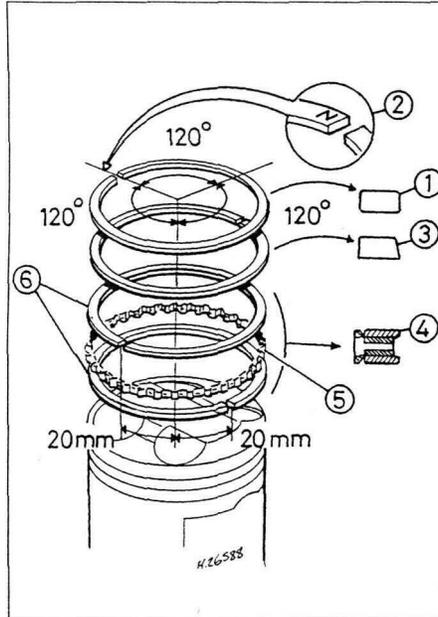
16.5 End gap can be enlarged by clamping a file in a vice and filing the ring ends



16.9a Install the oil ring expander in its groove . . .

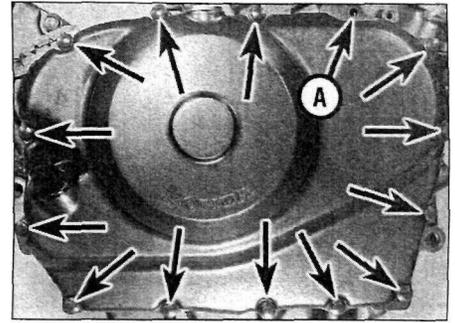


16.9b . . . and fit the side rails each side of it. The oil ring must be installed by hand

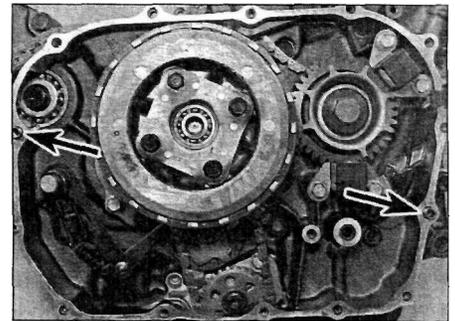


16.13 Arrange the ring end gaps like this

- 1 Top compression ring
- 2 Compression ring top marking (N or R)
- 3 Second compression ring
- 4 Oil ring complete
- 5 Expander ring
- 6 Side rails



17.5 Right side crankcase cover bolts (arrows). Note the location of the cable bracket (A) (shown removed)



17.6 Note the position of the two dowels (arrows) and remove them if they are loose

make sure you have the correct rings for your engine and check that the bore is not worn.

7 Repeat the procedure for each ring that will be installed in the front cylinder and for each ring in the rear cylinder. Remember to keep the rings, pistons and cylinders matched up.

8 Once the ring end gaps have been checked/corrected, the rings can be installed on the pistons.

9 The oil control ring (lowest on the piston) is installed first. It is composed of three separate components. Slip the expander into the groove between the expander and the ring land. Hold it firmly in place and slide a finger around the piston while pushing the rail into the groove. Next, install the lower side rail in the same manner (see illustrations).

10 After the three oil ring components have been installed, check to make sure that both the upper and lower side rails can be turned smoothly in the ring groove.

11 Install the second (middle) ring next. It can be readily distinguished from the top ring by its cross-section shape (see illustration 16.13). To avoid breaking the ring, use a piston ring installation tool and make sure that the identification letter (an "N" on 600 cc engines and an "R" on 650 cc engines) near the end gap is facing up. Fit the ring into the middle groove on the piston. Do not expand

the ring any more than is necessary to slide it into place.

12 Finally, install the top ring in the same manner. The top ring can be distinguished from the second ring by its cross-section shape (see illustration 16.13). Make sure the identification letter (an "N" on 600 cc engines and an "R" on 650 cc engines) near the end gap is facing up.

13 Once the rings are correctly installed, check they move freely without snagging and stagger their end gaps as shown (see illustration).

## 17 Clutch - removal, inspection and installation



**Note:** The clutch can be removed with the engine in the frame. If the engine has already been removed, ignore the preliminary steps which don't apply.

### Removal

- 1 Drain the engine oil as described in Chapter 1.
- 2 Detach the clutch cable from the lever on the crankcase cover (see Section 18).
- 3 Remove the rear cylinder exhaust pipe (see Chapter 4).
- 4 On J and K models, unscrew the external oil pipe lower bolt from the right-hand side crankcase cover, and the pipe holder bolt

from the crankcase. Discard the lower bolt sealing washers as new ones must be used.

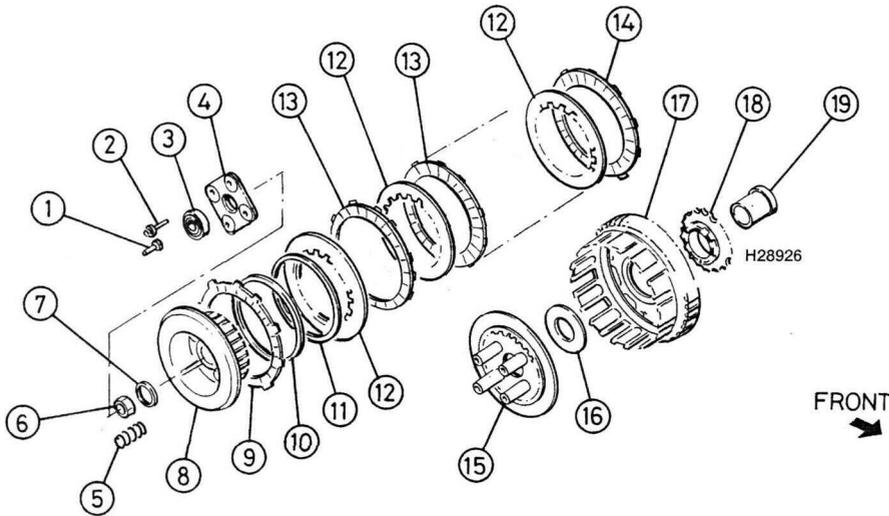
5 Working in a criss-cross pattern, evenly slacken the right-hand side crankcase cover retaining bolts, noting the position of the clutch cable bracket (see illustration). Lift the cover away from the engine, being prepared to catch any residual oil which may be released as the cover is removed.

6 Remove the gasket and discard it. Note the positions of the two locating dowels fitted to the crankcase and remove them for safe-keeping if they are loose (see illustration). On J and K models, remove the oil orifice, noting which way round it fits, and discard its O-ring as a new one must be used.

7 Working in a criss-cross pattern, gradually slacken the clutch release plate retaining bolts until spring pressure is released, then remove the bolts, plate and springs (see illustrations).

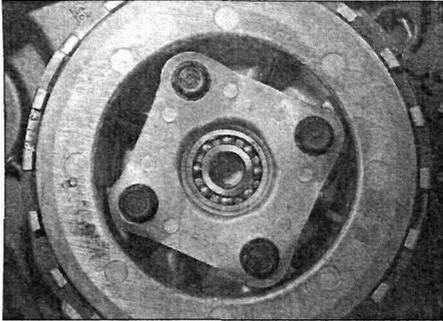
8 To remove the clutch nut the mainshaft must be locked. This can be done in several ways. If the engine is in the frame, engage 1st gear and have an assistant hold the rear brake on hard with the rear tyre in firm contact with the ground. Alternatively, the Honda service tool (Pt. No. 07923-KE10000) can be used to stop the clutch centre from turning whilst the nut is slackened. If the engine has been removed from the frame (and the Honda tool is not available), install the universal joint onto the output driven shaft and engage 5th gear, then fit a suitable spanner onto the flats of the

2•28 Engine, clutch and transmission



17.7a Clutch components

- |                       |                             |                            |
|-----------------------|-----------------------------|----------------------------|
| 1 Release rod         | 8 Clutch centre             | 15 Pressure plate          |
| 2 Release plate bolts | 9 Friction plate - type A   | 16 Thrust washer           |
| 3 Release bearing     | 10 Spring seat              | 17 Clutch housing          |
| 4 Release plate       | 11 Anti-judder spring       | 18 Oil pump drive sprocket |
| 5 Springs             | 12 Plain plates             | 19 Clutch housing guide    |
| 6 Clutch nut          | 13 Friction plates - type B |                            |
| 7 Washer              | 14 Friction plate - type C  |                            |



17.7b Remove the four bolts to free the release plate

replaced with new ones, keep them in their original order. Note that of the eight friction plates, there are three types, identified as A, B and C (see illustration). The outermost (type A) plate has a slightly larger internal diameter allowing it to fit over the anti-judder spring and spring seat, and its tangs fit into the shallow slots in the clutch housing. It is also slightly thicker than the rest. The innermost (type C) plate has different tang ends to the rest. The six middle plates are type B. Take care not to mix them up.

10 Remove the thrust washer from the shaft.

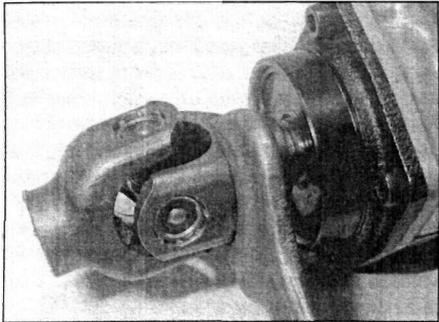
11 Remove the clutch housing (see illustration).

12 Note the tabs on the oil pump drive sprocket behind the clutch housing which must locate in the slots in the back of the housing on reassembly. Unscrew the oil pump driven sprocket bolt and remove the sprocket

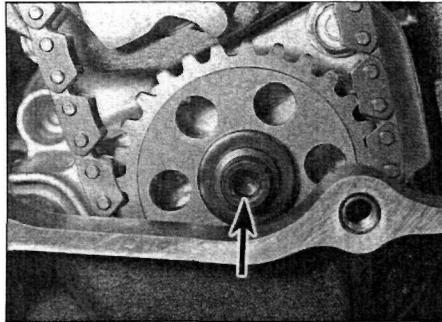
universal joint and secure it against the work surface (see illustration). This locks the mainshaft and allows the clutch nut to be removed. Whilst the shaft is locked, also slacken the oil pump driven sprocket bolt (see illustration). Unscrew the clutch nut and

remove the washer from the mainshaft, noting how it fits (see illustration).

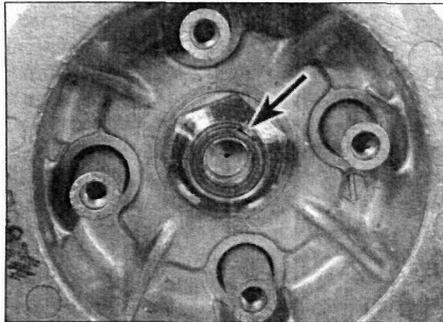
9 Grasp the clutch centre with the complete set of clutch plates and the pressure plate and remove them as a pack (see illustration). Unless the plates are being



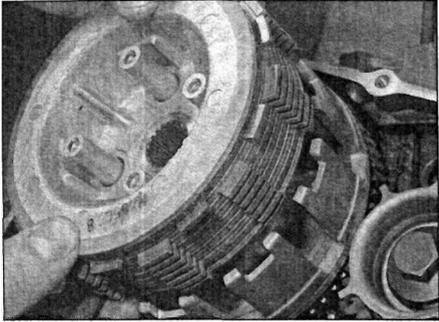
17.8a Using a spanner on the universal joint to lock the mainshaft



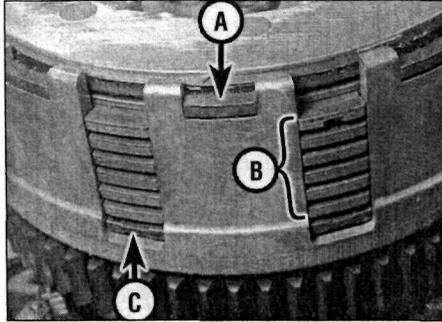
17.8b Slacken the oil pump sprocket bolt (arrow) whilst the shaft is locked



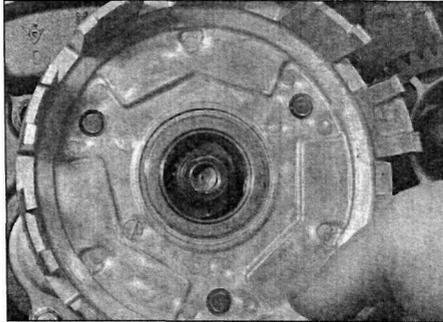
17.8c Remove the clutch nut, noting how it is staked to the mainshaft (arrow)



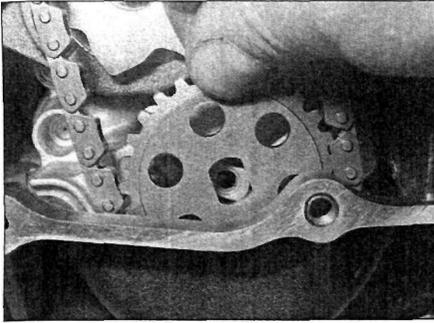
17.9a Remove the clutch centre and plates as a pack



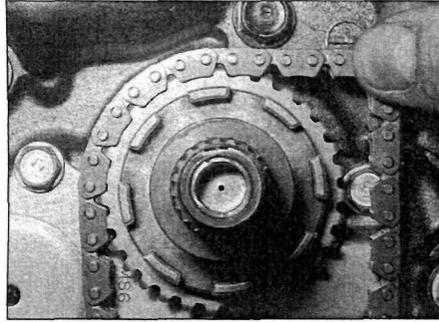
17.9b Clutch friction plates • type A, type B, type C



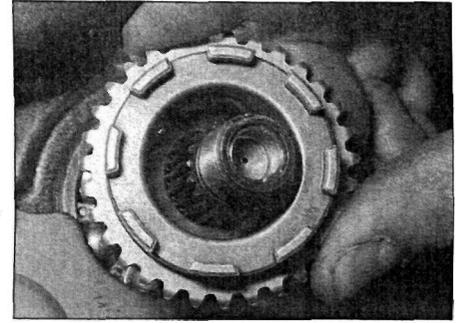
17.11 Remove the clutch housing



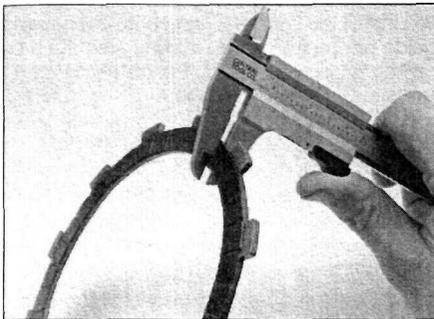
17.12a Slip the oil pump sprocket off the pump shaft . . .



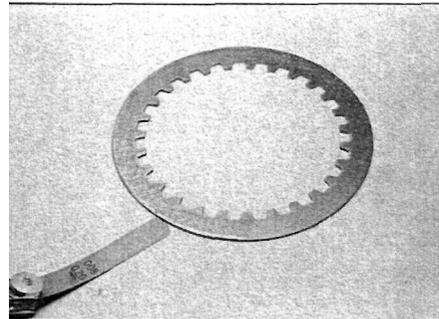
17.12b . . . and disengage the chain from the drive sprocket



17.12c Remove the oil pump drive sprocket



17.13 Measure the thickness of the friction plates



17.14 Check the plain plates for warpage

from the pump, then disengage the pump drive chain and withdraw the drive sprocket from the mainshaft (**see illustrations**). Note the "IN" mark on the back of the oil pump driven sprocket which must face inwards. Remove the clutch housing guide from the mainshaft.

**Inspection**

13 After an extended period of service the clutch friction plates will wear and promote clutch slip. Measure the thickness of each friction plate using a vernier caliper (**see illustration**). If any plate has worn to or beyond the service limit given in the Specifications at the beginning of the Chapter, the friction plates must be replaced as a set. Also, if any of the plates smell burnt or are glazed, they must be replaced as a set.

14 The plain plates should not show any signs of excess heating (bluing). Check for warpage using a flat surface and feeler gauges (**see illustration**). If any plate exceeds the maximum permissible amount of warpage, or shows signs of bluing, all plain plates must be replaced as a set.

15 Measure the free length of each clutch spring using a vernier caliper (**see illustration 13.17a**). If any spring is below the service limit specified, replace all the springs as a set.

16 Inspect the clutch assembly for burrs and indentations on the edges of the protruding tangs of the friction plates and/or slots in the edge of the housing with which they engage. Similarly check for wear between the inner tongues of the plain plates and the slots in the clutch centre. Wear of this nature will cause

clutch drag and slow disengagement during gear changes, since the plates will snag when the pressure plate is lifted. With care a small amount of wear can be corrected by dressing with a fine file, but if this is excessive the worn components should be replaced.

17 Using a vernier caliper, measure the diameter of the mainshaft where the clutch housing guide fits over it. Also measure the

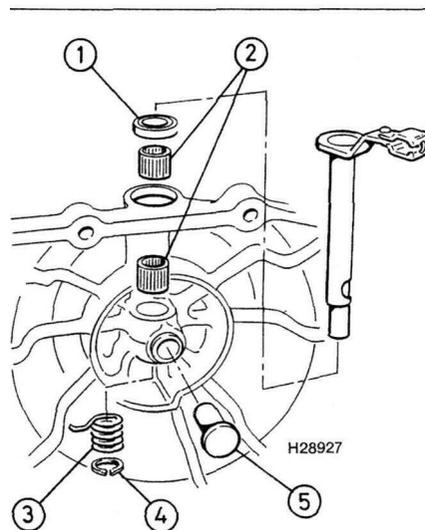
internal and external diameter of the housing guide, and the internal diameter of the clutch housing and the oil pump drive sprocket. Compare the measurements to the specifications at the beginning of the Chapter and replace any components that are worn beyond their service limit. Also check all the above components for signs of damage or scoring, and replace if necessary.

18 Check the pressure plate and thrust washer for signs of roughness, wear or damage, and replace any parts as necessary.

19 Check the clutch release plate for signs of damage. Check that the bearing outer race is a tight fit in the centre of the plate, and that the inner race rotates freely without any rough spots. Replace the bearing if necessary.

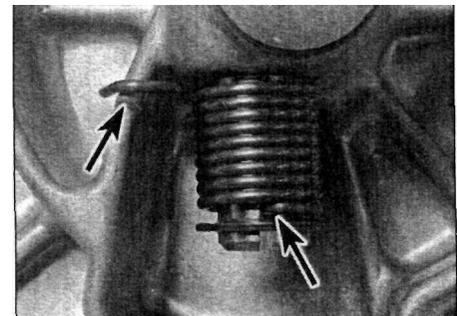
20 Check the Clutch anti-judder spring and spring seat for distortion, wear or damage, and replace them if necessary.

21 Check the clutch release mechanism in the clutch cover for smooth operation (**see illustration**). Check the shaft and release rod for signs of damage. If necessary, prise off the circlip and withdraw the shaft from the cover, noting how the return spring fits (**see illustration**). Check the two needle roller bearings for roughness, wear or damage, or looseness in the cover. If they need to be replaced, heat the cover in very hot water to ease removal and drift them out. If the shaft is removed, lever out the dust seal and replace it with a new one. Check the shaft return spring for fatigue or damage and replace it if necessary. Clean all components and lubricate the seal and bearings with grease.



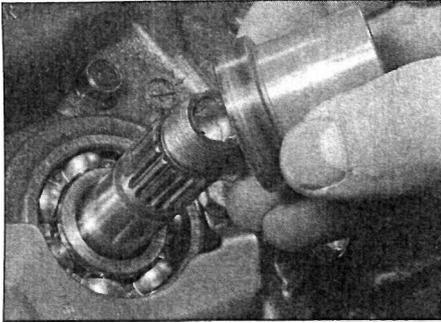
17.21a Clutch release mechanism

- 1 Dust seal
- 2 Needle bearings
- 3 Spring
- 4 Circlip
- 5 Release rod

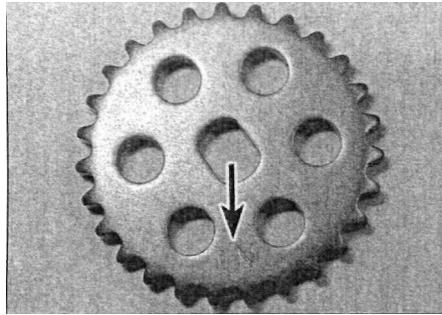


17.21b Note how the ends of the return spring locate (arrows)

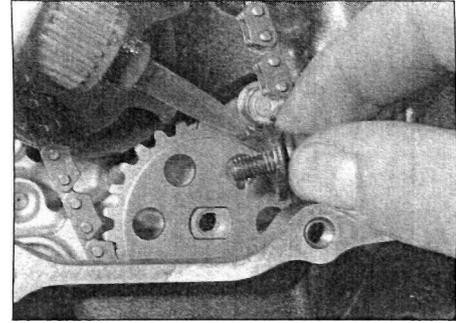
## 2•30 Engine, clutch and transmission



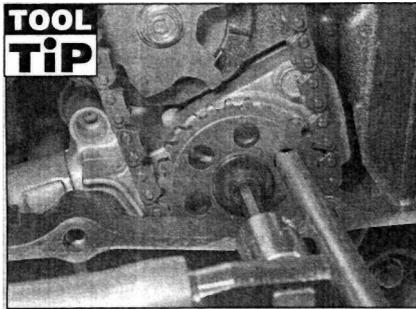
17.23 Install the clutch housing guide



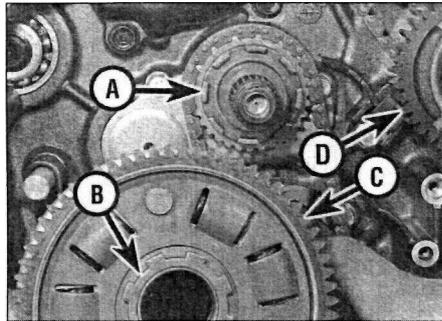
17.24a Note the "IN" mark on the driven sprocket (arrow) which must face inwards



17.24b Apply a thread locking compound to the oil pump sprocket bolt



**Insert a screwdriver through one of the holes in the sprocket and lock it against the crankcase to prevent the sprocket from turning whilst tightening the bolt.**



17.25 Make sure the tabs (A) engage in the slots (B) in the back of the clutch housing, and that the teeth (C) mesh with those on the primary drive gear (D)

25 Install the clutch housing onto the housing guide on the mainshaft, making sure the tabs on the oil pump drive sprocket engage with the slots in the rear of the housing, and the teeth of the clutch housing engage with those of the primary drive gear (see illustration).

26 Install the thrust washer onto the shaft, followed by the clutch pressure plate (see illustrations).

27 Coat each clutch plate with engine oil, then build up the plates in the housing, starting with the type C friction plate, then a plain plate and alternating type B friction and plain plates until all are installed (see illustrations). Finally install the type A friction plate, locating its tangs in the shallow slots in the clutch housing rather than in the deep slots of the type B and C plates (see illustration).

28 Install the anti-judder spring seat onto the clutch centre, followed by the anti-judder spring; note that the inner edge of the spring faces outwards (see illustration).

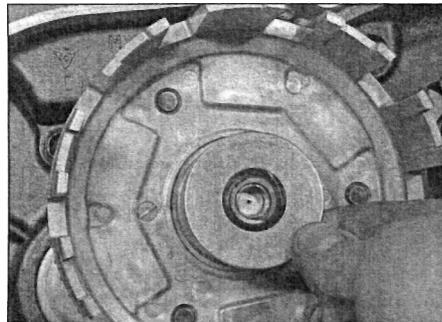
### Installation

22 Remove all traces of old gasket from the crankcase and clutch cover surfaces.

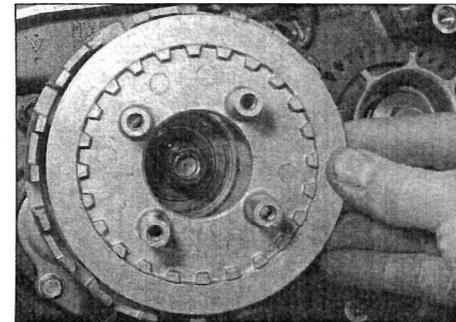
23 Smear the outside of the clutch housing guide with molybdenum disulphide grease, then install the guide onto the mainshaft (see illustration).

24 Install the oil pump drive chain onto its drive and driven sprockets, then install the sprockets and chain as an assembly onto the clutch housing guide and oil pump, making sure that the "IN" mark on the driven sprocket faces the engine (see illustration) and that the tabs on the drive sprocket face out (see illustration 17.12b). Apply a suitable non-permanent thread locking compound to the sprocket bolt (see illustration) and tighten it to the torque setting specified at the

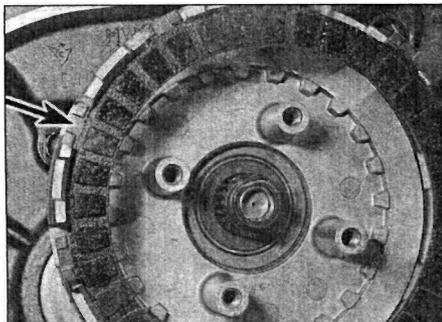
beginning of the chapter (see *Tool Tip*). Alternatively, tighten the bolt when tightening the clutch nut (see Step 29).



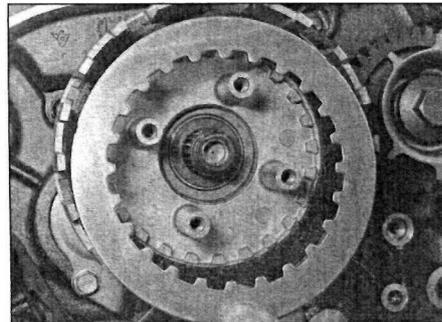
17.26a Install the thrust washer .



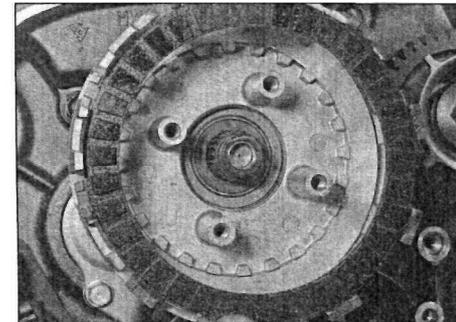
17.26b . . . followed by the pressure plate



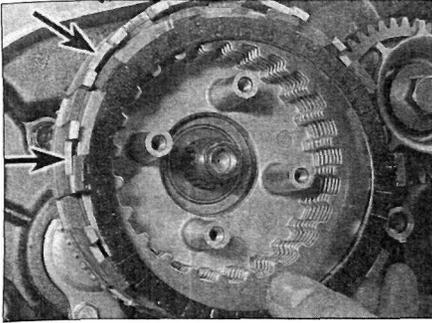
17.27a Fit the type C friction plate, identified by indents on its tangs (arrow) . . .



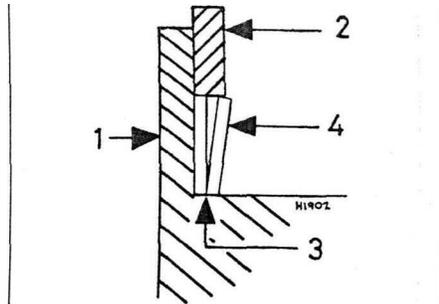
17.27b . . . followed by a plain plate .



17.27c . . . then alternating type B friction plates and plain plates . . .

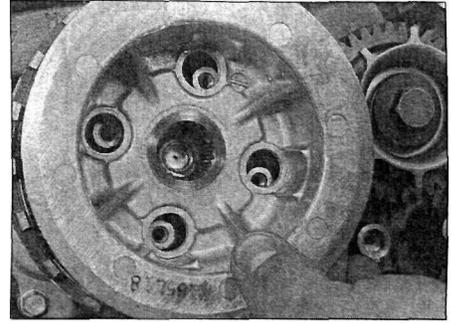


17.27d ... and finally install the type A friction plate, the tangs of which locate in the shallow slots in the housing (arrows)

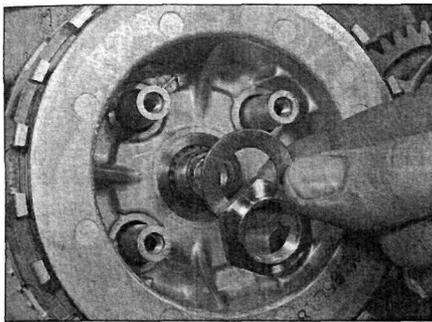


17.28 Correct fitting of anti-judder spring

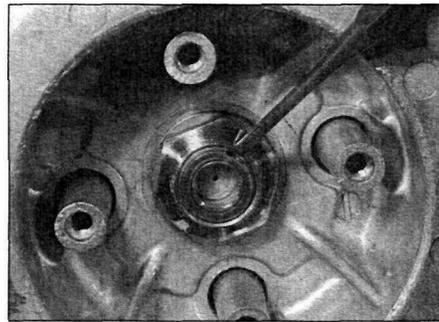
1 Clutch centre      3 Spring seat  
Type A plate      Anti-judder spring



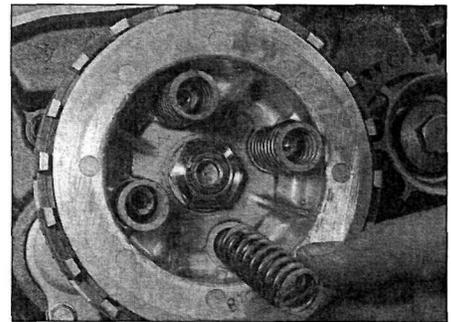
17.29a Install the clutch centre .



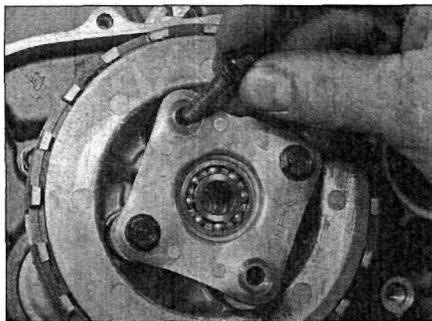
17.29b ... followed by the washer and clutch nut



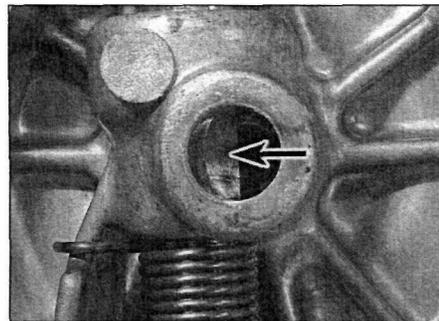
17.29c Stake the clutch nut against the indent in the end of the mainshaft using a suitable punch



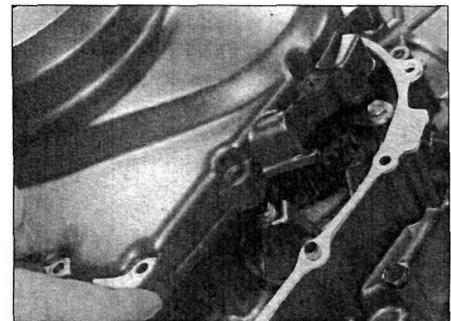
17.30a Install the clutch springs ...



17.30b ... followed by the release plate and its bolts



17.31 The release rod must locate in the cutout in the shaft (arrow)



17.32 Install the crankcase cover

**29** Install the clutch centre onto the mainshaft splines, then install the washer and the clutch nut (**see illustrations**). Using the method employed on removal to lock the mainshaft, tighten the nut to the torque setting specified at the beginning of the Chapter. Stake the rim of the nut into the indent in the end of the mainshaft using a suitable punch (**see illustration**). Whilst the clutch is locked, and if not already done (see Step 24), also tighten the oil pump driven sprocket bolt to the specified torque setting, having first applied a suitable non-permanent thread locking compound to its threads. **Note:** Check that the clutch centre rotates freely after tightening.

**30** Install the clutch springs, release plate and release plate bolts and tighten them evenly in a criss-cross sequence (**see illustrations**).

**31** If disassembled, install the clutch release mechanism in the clutch cover (**see illustrations 17.21a and 17.21b**). Align the shaft so that the release rod fits into its recess in the shaft (**see illustration**).

**32** If removed, insert the dowels in the crankcase (**see illustration 17.6**). On J and K models, fit a new O-ring onto the oil orifice, then install the orifice into the crankcase with its larger diameter hole facing out. Install the crankcase cover using a new gasket, making sure it locates correctly over the dowels (**see**

**illustration**). Tighten the cover bolts evenly in a criss-cross sequence, making sure the clutch cable bracket is in its correct position (**see illustration 17.5**).

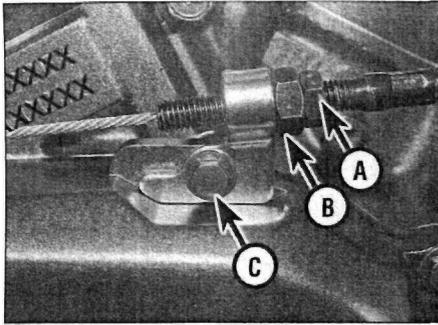
**33** On J and K models, install the external oil pipe lower bolt, using new sealing washers, and the pipe holder bolt, and tighten them to the specified torque setting.

**34** Install the clutch cable onto the lever on the crankcase cover (see Section 18).

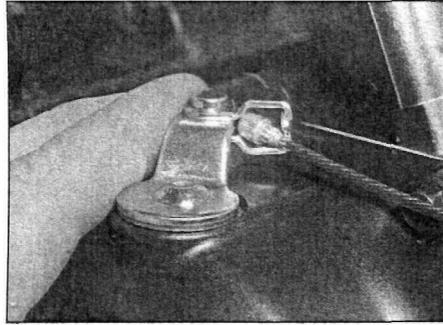
**35** Install the rear cylinder exhaust pipe (see Chapter 4).

**36** Refill the engine with oil (see Chapter 1).

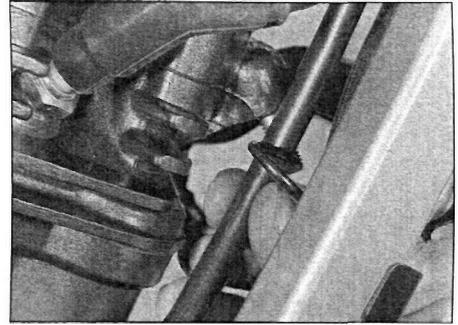
**37** Check the clutch lever freeplay and adjust if necessary (see Chapter 1).



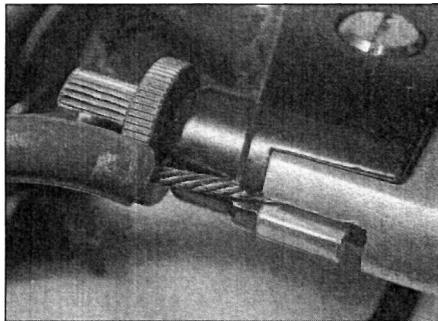
18.1a Clutch cable adjuster locknut (A), adjuster nut (B), and bracket bolt (C)



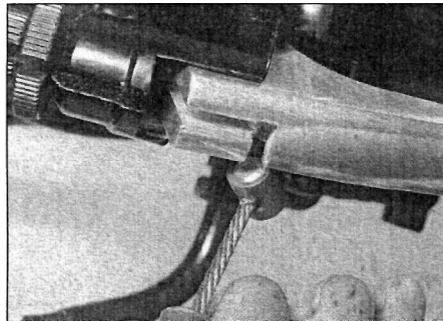
18.1b Detach the cable end from the lever . . .



18.1c . . . and release the cable from its guide



18.4a Detach cable from the adjuster . . .



18.4b . . . and from the lever

## 18 Clutch cable - removal and installation



1 Fully slacken the cable adjuster locknut and adjuster nut from the cable bracket mounted to the right-hand side crankcase cover (**see illustration**). Disconnect the cable end from the clutch release mechanism lever, noting how it fits and release the adjuster from the bracket (**see illustration**). Release the cable from the guide on the right-hand side frame downtube (**see illustration**).

2 If necessary, unscrew the bolt securing the cable bracket to the crankcase and remove the bracket (**see illustration 18.1a**).

3 Pull back the rubber cover from the clutch adjuster at the handlebar end of the cable (J and K models only). Fully slacken the lockwheel then screw the adjuster nut fully in. This resets it to the beginning of its adjustment span.

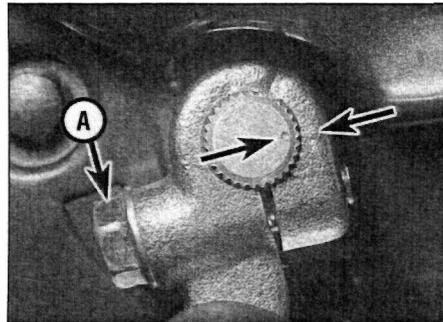
4 Align the slots in the adjuster and lockwheel with that in the lever bracket, then pull the outer cable end from the socket in the adjuster and release the inner cable from the lever (**see illustrations**). Take note of the exact routing of the cable before withdrawing it - incorrect installation could result in poor steering movement.

5 Installation is the reverse of removal. Adjust the amount of clutch lever freeplay (see Chapter 1).

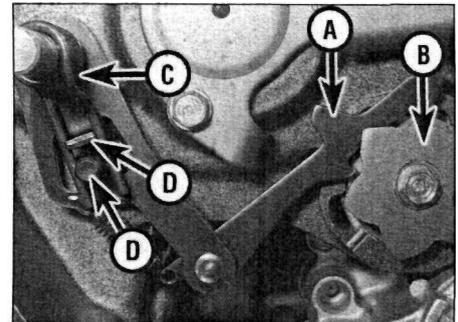
## 19 Gearchange mechanism - removal, inspection and installation



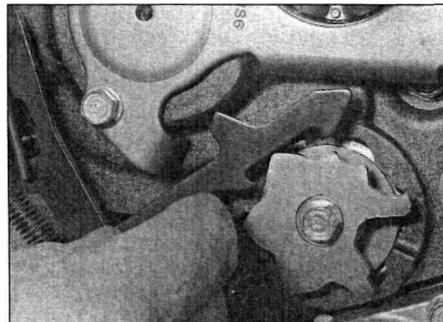
**Note:** The gearchange mechanism can be removed with the engine in the frame.



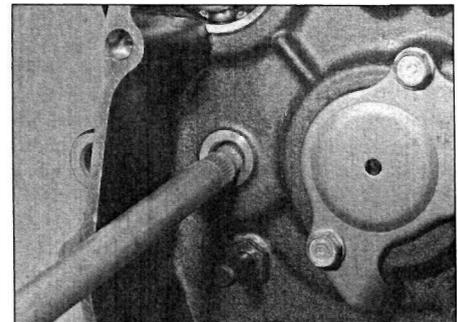
19.2 Unscrew the gearchange lever pinch bolt (A). Note the punch marks (arrows)



19.4a Selector arm claw (A), selector drum (B), centralising spring (C), pins (D)



19.4b Lift the selector arm claw off the drum pins . . .

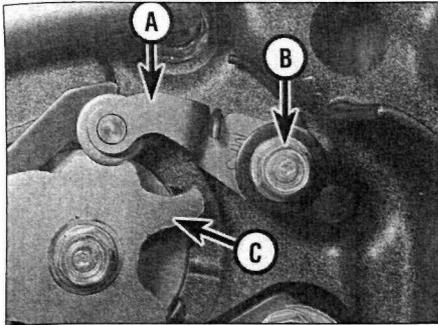


19.4c . . . and withdraw the shaft

If this work is being carried out with the engine already removed, ignore the preliminary steps.

### Removal

- 1 Drain the engine oil (see Chapter 1).
- 2 Unscrew the gearchange linkage arm pinch bolt and remove the linkage arm from the shaft. Note the punch marks on the arm and the shaft which must be aligned on installation (**see illustration**).
- 3 Remove the clutch (see Section 17).
- 4 Note how the gearchange selector arm claw fits onto the selector drum pins, and how the gearchange shaft centralising spring ends fit on each side of the locating pins (**see illustration**). Lift the selector arm claw off the dowel pins in the selector drum and withdraw the gearchange shaft from the engine (**see illustrations**).
- 5 Unscrew the bolt securing the selector drum stopper arm to the crankcase, then lift



**19.5** Stopper arm (A), stopper arm bolt (B), stopper plate (C)

the stopper arm off the stopper plate on the selector drum and remove the arm with its collar and return spring, noting how they fit (see illustration).

6 If necessary, unscrew the bolt securing the stopper plate to the selector drum, then remove the plate, taking care not to lose any of the pins as you do. Remove the pins for safekeeping.

**Inspection**

7 Inspect the selector arm and the stopper arm return springs and the shaft centralising spring. If they are fatigued, worn or damaged they must be replaced.

8 Check the gearchange shaft for straightness and damage to the splines. If the shaft is bent you can attempt to straighten it, but if the splines are damaged the shaft must be replaced.

9 Inspect the selector arm claw and the pins, and the stopper arm roller and the stopper plate. If they are worn or damaged they must be replaced.

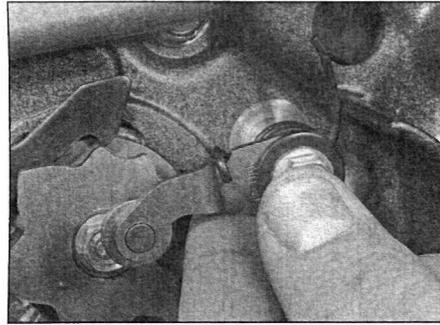
**Installation**

10 If removed, install the pins into the end of the selector drum, then install the stopper plate, making sure it locates correctly on the pins. Apply a suitable thread locking compound to the threads of the stopper plate bolt, then install the bolt and tighten it to the specified torque setting.

11 Install the stopper arm bolt with its washer through the stopper arm, the return spring and the collar, then install the assembly onto the crankcase. Position the stopper arm roller on the stopper plate and locate the spring ends correctly over the stopper arm and against the crankcase (see illustration). Tighten the bolt securely. Make sure the stopper arm is free to move and is returned by the pressure of the spring.

12 Install the gearchange shaft assembly into its hole in the engine, lifting the selector arm claw into position on the selector drum pins. Ensure the centralising spring ends are correctly located on each side of the pins on the shaft and the crankcase (see illustration).

13 Install the gearchange linkage arm onto the end of the shaft on the left-hand side of the engine, aligning the punch marks on the



**19.11** Install the stopper arm assembly

arm and shaft, and check that the mechanism works correctly (see illustration 19.2). Tighten the pinch bolt to the specified torque. 14 Install the clutch (see Section 17). Replenish the engine with oil (see Chapter 1).

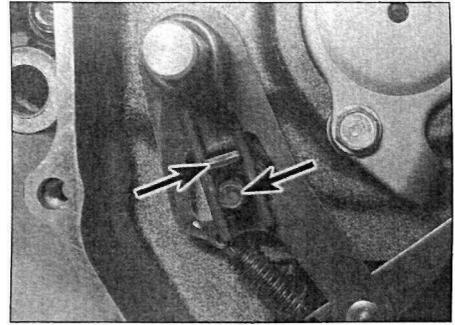
**20 Starter clutch and gear assembly - removal, inspection and installation**



**Note:** The starter clutch and idle gear assembly can be removed with the engine in the frame.

**Removal**

1 Working in a criss-cross pattern, evenly slacken the left-hand side crankcase front cover retaining bolts (see illustration). Lift the cover away from the engine, being prepared to catch any residual oil which may be



**19.12** Make sure the centralising spring ends locate correctly over the pins (arrows)

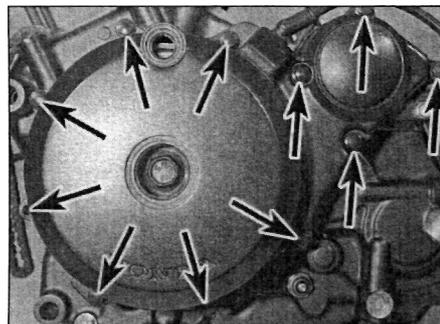
released as the cover is removed. Remove the gasket and discard it. Note the positions of the two locating dowels fitted to the crankcase and remove them for safe-keeping if they are loose (see illustration).

2 Remove the starter drive gear and the idle/reduction gear along with their shafts (see illustration). Note the "OUT" mark on the starter drive gear which must face outwards. Note also that the drive gear shaft is shorter than the idle/reduction gear shaft.

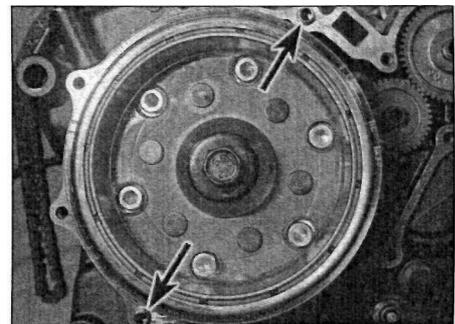
3 Remove the alternator rotor (see Chapter 9). If the starter driven gear does not come away with the rotor, remove it from the crankshaft along with the needle roller bearing. The starter clutch is secured to the back of the rotor by six Torx bolts.

**Inspection**

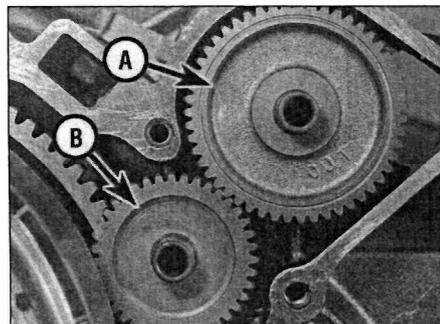
4 Install the starter driven gear into the starter clutch (if removed) (see illustration) and, with



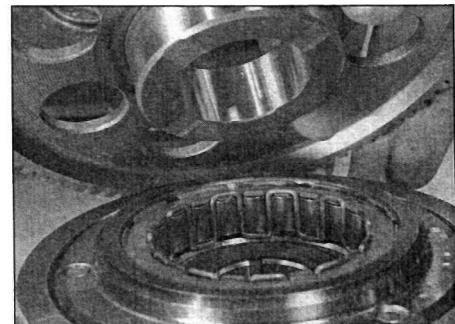
**20.1 a** Left side crankcase front cover bolt locations (arrows)



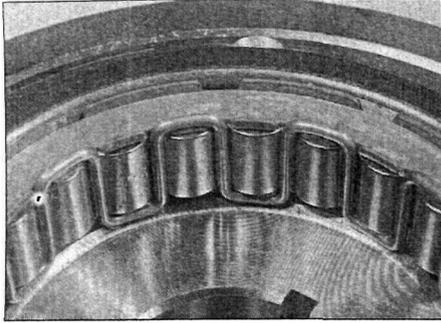
**20.1 b** Note the positions of the two dowels (arrows) - remove them if loose



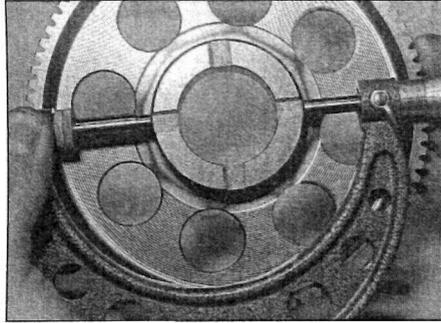
**20.2** Starter drive gear (A), idle/reduction gear (B)



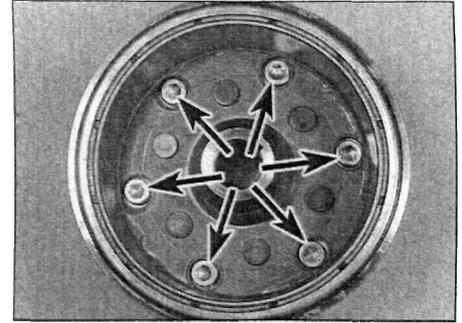
**20.4** Insert the driven gear into the starter clutch



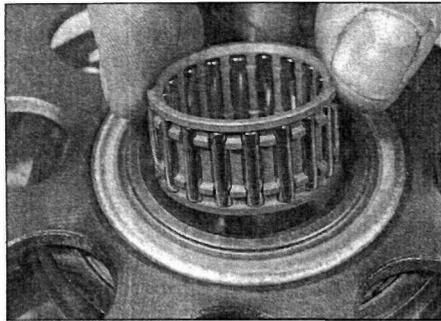
20.6 Check the condition of the sprags in the starter clutch



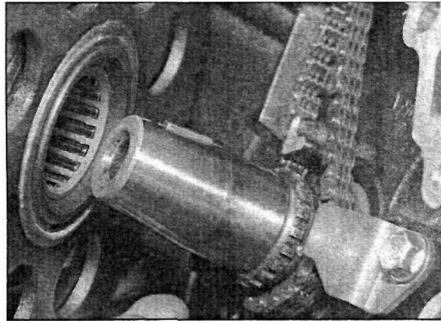
20.7 Measure the driven gear hub diameter



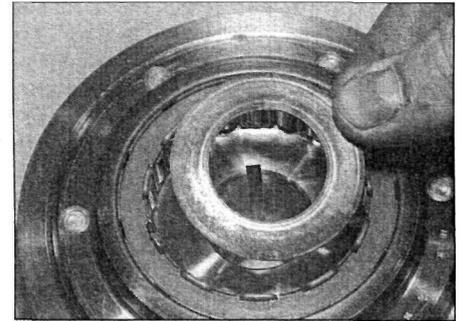
20.10 The starter clutch is secured to the alternator rotor by six Torx bolts (arrows)



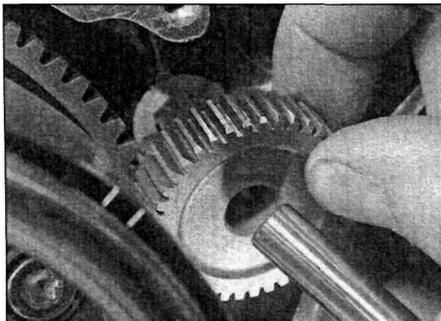
20.11 a Fit the needle roller bearing into the starter driven gear . . .



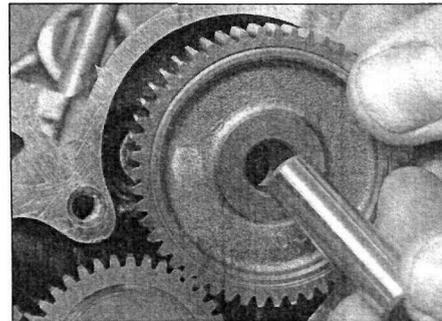
20.11b . . . then fit the driven gear onto the end of the crankshaft



20.12 Make sure the thrust washer is installed in the starter clutch



20.13a Install the idle/reduction gear . . .



20.13b . . . and the starter drive gear with its "OUT" mark facing out

the rotor face down on a workbench, check that the gear rotates freely in an anti-clockwise direction and locks against the rotor in a clockwise direction. If it doesn't, replace the starter clutch.

5 Withdraw the starter driven gear from the starter clutch. If it appears stuck, rotate it anti-clockwise as you withdraw it to free it from the starter clutch.

6 Check the bearing surface of the starter driven gear hub and the condition of the sprags inside the clutch body (see illustration). If the bearing surface shows signs of excessive wear or the sprags are damaged, marked or flattened at any point, they should be replaced.

7 Measure the external diameter of the driven gear hub and compare it to the specifications at the beginning of the Chapter (see illustration). Replace the gear if it is worn beyond the service limit.

8 Check the needle roller bearing for signs of wear or damage and replace it if necessary.

9 Examine the teeth of the starter idle/reduction gear and the corresponding teeth of the starter driven gear and starter drive gear. Replace the gears as a set if worn or chipped teeth are discovered.

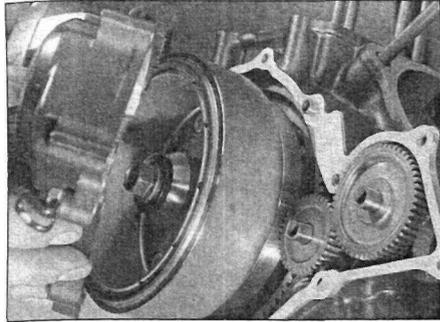
10 To replace the starter clutch sprag assembly, undo the six Torx bolts securing the clutch to the rotor (see illustration). Remove the clutch from the back of the rotor and separate the sprag assembly from the clutch body, noting how it fits. Install the new sprag assembly with its flanged side facing the alternator, then install the clutch assembly back onto the rotor. Apply a suitable thread locking compound to the bolts and tighten them to the torque setting specified at the beginning of the Chapter. Lubricate the starter clutch sprags with new engine oil.

### Installation

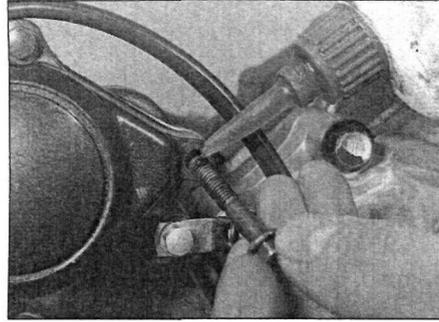
11 Install the needle roller bearing into the starter driven gear, then install the starter driven gear over the bearing with the gear hub facing outwards (see illustrations).

12 Install the alternator rotor (see Chapter 9), making sure the thrust washer is installed in the back of the starter clutch (see illustration).

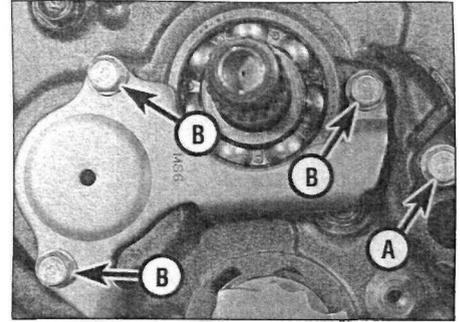
13 Install the idle/reduction gear and the starter drive gear with their shafts, making sure the longer shaft is installed with idle/reduction gear and the shorter shaft with the drive gear. Make sure the "OUT" mark on the drive gear faces outwards and that the smaller pinion on the idle/reduction gear faces inwards and meshes correctly with the teeth of the starter driven gear (see illustrations).



20.14a Fit a new gasket then install the cover



20.14b Apply thread-locking compound to the top right cover bolt



21.3 Cam chain tensioner set plate bolt (A), transmission shaft bearing set plate bolts (B) - later model type shown

14 If removed, insert the dowels in the crankcase (see illustration 20.1b). Install the crankcase cover using a new gasket, making sure it locates correctly onto the dowels (see illustration). Apply a suitable thread-locking compound to the top right-hand cover bolt (see illustration), then tighten the cover bolts evenly in a criss-cross sequence.

## 21 Crankcase - separation and reassembly

### Separation

1 To access the crankshaft and connecting rods, bearings, oil pump and transmission components, the crankcase must be split into two parts.

2 To enable the crankcases to be separated, the engine must be removed from the frame (see Section 5). Before the crankcases can be separated, the camshafts, cam chain tensioners, cylinder heads, cylinder blocks, ignition pulse generator coils, cam chains, clutch, gearchange mechanism, oil filter,

water pump, starter motor, alternator, starter clutch and starter idle/reduction gears must be removed. See the relevant Sections or Chapters for details.

3 Unscrew the bolt securing the cam chain tensioner set plate to the right-hand crankcase half and remove the set plate, noting how it fits (see illustration). On J and K models the bolt for the plate on the right-hand side crankcase half also secures the right-hand end of the transmission shaft bearing set plate (see Step 4).

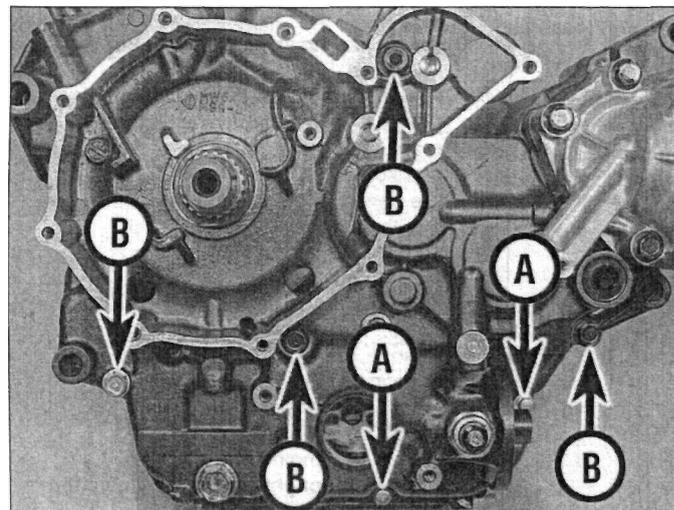
4 Unscrew the bolts securing the transmission shaft bearing set plate to the right-hand side crankcase half and remove the set plate, noting how it fits (see illustration 21.3). On J and K models the right-hand bolt also secures the cam chain tensioner set plate and will already have been removed (see Step 3), and the mainshaft bearing has another retainer plate secured by one bolt on the right-hand side of the bearing.

5 Starting with the left-hand side crankcase half, unscrew the two 6 mm bolts followed by the four 8 mm bolts (see illustration). Slacken each bolt 1/2 a turn at a time in a criss-cross pattern until they are all loose, then remove

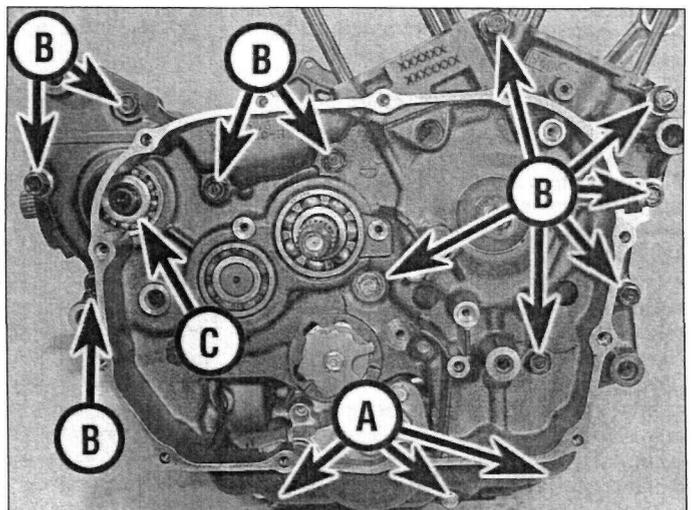
the bolts. **Note:** As each bolt is removed, store it in its relative position in a cardboard template of the crankcase halves. This will ensure all bolts are installed in the correct location on reassembly.

6 Moving to the right-hand side crankcase half, unscrew the three 6 mm bolts followed by the eleven 8 mm bolts (see illustration). Slacken each bolt 1/2 a turn at a time in a criss-cross pattern until they are all loose, then remove the bolts. Note the copper sealing washer on the top 8 mm bolt in between the cylinders. **Note:** As each bolt is removed, store it in its relative position in a cardboard template of the crankcase halves. This will ensure all bolts are installed in the correct location on reassembly.

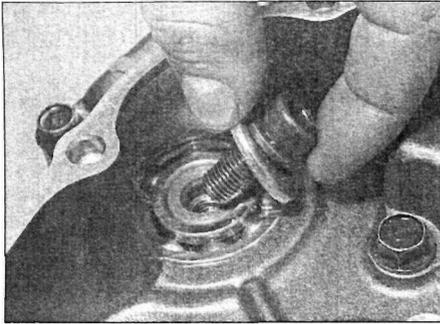
7 Now the output driven shaft must be locked in order for the output drive shaft bolt to be removed (see illustration 21.6). Honda provide a special tool (Pt. No. 07923-6890101) for locking the shaft, or alternatively install the universal joint onto the output driven shaft and engage 5th gear, then fit a suitable spanner onto the flats of the universal joint and secure it against the work surface (see illustration 17.8a). This



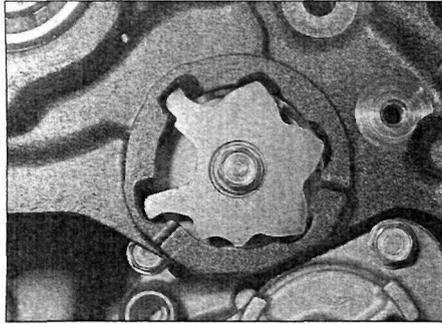
21.5 Left-hand side crankcase bolts • 6 mm (A), 8 mm (B)



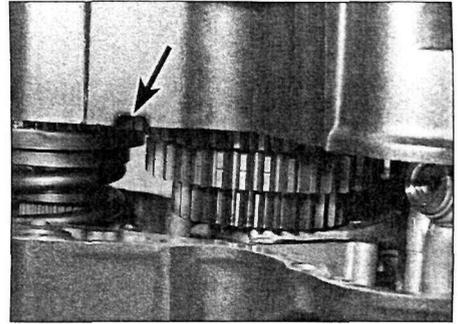
21.6 Right-hand side crankcase bolts - 6 mm (A), 8 mm (B) - and output drive shaft bolt (C)



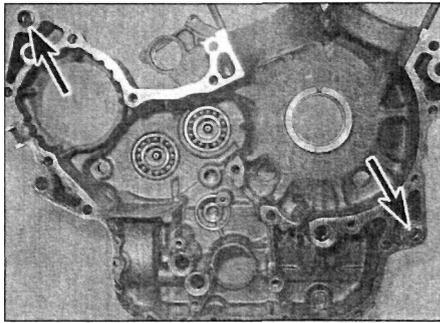
21.7 With the transmission locked, remove the output drive shaft bolt



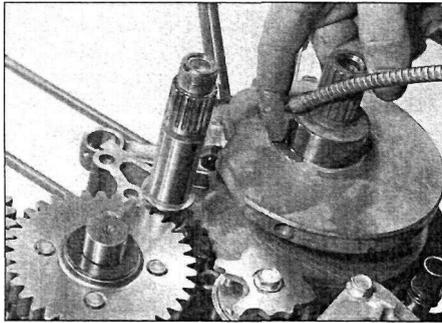
21.8a Rotate the selector drum stopper plate until the arms match the holes in the crankcase



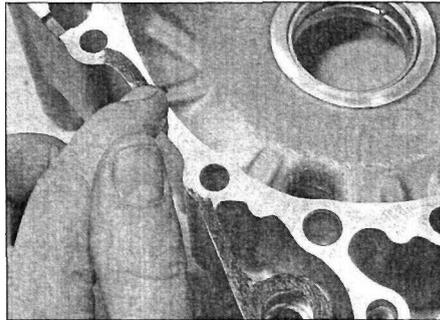
21.8b Use a screwdriver on the leverage point (arrow) if necessary



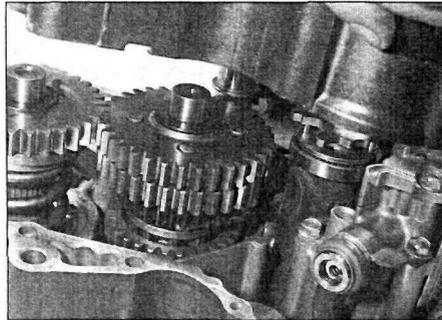
21.9 Remove the two dowels (arrows) if they are loose



21.12 Lubricate all components, especially around the bearings, with oil



21.15 Apply sealant to the mating surface of the right-hand crankcase half



21.16 Fit the right-hand crankcase half down onto the left

locks the transmission and allows the output drive shaft bolt to be removed (see illustration).

8 Carefully turn the engine onto its side with the left-hand side crankcase half facing down. If the gear selector drum stopper plate has not been removed (see Section 19), rotate it so that its outline shape matches the hole in the right-hand crankcase half, otherwise it will snag on the case when it is lifted (see illustration). Carefully lift the right-hand crankcase half off the left-hand half, using a screwdriver on the leverage point and a soft hammer to tap around the joint to initially separate the halves if necessary (see illustration). **Note:** If the halves do not separate easily, make sure all fasteners have been removed. Do not try and separate the halves by levering against the crankcase

mating surfaces as they are easily scored and will leak oil. Use only the special leverage point. The right-hand side crankcase half will come away by itself, leaving the oil pump, crankshaft, transmission shafts, selector drum and selector forks in the left-hand crankcase half.

9 Remove the two locating dowels from the crankcase if they are loose (they could be in either crankcase half), noting their locations (see illustration). If the oil pump and its T-pipe are not being disturbed, remove the exposed O-ring from the oil pipe T-piece, noting which way up it fits, and discard it as a new one must be used. Check that the thrust washer is on the right-hand end of the transmission countershaft; if not, it is probably stuck to the bearing in the right-hand crankcase half.

### Reassembly

10 Remove all traces of sealant from the crankcase mating surfaces.

11 Ensure that all components and their bearings are in place in the right and left-hand crankcase halves. If the oil pump and its T-pipe have not been removed, install a new O-ring, with its tapered side facing out, onto the exposed end of the pipe T-piece. Check that the thrust washer is installed on the right-hand end of the transmission countershaft.

12 Generously lubricate the transmission shafts, selector drum and forks, and the crankshaft, particularly around the bearings, with clean engine oil, then use a rag soaked in high flash-point solvent to wipe over the gasket surfaces of both halves to remove all traces of oil (see illustration).

13 Install the two locating dowels in the left-hand crankcase half (see illustration 21.9).

14 If installed, make sure the stopper plate is positioned as on removal to allow the right-hand crankcase half to fit over it (see illustration 21.8a).

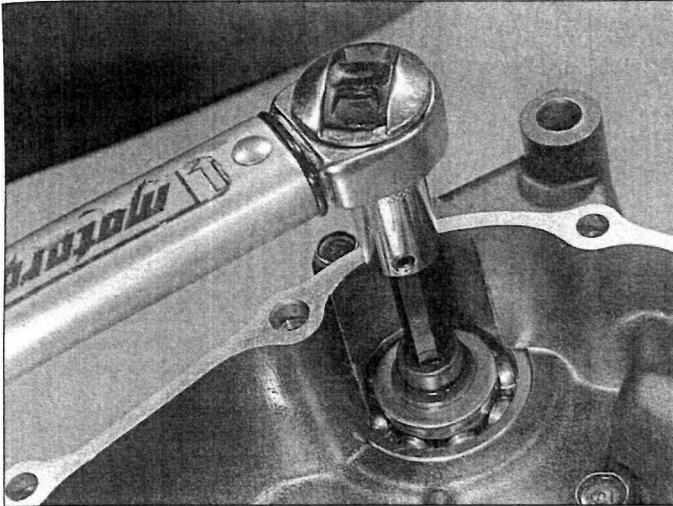
15 Apply a small amount of suitable sealant to the mating surface of the right-hand crankcase half (see illustration).

**Caution:** Do not apply an excessive amount of sealant, as it will ooze out when the case halves are assembled and may obstruct oil passages.

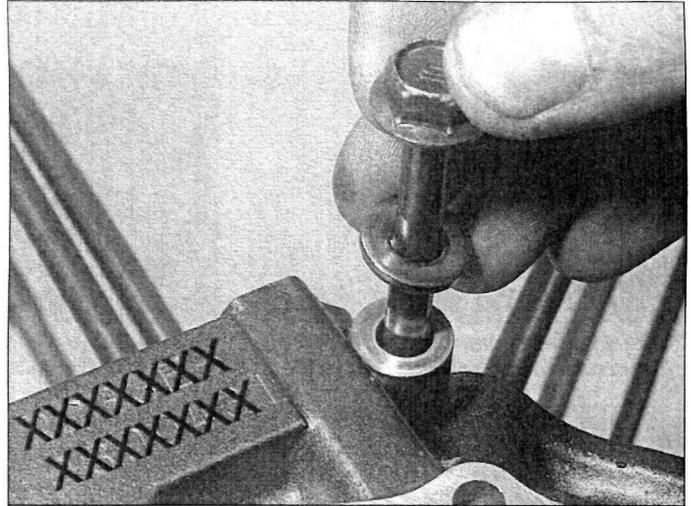
16 Check again that all components are in position, then carefully install the right-hand crankcase half down onto the left-hand crankcase half (see illustration). Make sure the dowels and shaft ends all locate correctly into the right-hand crankcase half.

17 Check that the right-hand crankcase half is correctly seated. **Note:** The crankcase halves should fit together without being forced. If the casings are not correctly seated, remove the right-hand crankcase half and investigate the problem. Do not attempt to pull them together using the crankcase bolts as the casing will crack and be ruined.

18 Lift the engine off its left-hand side and position it upright. Apply a suitable thread-locking compound to the threads of the output drive shaft bolt, then, using the method employed in Step 7 to lock the output driven



**21.18** Apply thread-locking compound to the output drive shaft bolt threads and tighten it to the specified torque setting



**21.20** Make sure the copper sealing washer is installed with the top bolt between the cylinders

shaft, tighten the bolt to the torque setting specified at the beginning of the Chapter (see illustration).

**19** Check that the transmission shafts rotate freely and independently in neutral, then rotate the selector drum by hand and select each gear in turn whilst rotating the mainshaft. Check that all gears can be selected and that the shafts rotate freely in every gear.

**20** Clean and oil the threads of the right-hand crankcase bolts and insert them in their original locations (see illustration 21.6). Make sure the copper sealing washer is installed with the top 8 mm bolt in between the cylinders (see illustration). Secure all bolts hand-tight at first, then tighten the eleven 8 mm bolts followed by the three 6 mm bolts 1/2 a turn at a time in a criss-cross pattern to the torque setting specified at the beginning of the Chapter. When torquing the bolts, be sure to distinguish correctly between the 8 mm bolts and the 6 mm bolts.

**21** Clean and oil the threads of the left-hand crankcase bolts and install them in their original locations (see illustration 21.5). Secure all bolts hand-tight at first, then tighten the four 8 mm bolts followed by the two 6 mm bolts 1/2 a turn at a time in a criss-cross pattern to the torque setting specified at the beginning of the Chapter. When torquing the bolts, be sure to distinguish correctly between the 8 mm bolts and the 6 mm bolts.

**22** With all crankcase fasteners tightened, check that the crankshaft and transmission shafts rotate smoothly and easily. Check the operation of the transmission in each gear (see Step 19). If there are any signs of undue stiffness, tight or rough spots, or of any other problem, the fault must be rectified before proceeding further.

**23** Install all other removed assemblies in the reverse of the sequence given in Steps 2 to 4. Apply a suitable thread-locking compound to the transmission shaft bearing set plate bolts.

## 22 Crankcase - inspection and servicing



**1** After the crankcases have been separated and the crankshaft, oil pump and transmission components have been removed, the crankcases should be cleaned thoroughly with solvent and dried with compressed air.

**2** Remove the oil jet from each crankcase half, and check the condition of their O-rings, replacing them if necessary (see illustrations). All oil passages should be blown out with compressed air. Apply clean engine oil to the oil jet O-rings before installing them back in the engine.

**3** All traces of old gasket sealant should be removed from the mating surfaces. Minor damage to the surfaces can be cleaned up with a fine sharpening stone or grindstone.

**Caution:** Be very careful not to nick or gouge the crankcase mating surfaces or oil leaks will result. Check both crankcase halves very carefully for cracks and other damage.

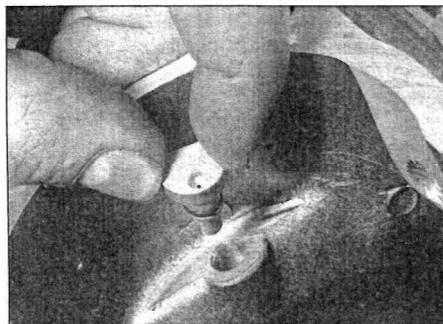
**4** Small cracks or holes in aluminium castings may be repaired with an epoxy resin adhesive as a temporary measure. Permanent repairs can only be effected by argon-arc welding, and only a specialist in this process is in a

position to advise on the economy or practical aspect of such a repair. If any damage is found that can't be repaired, replace the crankcase halves as a set.

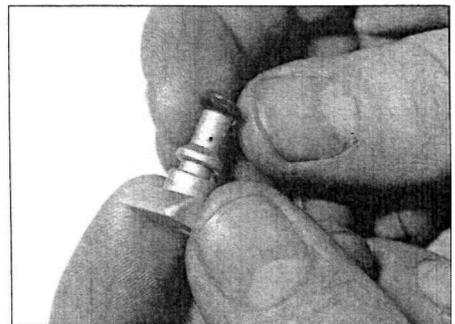
**5** Damaged threads can be economically reclaimed by using a diamond section wire insert, of the Helicoil type, which is easily fitted after drilling and re-tapping the affected thread. Most motorcycle dealers and small engineering firms offer a service of this kind.

**6** Sheared studs or screws can usually be removed with screw extractors, which consist of a tapered, left-hand thread screw of very hard steel. These are inserted into a pre-drilled hole in the stud or screw, and usually succeed in dislodging the most stubborn stud or screw. If a problem arises which seems beyond your scope, it is worth consulting an engineering firm before condemning an otherwise sound casing. Many of these firms advertise regularly in the motorcycle press.

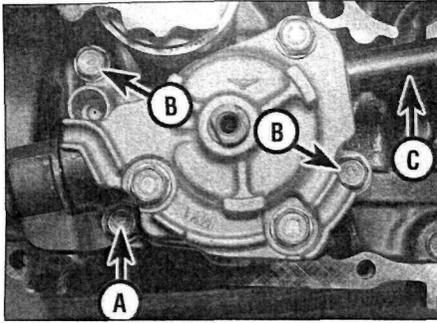
**7** Check that all the cylinder studs are tight in the crankcase halves. If any are loose, remove them, then clean their threads and apply a suitable non-permanent thread locking compound and tighten them to the torque setting specified at the beginning of the Chapter. When torquing the studs, be sure to distinguish correctly between the 8 mm stud and the 10 mm studs.



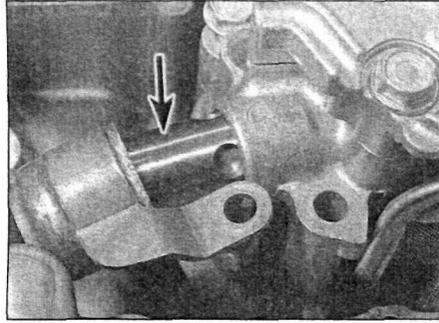
**22.2a** Remove the oil jet . . .



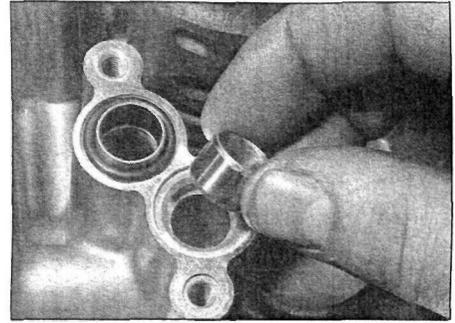
**22.2b** . . . renew the O-ring if necessary



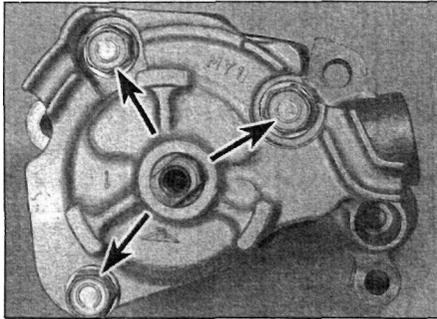
23.2a Pressure relief valve cover bolt (A), pump mounting bolts (B), T-pipe (C)



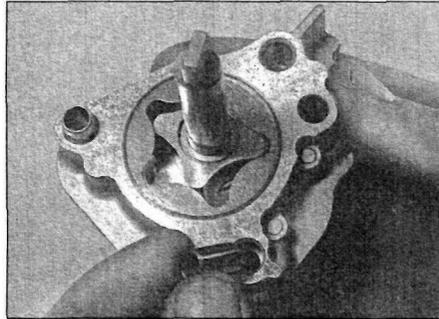
23.2b Remove the pressure relief valve cover and withdraw the valve (arrow) from the pump



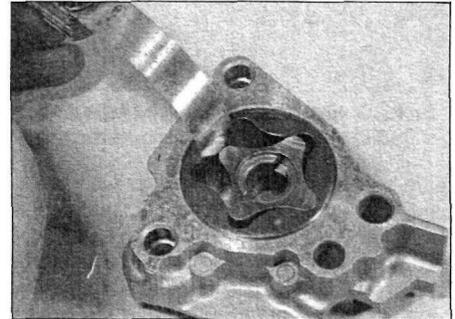
23.3 Remove the dowels and discard their O-rings



23.5a Unscrew the three bolts (arrows)



23.5b Remove the two dowels if they are loose



23.9 Measure the rotor tip clearance as shown

**23 Oil pump and pressure relief valve - removal, inspection, installation and pressure check**

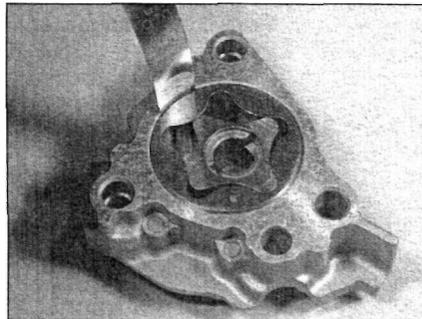


**Removal**

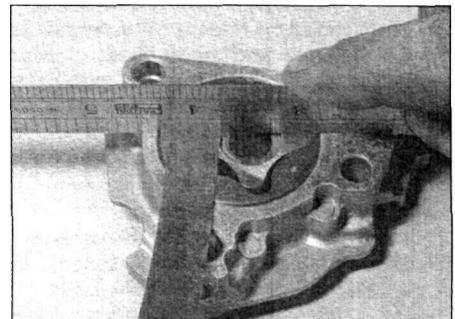
- 1 Separate the crankcase halves (Section 21).
- 2 Unscrew the bolt securing the pressure relief valve cover to the pump, then remove the cover from the end of the relief valve and withdraw the valve from the pump (see illustrations). Discard the valve O-ring as a new one must be used.
- 3 Unscrew the two bolts securing the pump assembly to the crankcase, then remove the pump along with its T-pipe (see illustration 23.2a). Remove the two large pump dowels from the crankcase and discard their O-rings as new ones must be used (see illustration). Remove the small pump dowel if it is loose.

**Inspection**

- 4 Remove the T-pipe from the pump and discard its O-rings as new ones must be used.
- 5 Unscrew the three bolts securing the pump body to the cover and separate the body from the cover (see illustration). Remove the dowels from either the body or the cover if they are loose (see illustration).
- 6 Remove the oil strainer and its seal from the pump cover. Discard the seal as a new one must be used.
- 7 Withdraw the pump drive shaft along with its thrust washer, and the inner and outer



23.10 Measure the outer rotor to body clearance as shown



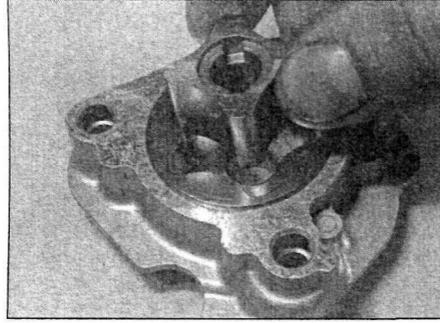
23.11 Measure the rotor end float as shown

- rotors from the pump body. Note how the pin locates through the shaft and in the notches in the inner rotor, and how the punch mark on the outer rotor faces the pump cover. Clean all the components in solvent.
- 8 Inspect the pump body and rotors for scoring and wear. If any damage, scoring or uneven or excessive wear is evident, replace the pump (individual components are not available).
- 9 Measure the clearance between the inner rotor tip and the outer rotor with a feeler gauge and compare it to the maximum clearance listed in the specifications at the beginning of the Chapter (see illustration). If the clearance measured is greater than the maximum listed, replace the pump.
- 10 Measure the clearance between the outer rotor and the pump body with a feeler gauge and compare it to the maximum clearance listed in the specifications at the beginning of

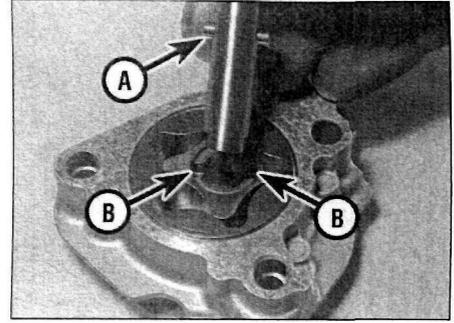
- the Chapter (see illustration). If the clearance measured is greater than the maximum listed, replace the pump.
- 11 Lay a straightedge across the rotors and the pump body and, using a feeler gauge, measure the rotor end float (the gap between the rotors and the straightedge) (see illustration). If the clearance measured is greater than the maximum listed, replace the pump.
- 12 Remove the circlip from the end of the relief valve body and withdraw the washer, spring and valve plunger. Clean all the components in solvent. Check that the plunger moves freely in the body and inspect it for wear or damage. If the valve is good, install the plunger into the body, followed by the spring and the washer, and secure them in place with the circlip. Note that apart from the O-ring, none of the relief valve components are available separately.



23.14a Install the outer rotor .



23.14b . . . followed by the inner rotor



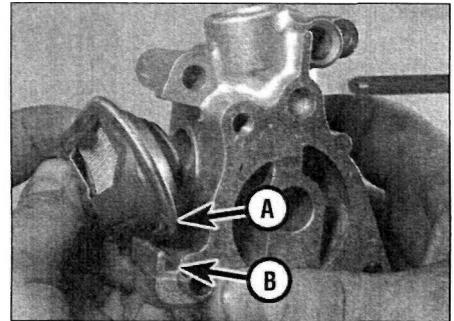
23.14c The pin (A) must locate in the notches (B) in the inner rotor



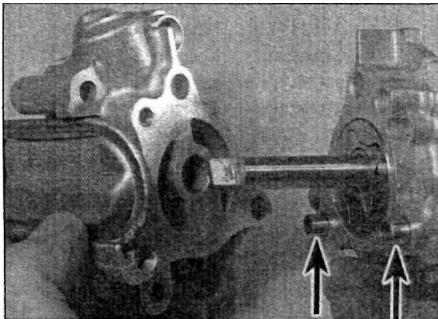
23.14d Install the thrust washer over the shaft and onto the inner rotor



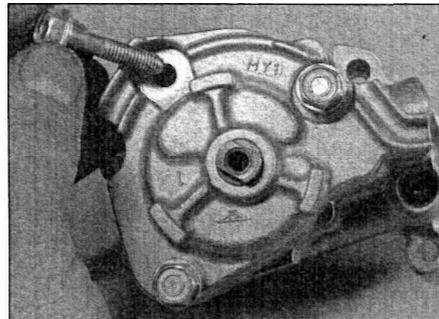
23.15a Fit a new seal to the strainer . . .



23.15b . . . then install the strainer with its rim (A) fitting into the slot (B) in the cover



23.16a Fit the two dowels (arrows), then install the cover onto the pump . . .



23.16b . . . and secure it with its bolts

13 Check the pump drive chain and sprockets for wear or damage, and replace them as a set if necessary.

14 If the pump is good, make sure all the components are clean, then lubricate them with new engine oil. Install the outer rotor into the pump body with the punch mark facing out, towards the pump cover (see illustration). Install the inner rotor into the outer rotor so that its notches face outwards (see illustration). Fit the pin into the pump drive shaft and install the shaft into the inner rotor, making sure the pin fits into the notches in the inner rotor (see illustration). Install the thrust washer over the shaft and onto the inner rotor (see illustration).

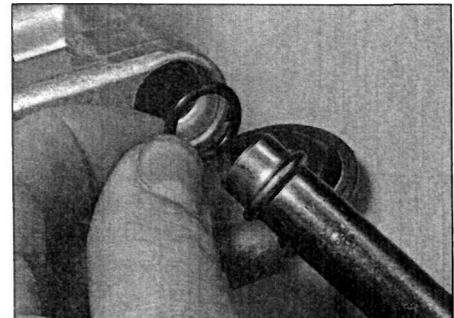
15 Make sure the strainer is clean and free of any debris, then install it onto the pump cover using a new seal, making sure its rim fits into the slot in the cover (see illustrations).

16 Install the dowels into the pump body, then install the cover, making sure it locates correctly over the dowels (see illustration). Install the three bolts into the pump body and tighten them securely (see illustration).

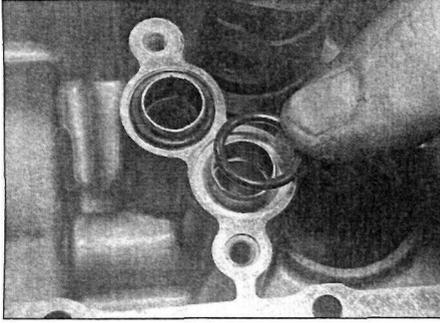


23.17a Fit new O-rings to the pump T-pipe with their tapered side facing out . . .

17 Fit new O-rings, with their tapered side facing out, to each end of the pump T-pipe, then install the pipe into the pump (see illustrations).



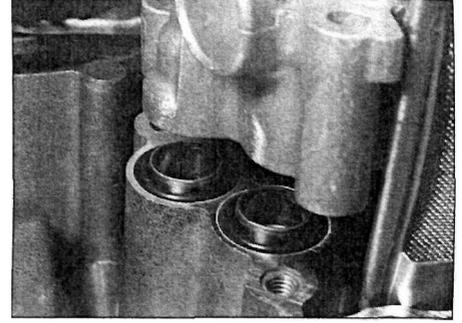
23.17b . . . then install the pipe into the pump



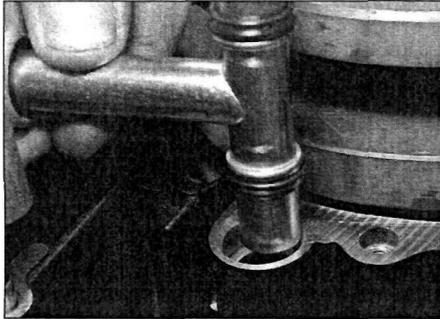
23.18a Fit new O-rings around the two large dowels



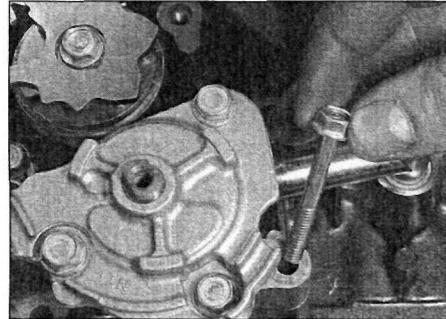
23.18b Install the small pump dowel if removed



23.20a Make sure the pump locates onto the dowels . . .



23.20b . . . and the T-pipe fits into its hole



23.20c Secure the pump with its mounting bolts

### Installation

18 Install the two large pump dowels into the crankcase and fit new O-rings around them (see illustration). If removed, also install the small pump dowel (see illustration).

19 Before installing the pump, prime it by pouring oil into the outlet and turning the shaft by hand. This ensures that oil is being pumped as soon as the engine is turned over.

20 Install the pump with its T-pipe onto the crankcase, making sure the pump locates correctly onto the dowels and the pipe is properly inserted into its hole (see

illustrations). Install the pump assembly bolts and tighten them securely (see illustration).

21 Fit a new O-ring onto the pressure relief valve, then install the valve into the pump (see illustration). Install the valve cover over the end of the valve and secure it with its bolt (see illustration).

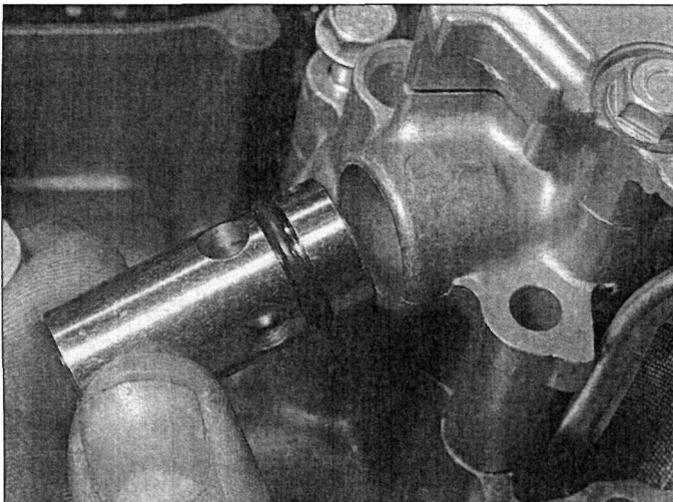
### Pressure check

22 To check the oil pressure, a suitable gauge and adapter piece (which screws into the oil pressure switch thread) will be needed.

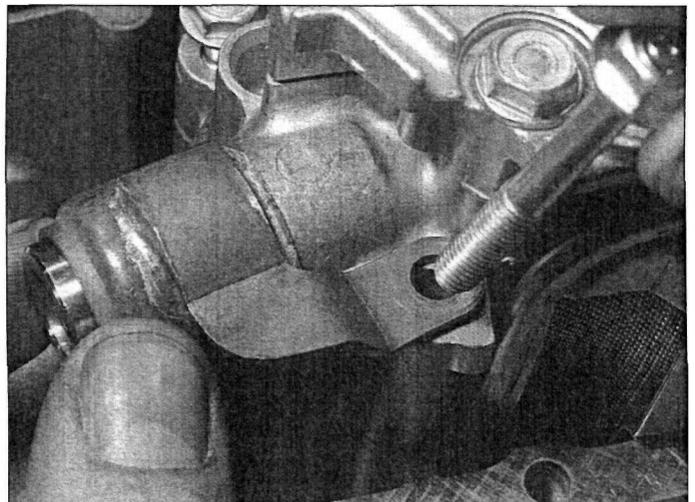
23 Warm the engine up to normal operating temperature then stop it.

24 Unscrew the gearchange linkage arm pinch bolt and remove the linkage arm from the shaft (see illustration 5.16). Note the punch marks on the arm and the shaft which must be aligned on installation.

25 Unscrew the bolts securing the left-hand side crankcase rear cover and remove the cover (see illustration 5.17a). The oil pressure switch is located between the water pump and oil filter. Pull back the rubber boot, then remove the screw securing the wiring connector to the switch (see illustration 5.17c).



23.21 a Install the pressure relief valve with a new O-ring . . .



23.21 b . . . then fit the valve cover

26 Unscrew the switch and swiftly screw the adapter into the crankcase threads. Connect the gauge to the adapter.

27 Start the engine and increase the engine speed to 6000 rpm whilst watching the gauge reading. The oil pressure should be similar to that given in the Specifications at the start of this Chapter.

28 If the pressure is significantly lower than the standard, either the relief valve is stuck open, the oil pump is faulty, the oil pump pick-up strainer is blocked or there is other engine damage. Begin diagnosis by checking the oil pump pick-up strainer and relief valve, then the oil pump. If those items check out okay, chances are the bearing oil clearances are excessive and the engine needs to be overhauled.

29 If the pressure is too high, the relief valve is stuck closed. To check it, see above.

30 Stop the engine and unscrew the gauge and adapter from the crankcase.

31\* Having applied a smear of sealant to its threads, install the oil pressure switch and tighten it securely. Reconnect its wire terminal and fit the dust cover over the switch. Check the oil level (see Chapter 1).

32 Install the crankcase rear cover. Align the punch marks on the gearchange linkage arm and shaft when installing the arm on the shaft (see illustration 5.28), and tighten the pinch bolt to the specified torque setting.

## 24 Transmission shafts - removal and installation



### Mainshaft and countershaft

#### Removal

1 Separate the crankcase halves (Section 21).  
2 Remove the thrust washer, driven gear and its bushing from the end of the output drive shaft (see illustrations). Note how the driven gear locates onto the damper cam on the shaft.

3 Grasp the mainshaft and countershaft and the selector drum and forks as an assembly and withdraw them from the crankcase as a unit, noting their relative positions in the crankcase and how they fit. With the assembly on a bench, separate the mainshaft, countershaft and selector drum and forks, noting how the selector forks engage in the grooves on the gear pinions and the tracks in the selector drum.

4 Note that each selector fork is marked for identification. The left-hand shift fork is marked with an "L", the middle shift fork is marked with a "C", and the right-hand shift fork is marked with an "R", all of which must face the right-hand crankcase. If removed, install the forks back on the shaft in their correct positions as a reminder for installation.

5 Check whether the thrust washer for the countershaft end is on the shaft or in the crankcase (probably lying loose on the bearing). Install the washer onto the left-hand end of the shaft as a reminder for installation. Also check that the thrust washer is in position on the right-hand end of the countershaft.

6 If necessary, the mainshaft and countershaft can be disassembled and inspected for wear or damage as described in Section 25.

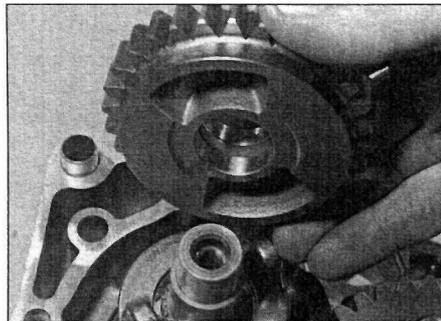
#### Installation

7 Lay the mainshaft and countershaft side by side on the bench so that the pinions for each gear are meshed together. Make sure that the shafts are the correct way round, in which case the smallest pinion on the mainshaft is on the right-hand end and meshes with the second largest pinion on the countershaft, which is the second pinion from the right. Also make sure that the thrust washer is installed on each end of the countershaft. Install the selector forks in position with their identification marks positioned as described in Step 4. Engage the forks in their grooves in the pinions on the shafts.

8 The mainshaft and countershaft and the selector drum and forks must be installed as a complete assembly. To achieve this without the entire assembly falling apart as it is installed, it is advisable to strap the shafts and selector forks together using cable ties (see illustrations).



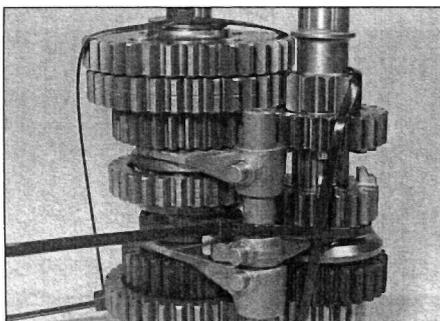
24.2a Remove the thrust washer ...



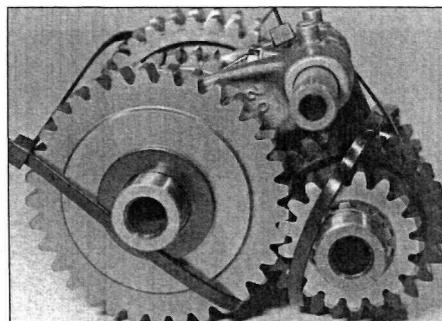
24.2b ... the driven gear ...



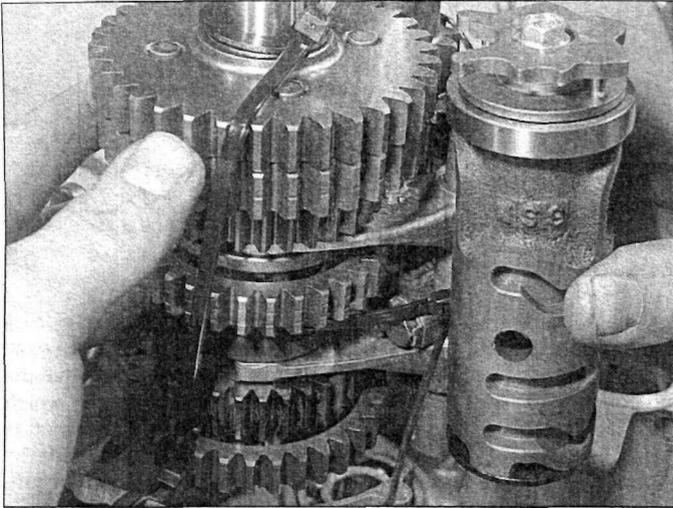
24.2c ... and the bushing from the output drive shaft



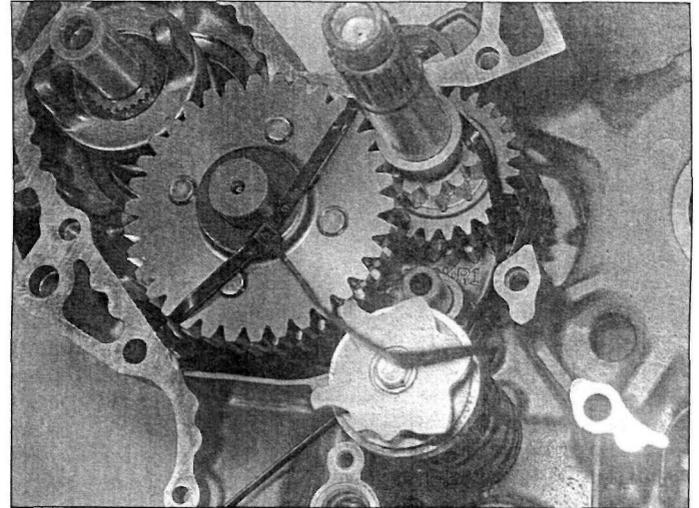
24.8a Transmission shafts and selector forks shown strapped as an assembly with the right-hand end upwards



24.8b Transmission shafts and selector forks shown strapped as an assembly with the left-hand end facing



24.9a Engage the selector drum tracks with the guide pins on the selector forks . . .



24.9b . . . and install the assembly into the crankcase

9 Engage the forks with the selector drum so that their guide pins locate in the selector drum tracks (see illustration). Grasp the mainshaft and countershaft and the selector drum and forks and install them into the left-hand crankcase, making sure that both mainshaft and countershaft ends engage in their bearings and the selector fork shaft end and the selector drum end engage in their holes in the crankcase. If cable ties were used, cut them and slip them out of position.

10 Check that both the mainshaft and countershaft, the selector drum and selector forks all rotate or move freely.

11 Install the driven gear bushing, driven gear pinion and thrust washer on the end of the output drive shaft (see illustrations 24.2c, 24.2b and 24.2a).

12 Reassemble the crankcase halves (see Section 21).

**Output shafts**

**Removal**

13 Separate the crankcase halves and remove the mainshaft, countershaft and selector drum (see Section 21 and Steps 2 to 5 above).

14 Unscrew the three bolts securing the output shaft housing assembly to the left-hand

crankcase, noting the locations of the different length bolts, and remove the assembly (see illustration). Discard the housing O-ring as a new one must be used.

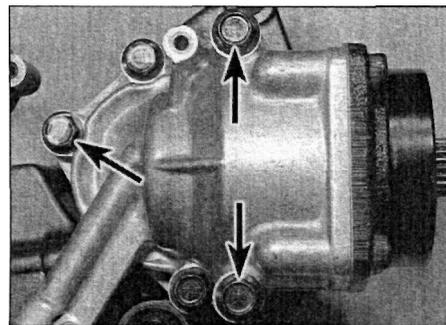
15 Remove the oil orifice from the crankcase or the housing (see illustration). Discard its O-rings as new ones must be used.

**Installation**

16 Make sure the oil orifice is clear, using compressed air to blow through it if available. Fit new O-Rings to the orifice and install it into the output shaft housing.

17 Fit a new O-ring to the output shaft housing assembly (see illustration). Install the housing into the crankcase, making sure the locating pin on the mating surface of the housing fits into its hole in the crankcase (see illustrations). Install the three housing bolts, making sure they are installed in their correct locations (see illustration 24.14), and tighten them to the specified torque setting.

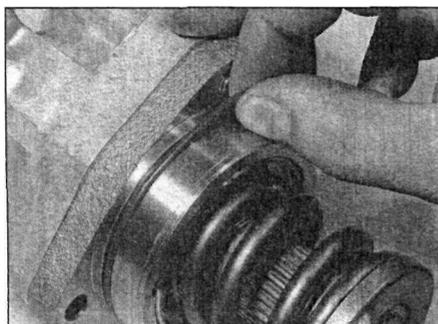
18 Install the mainshaft, countershaft and selector drum assembly, then reassemble the crankcase halves (see Steps 7 to 11 above and Section 21).



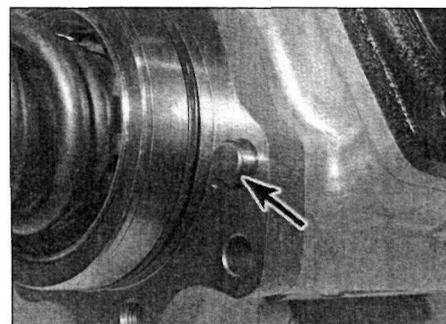
24.14 The output shaft housing assembly is secured to the crankcase by three bolts (arrows)



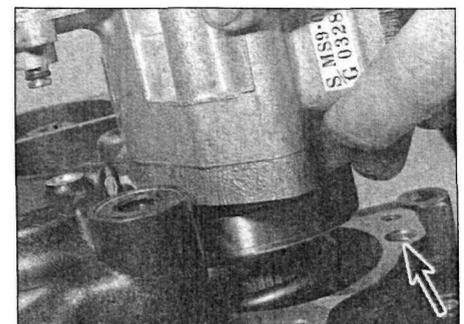
24.15 Remove the oil orifice and replace its O-rings with new ones



24.17a Fit a new O-ring to the housing



24.17b Make sure the locating pin (arrow) . . .



24.17c . . . fits into its hole in the crankcase (arrow)

## 25 Transmission shafts - disassembly, inspection and reassembly



1 Remove the transmission shafts from the left crankcase half (see Section 24). Always disassemble the transmission shafts separately to avoid mixing up the components.

### Mainshaft

#### Disassembly

2 Remove the thrust washer from the left-hand end of the shaft, followed by the 2nd gear pinion (see illustration).

**HAYNES HINT** When disassembling the transmission shafts, place the parts on a long rod or thread a wire through them to keep them in order and facing the proper direction.

3 Remove the circlip from the shaft. Slide the splined washer and the 5th gear pinion off the shaft, followed by the 5th gear splined bush and splined washer.

4 Remove the circlip securing the 3rd gear pinion, then slide the pinion off the shaft.

5 Remove the circlip securing the 4th gear pinion, then slide the splined washer and the pinion off the shaft, followed by the 4th gear bush and the thrust washer.

6 The 1st gear pinion is integral with the shaft.

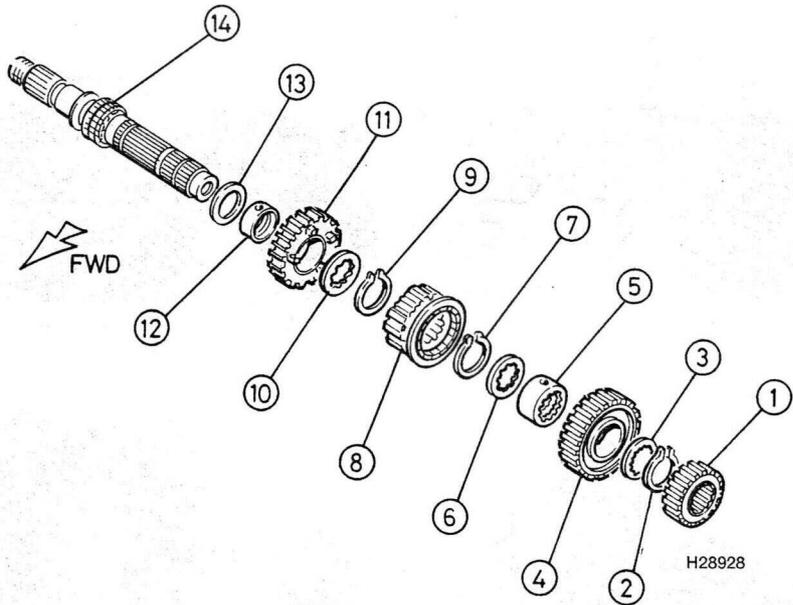
#### Inspection

7 Wash all of the components in clean solvent and dry them off.

8 Check the gear teeth for cracking chipping, pitting and other obvious wear or damage. Any pinion that is damaged as such must be replaced.

9 Inspect the dogs and the dog holes in the gears for cracks, chips, and excessive wear especially in the form of rounded edges. Make sure mating gears engage properly. Replace the paired gears as a set if necessary.

10 Check for signs of scoring or blueing on the pinions, bushes and shaft. This could be caused by overheating due to inadequate



### 25.2 Mainshaft components

- |                         |                   |  |
|-------------------------|-------------------|--|
| 1 2nd gear pinion       | 6 Splined washer  | 11 4th gear pinion                       |
| 2 Circlip               | 7 Circlip         | 12 4th gear bush                         |
| 3 Splined washer        | 8 3rd gear pinion | 13 Thrust washer                         |
| 4 5th gear pinion       | 9 Circlip         | 14 1st gear pinion (integral with shaft) |
| 5 5th gear splined bush | 10 Splined washer |  |

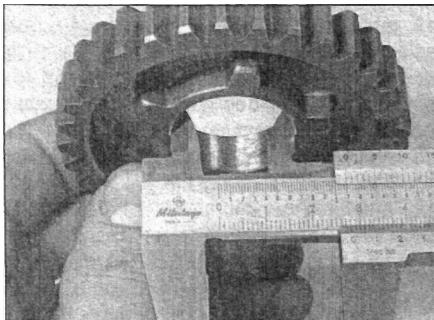
lubrication. Check that all the oil holes and passages are clear. Replace any damaged pinions or bushes.

11 Check that each pinion moves freely on the shaft or bush but without undue freeplay. Check that each bush moves freely on the shaft but without undue freeplay. Measure the internal diameter of all gears which run on bushes and the external diameter of the bushes which they run on (see illustrations). If either component has worn to beyond its service limit it must be replaced. Using the above measurements calculate the gear-to-bush clearance and compare the results to the specifications listed at the beginning of the Chapter. If the clearance exceeds the specified limit replace the relevant gear and bush as a pair. Also measure the internal diameters of the bushes and their

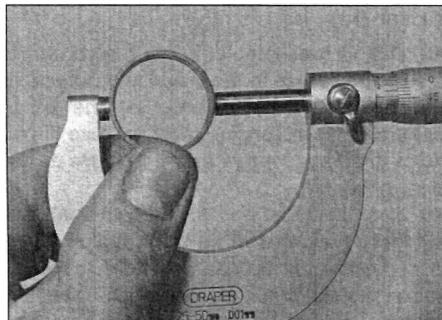
corresponding shaft external diameter, and calculate the shaft-to-bush clearance.

12 The shaft is unlikely to sustain damage unless the engine has seized, placing an unusually high loading on the transmission, or the machine has covered a very high mileage. Check the surface of the shaft, especially where a pinion turns on it, and replace the shaft if it has scored or picked up, or if there are any cracks. Place the shaft on V-blocks and check the runout at the shaft centre using a dial gauge. Damage of any kind can only be cured by replacement.

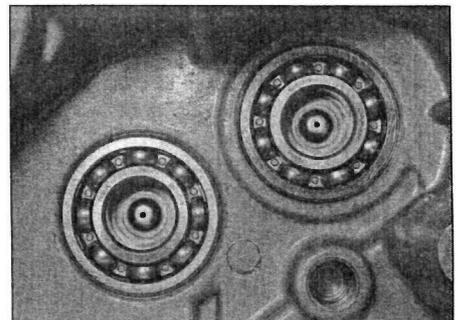
13 Check the bearings for play or roughness, and that they are a tight fit in the crankcase (see illustration). Replace any bearing that is worn. To remove the bearings, heat the crankcase half to loosen their fit in the casing. If all other components have been removed



25.11a Measure the internal diameter of the gear . . .



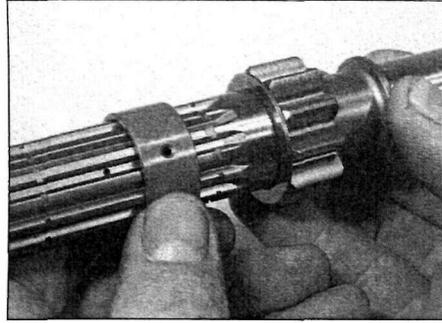
25.11b . . . and the external diameter of its bush



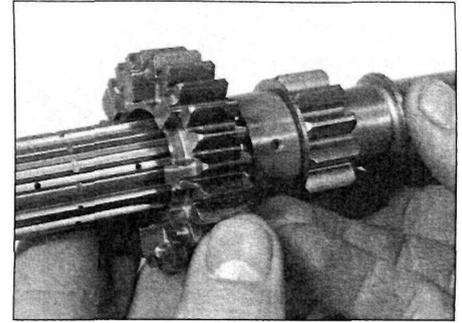
25.13 Check the transmission shaft bearings in the crankcase



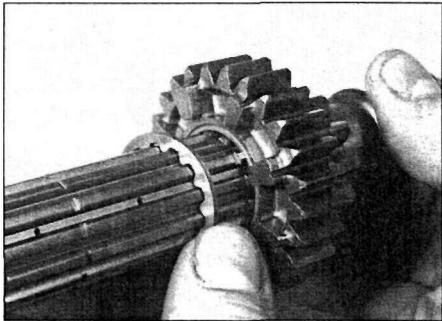
25.16a Install the thrust washer ...



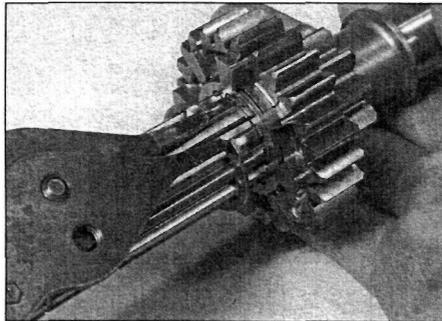
25.16b ... followed by the 4th gear bush ...



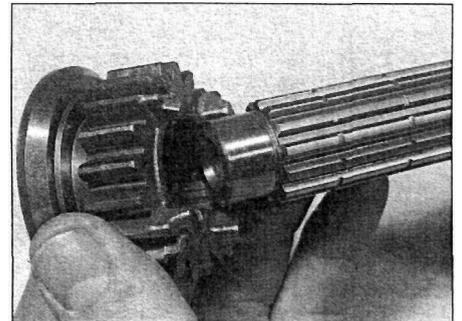
25.16c ... and the 4th gear pinion



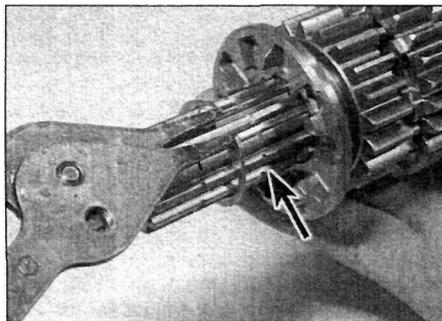
25.16d Install the splined washer ...



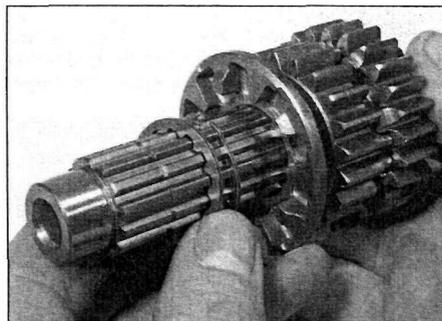
25.16e ... followed by the circlip



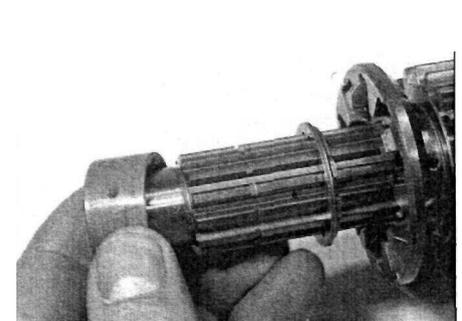
25.17a Install the 3rd gear pinion .



25.17b ... and the circlip, making sure it locates in its groove (arrow)



25.18a Install the splined washer .



25.18b ... followed by the 5th gear splined bush ...

from the casing, the best way to do this is to immerse the casing in boiling water for a few minutes (taking care not to scald your hands), then tap the casing face down on a wooden work surface - this should jar them free. If stubborn, the bearings in the right-hand half can be drifted from position, although be careful to support the area of casing around the bearing housing. The bearings in the left-hand half are fitted into blind holes, necessitating a knife-edged bearing puller with slide-hammer attachment to remove them. Note that the set plate behind each of the bearings in the left-hand half must be replaced with a new one on installation. Install all bearings using a hammer and drift (such as a socket) which only bears on the outer race of the bearing. Apply clean engine oil to the bearings.

14 Check the circlips and thrust washers and replace any that are bent or appear weakened or worn. It is a good idea to use new circlips as a matter of course.

#### Reassembly

15 During reassembly, apply molybdenum disulphide grease to the inside and outside of the bushes, and lubricate all the other components with engine oil. Make sure the oil holes in the shaft are aligned with those on the bush or pinion.

16 Slide the thrust washer, 4th gear bush and 4th gear pinion, with its dogs facing away from the integral 1st gear, onto the left-hand end of the shaft (see illustrations). Install the splined washer and circlip, making sure that the circlip locates in the groove in the shaft (see illustrations).

17 Install the 3rd gear pinion onto the shaft with its selector fork groove facing away from the 4th gear pinion and secure it in place with the circlip, making sure it locates properly in its groove (see illustrations).

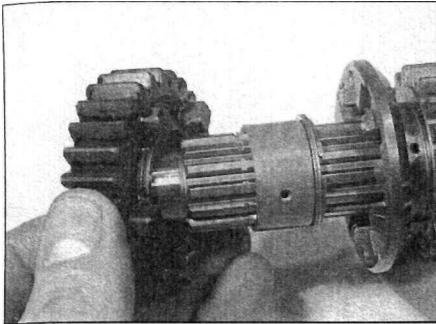
18 Install the splined washer, the 5th gear splined bushing, the 5th gear pinion, with its dogs facing the 3rd gear pinion, and the splined washer, then secure them in place with the circlip, making sure that the circlip locates in the groove in the shaft (see illustrations).

19 Install the 2nd gear pinion (see illustrations).

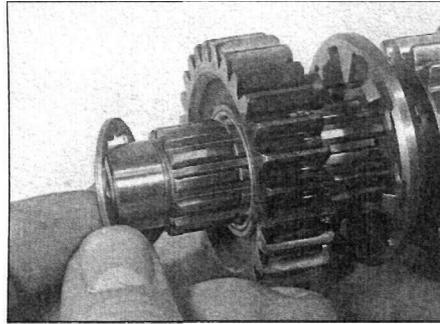
#### Countershaft

##### Disassembly

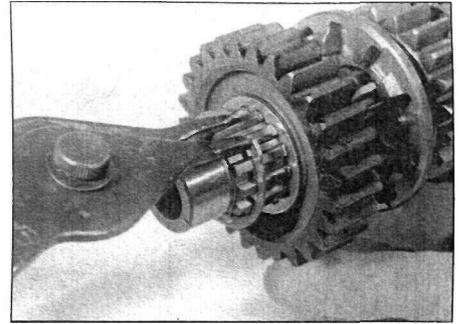
20 Remove the thrust washer from the left-hand end of the shaft, then slide the 2nd gear



25.18c ... the 5th gear pinion ...



25.18d ... the splined washer ...



25.18e ... and the circlip

pinion, the 2nd gear bushing, the thrust washer and the 5th gear pinion off the shaft (see illustration).

21 Remove the thrust washer from the right-hand end of the shaft, then slide the output drive gear, the 1st gear pinion, the 1st gear splined bushing and the splined washer off the shaft.

22 Remove the circlip securing the 4th gear pinion, then slide the pinion off the shaft.

23 Remove the circlip securing the 3rd gear pinion, then slide the splined washer, the 3rd gear bush, the 3rd gear pinion and the thrust washer off the shaft.

### Inspection

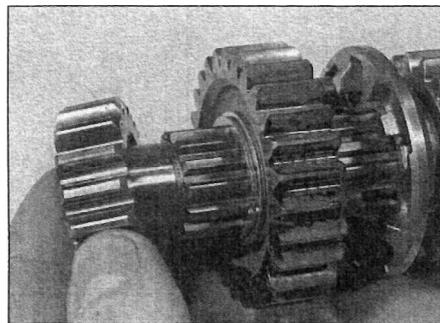
24 Wash all of the components in clean solvent and dry them off.

25 Check the gear teeth for cracking chipping, pitting and other obvious wear or damage. Check that the rivets in the output drive gear are tight and secure. Any pinion that is damaged as such must be replaced.

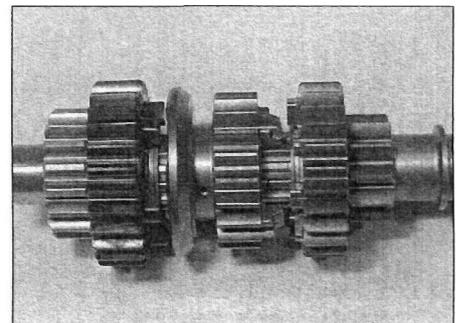
26 Inspect the dogs and the dog holes in the gears for cracks, chips, and excessive wear especially in the form of rounded edges. Make sure mating gears engage properly. Replace the paired gears as a set if necessary.

27 Check for signs of scoring or bluing on the pinions, bushes and shaft. This could be caused by overheating due to inadequate lubrication. Check that all the oil holes and passages are clear. Replace any damaged pinions or bushes.

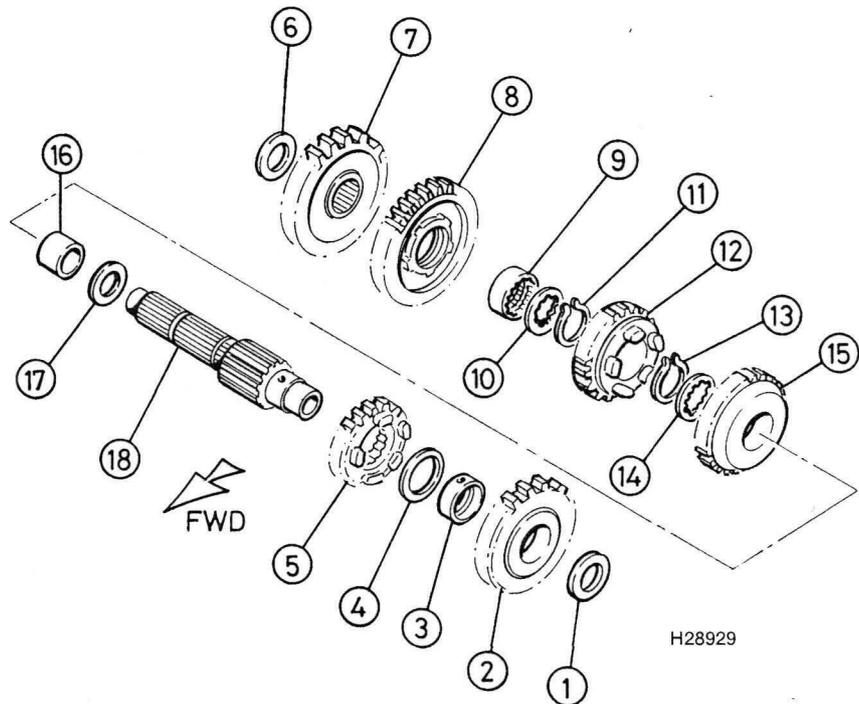
28 Check that each pinion moves freely on the shaft or bush but without undue freeplay. Check that each bush moves freely on the shaft but without undue freeplay. Measure the internal diameter of all gears which run on bushes and the external diameter of the bushes which they run on (see illustrations 25.11a and 25.11b). If either component has worn to beyond its service limit it must be replaced. Using the above measurements calculate the gear-to-bushing clearance and compare the results to the specifications listed at the beginning of the Chapter. If the clearance exceeds the specified limit replace the relevant gear and bushing as a pair. Also measure the internal diameters of the bushes and their corresponding shaft external diameter, and calculate the shaft-to-bushing clearance.



25.19a Install the 2nd gear pinion



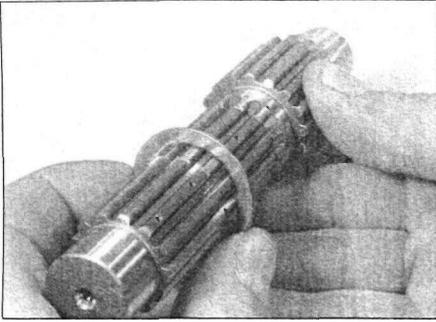
25.19b The assembled mainshaft should look like this



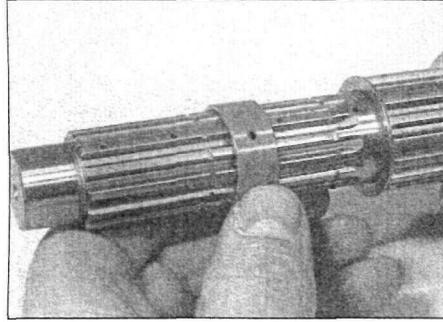
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### 25.20 Countershaft components

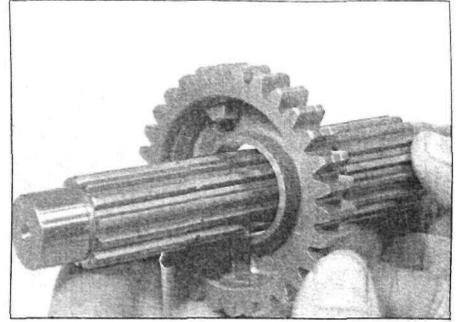
- |                   |                         |                    |
|-------------------|-------------------------|--------------------|
| 1 Thrust washer   | 7 Output drive gear     | 13 Circlip         |
| 2 2nd gear pinion | 8 1st gear pinion       | 14 Splined washer  |
| 3 2nd gear bush   | 9 1st gear splined bush | 15 3rd gear pinion |
| 4 Thrust washer   | 10 Splined washer       | 16 3rd gear bush   |
| 5 5th gear pinion | 11 Circlip              | 17 Thrust washer   |
| 6 Thrust washer   | 12 4th gear pinion      | 18 Countershaft    |



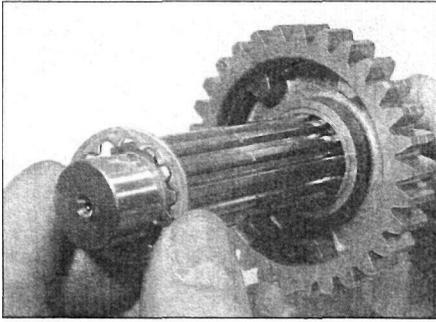
25.33a Install the thrust washer . . .



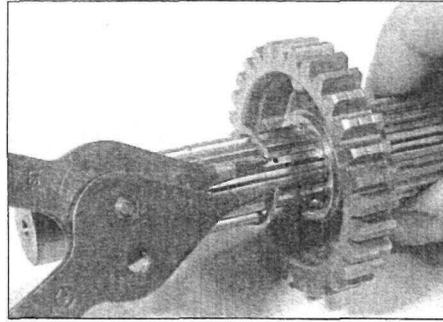
25.33b . . . then the 3rd gear bush .



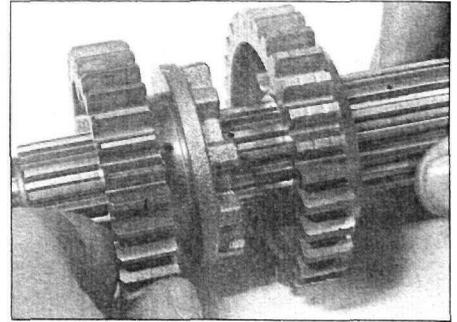
25.33c . . . the 3rd gear pinion .



25.33d . . . the splined washer . . .



25.33e . . . and the circlip



25.34a Install the 4th gear pinion . . .

**29** The shaft is unlikely to sustain damage unless the engine has seized, placing an unusually high loading on the transmission, or the machine has covered a very high mileage. Check the surface of the shaft, especially where a pinion turns on it, and replace the shaft if it has scored or picked up, or if there are any cracks. Place the shaft on V-blocks and check the runout at the shaft centre using a dial gauge. Damage of any kind can only be cured by replacement.

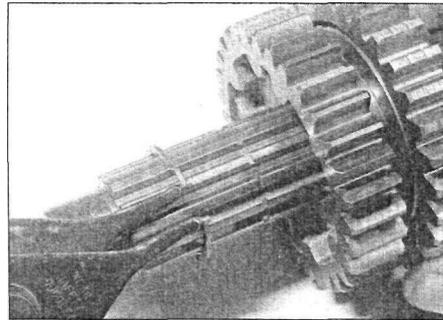
**30** Check the bearings for play or roughness, and that they are a tight fit in the crankcase (see illustration 25.13). Replace any bearing that is worn. To remove the bearings, heat the crankcase half and drift the bearing out using a suitable drift, or by using a bearing remover. Discard the bearing set plate from the left-hand side crankcase and install a new one. install the new bearings using a suitable bearing driver. Apply clean oil to the bearings before installation.

**31** Check the circlips and thrust washers and replace any that are bent or appear weakened or worn. It is a good idea to use new circlips as a matter of course.

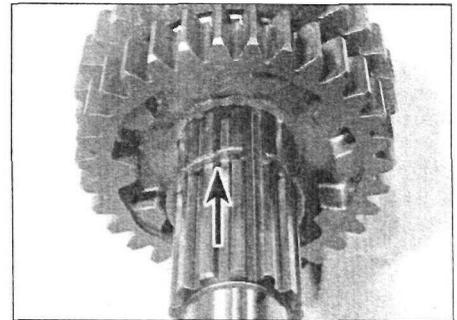
### Reassembly

**32** During reassembly, apply molybdenum disulphide grease inside and outside of the bushes, and lubricate all the other parts with engine oil. Make sure the oil holes in the shaft are aligned with those on the bush or pinion.

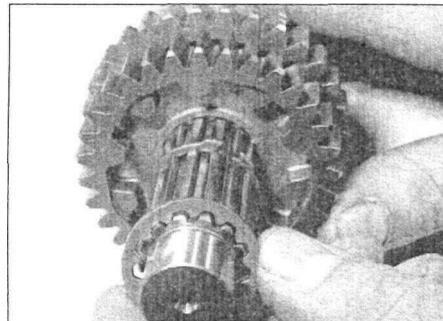
**33** Install the thrust washer onto the narrow end of the shaft, followed by the 3rd gear bush, the 3rd gear pinion, with its dog holes facing out, and the splined washer, and secure them in place with the circlip, making



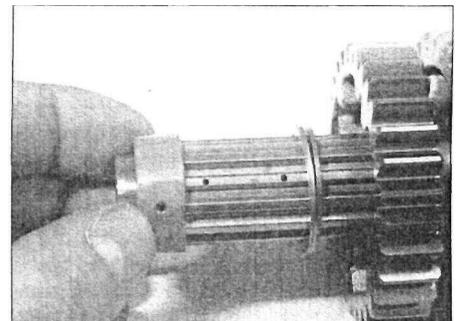
25.34b . . . and the circlip .



25.34c . . . making sure it is correctly seated in its groove (arrow)



25.35a Install the splined washer . . .



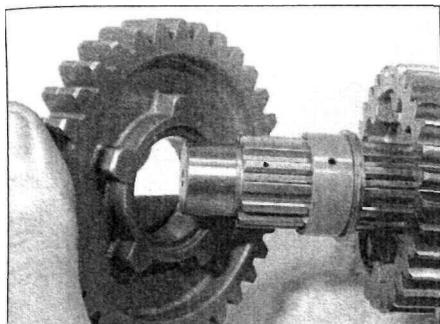
25.35b . . . followed by the 1st gear splined bush . . .

sure it is properly seated in its groove (see illustrations).

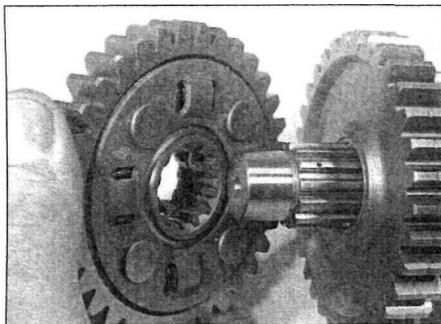
**34** Install the 4th gear pinion onto the shaft with its selector fork groove facing the 3rd gear pinion and secure it in place with the circlip, making sure it is properly seated in its groove (see illustrations).

**35** Install the splined washer, followed by the 1st gear splined bush, the 1st gear pinion, the output drive gear and the thrust washer (see illustrations).

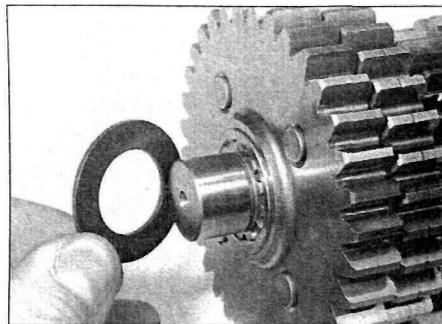
**36** Install the 5th gear pinion onto the wide end of the shaft with its dogs facing away from the 3rd gear pinion, followed by the



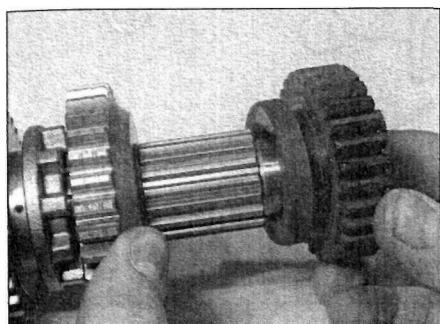
25.35c ... the 1st gear pinion ...



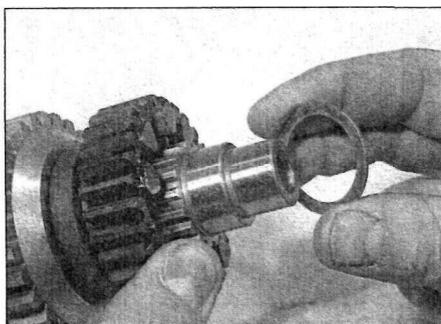
25.35d ... the output drive gear ...



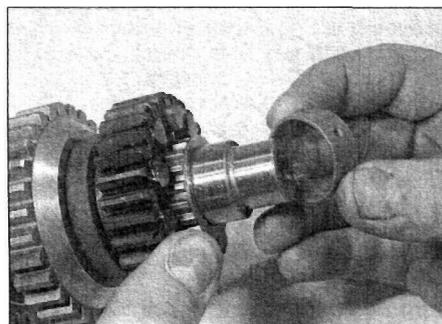
25.35e ... and the thrust washer



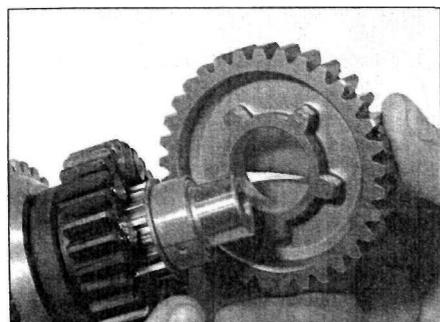
25.36a Install the 5th gear pinion ...



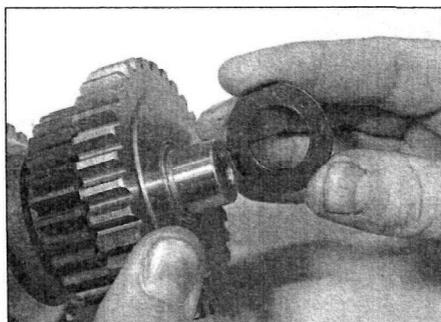
25.36b ... then the thrust washer ...



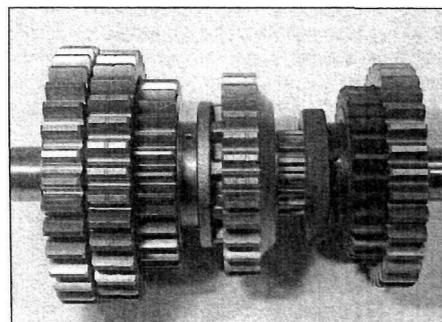
25.36c ... the 2nd gear bush .



25.36d ... the 2nd gear pinion ...



25.36e ... and the thrust washer



25.36f The assembled countershaft should look like this

thrust washer, the 2nd gear bush, the 2nd gear pinion and the thrust washer (see illustrations).

### Output shafts

#### Disassembly

37 During the normal course of events the output shaft assemblies should last throughout the life of the motorcycle without the need for overhaul or component replacement. If the bearings or any other components need to be removed or replaced, the whole housing assembly should be taken to a Honda dealer as specialised equipment and skills are needed to replace the bearings. If either of the bevel gear shafts become worn or damaged, they are only available, and must be replaced, as a matched pair, and again this should be carried out by a Honda dealer.

38 For access to the drive shaft bevel gear and shim, unscrew the two bolts securing the

drive shaft bearing housing to the main housing and remove the bearing housing and shaft as an assembly (see illustration). Discard the bearing housing O-ring as a new one must be used.

39 For access to the driven shaft bevel gear and shim, unscrew the four bolts securing the driven shaft bearing housing to the main housing and remove the bearing housing and shaft as an assembly. Discard the bearing housing O-ring as a new one must be used.

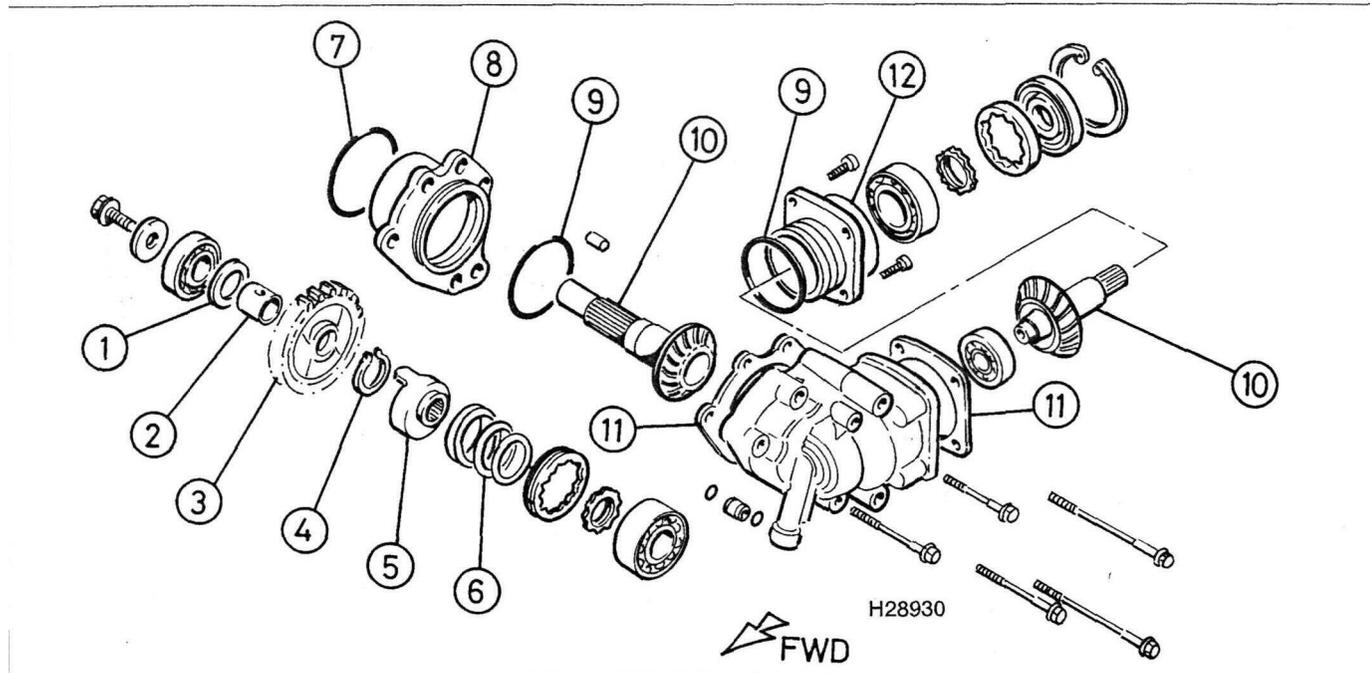
#### Inspection

40 Inspect the drive shaft bevel gear for signs of wear or damage and check that the shaft rotates freely in the bearing housing. If any wear or damage is evident, or if the bearing shows signs of roughness or play, replace the gear and/or bearing as necessary (see Step 37).

41 Inspect the driven shaft bevel gear for signs of wear or damage and check that the

shaft rotates freely in the bearing. If any wear or damage is evident, or if the bearing shows signs of roughness or play, replace the gear and/or bearing as necessary (see Step 37).

42 Check the drive shaft damper assembly for signs of wear or damage. In particular, check the damper spring and the damper cam surfaces. Using a spring compressor (Honda special tool Pt. No. 07964-ME90000 or the commercial equivalent), and using a spacer in between the compressor bolt and the shaft end to avoid damaging the shaft's internal threads, compress the damper spring and remove the circlip from the end of the shaft. Slowly release the compressor, and remove the damper cam and the spring. Measure the spring free length and compare it to the specifications. If the spring is shorter than the service limit, it must be replaced. Install the damper spring with its closer-wound coils facing the housing.



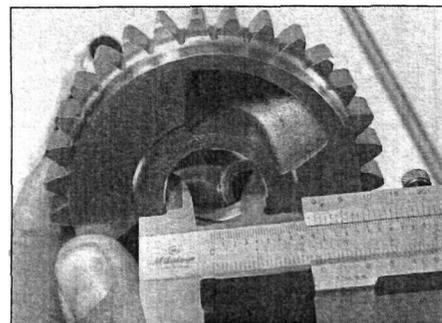
**25.38 Output shaft assembly components**

- |                             |                                      |  |
|-----------------------------|--------------------------------------|--|
| 1 Thrust washer             | 5 Damper cam                         | 9 O-ring                                   |
| 2 Output driven gear bush   | 6 Damper spring                      | 10 Output drive and driven bevel gear pair |
| 3 Output driven gear pinion | 7 O-ring                             | 11 Shim                                    |
| 4 Circlip                   | 8 Output drive shaft bearing housing | 12 Output driven shaft bearing housing     |

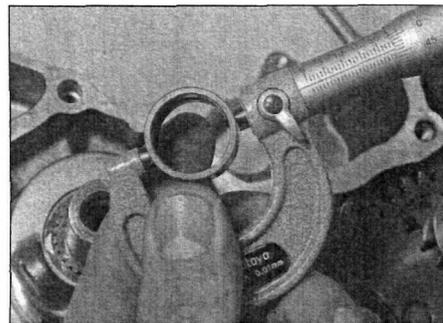
43 Measure the internal diameter of the output driven gear and the external diameter of its bush (see illustrations). If either

component has worn to or beyond its service limit it must be replaced. Using the above measurements calculate the gear-to-bush

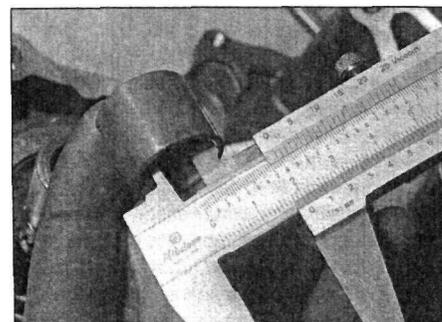
clearance and compare the results to the specifications listed at the beginning of the Chapter. If the clearance exceeds the specified limit replace the relevant gear and bush as a pair. Also measure the internal diameter of the bush and the corresponding shaft external diameter, and calculate the shaft-to-bush clearance (see illustrations).



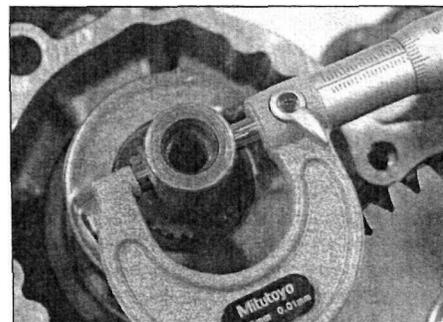
25.43a Measure the internal diameter of the output driven gear . . .



25.43b . . . and the external diameter of its bush



25.43c Measure the internal diameter of the bush . . .



25.43d . . . and the external diameter of the shaft

44 Check the amount of backlash by clamping the housing in a vice equipped with soft jaws, and positioning a dial gauge mounted on a stand adjacent to the drive shaft. A method of securing the driven shaft so that it does not rotate is required. Honda provide a special tool (Pt. No. 07923-6890101) for locking the shaft, or alternatively install the universal joint onto the output driven shaft and engage 5th gear, then fit a suitable spanner onto the flats of the universal joint and secure it against the work surface (see illustration 17.8a).

45 Set up the dial gauge, using the stand to position the gauge end against the shaft. With the driven shaft locked, rotate the drive shaft gently back and forward between the extremes of its free movement. Note the reading on the gauge, then release the driven shaft and rotate the drive shaft through 120° and repeat the process. Repeat once more so that three readings are obtained at three symmetrical points on the shaft.

46 If the amount of backlash measured differs from the standard specified at the beginning of the Chapter, the drive shaft must

be re-shimmed to bring it back within limits. If the difference between the three readings exceeds the specified limit, the bearings have not been installed squarely and must be removed and installed correctly (see Step 37).  
**47** If the amount of backlash exceeds the standard specified, the drive shaft shim must be replaced with a thinner one. If the amount of backlash is less than the standard specified, the drive shaft shim must be replaced with a thicker one. Replacement shims are available in 0.05 mm increments from 0.20 to 0.60 mm. A change of 0.05 mm in the thickness of the shim will result in a change of 0.015 mm in the amount of backlash.

**48** For access to the drive shaft shim, unscrew the two bolts securing the drive shaft bearing housing to the main housing and remove the bearing housing and shaft as an assembly. Install the correct shim(s), then install the bearing housing using the original O-ring and tighten the bolts to the torque setting specified at the beginning of the Chapter. Re-check the backlash.

**49** Check the gear tooth contact pattern using Prussian blue applied to the teeth of the driven shaft bevel gear. For access to the driven shaft bevel gear, unscrew the four bolts securing the driven shaft bearing housing to the main housing and remove the bearing housing and shaft as an assembly. Apply the Prussian blue, then install the bearing housing using the original shim and O-ring and tighten the bolts to the torque setting specified at the beginning of the Chapter. Rotate the drive shaft several turns in the normal direction of rotation, then remove the drive shaft bearing housing (see Step 38) and check the pattern of the Prussian blue that has been transferred from the driven gear to the drive gear.

**50** Contact between the bevel gears is correct if the Prussian blue has been transferred to the middle of each tooth. If the blue is either too high or too low on the teeth, the driven shaft must be re-shimmed to restore the pattern to the correct height.

**51** If the contact pattern is too high, the driven shaft shim must be replaced with a thinner one. If the contact pattern is too low, the driven shaft shim must be replaced with a thicker one. Replacement shims are available in 0.05 mm increments from 0.40 to 0.60 mm.

A change of 0.10 mm in the thickness of the shim will result in a change of 1.5 to 2.0 mm in the height of the contact pattern.

**52** For access to the driven shaft shim, unscrew the four bolts securing the driven shaft bearing housing to the main housing and remove the bearing housing and shaft as an assembly. Install the correct shim(s), then install the bearing housing using the original O-ring and tighten the bolts to the specified torque setting. Re-check the contact pattern. When the contact pattern is correct, re-check the backlash (see Steps 44 to 48).

**Reassembly**

**53** When the amount of backlash and the contact pattern are correct, remove both bearing housings and discard their O-rings. Fit new O-rings to the bearing housings, then install them with their correct shims onto the main housing and tighten their bolts to the specified torque setting.

**26 Selector drum and forks - removal, inspection and installation**



**Note:** Access can be gained to the stopper plate, stopper arm and selector arm with the engine in the frame and the clutch removed (see Section 19). All other operations require the crankcases to be separated.

**Removal**

1 Remove the transmission shafts (see Section 24).

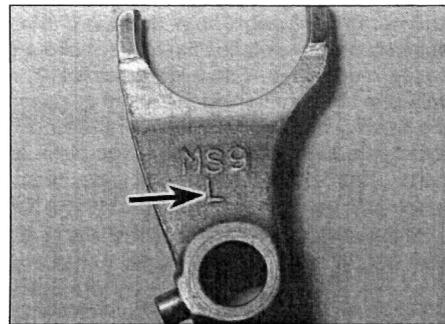
2 Note that each selector fork is marked for identification. The left-hand fork is marked with an "L", the middle fork is marked with a "C", and the right-hand fork is marked with an "R", all of which must face the right-hand crankcase half (see illustration). Remove the outer selector forks from the fork shaft. Bend back the tabs on the centre fork lockwasher, then unscrew the bolt and remove the lockwasher; slide the fork off the shaft, noting how it fits (see illustration).

**Inspection**

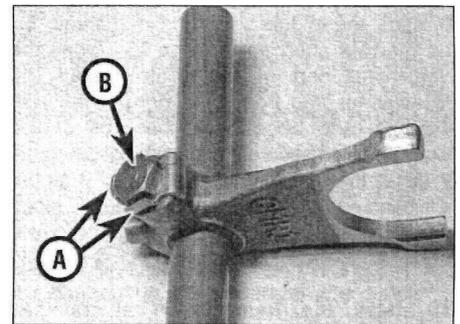
3 Inspect the selector forks for any signs of wear or damage, especially around the fork ends where they engage with the groove in the pinion. Check also that the forks fit correctly in their pinion groove. Measure the thickness of the fork ends and compare the readings to the specifications at the beginning of the Chapter (see illustration). Check closely to see if the forks are bent. If the forks are in any way damaged or worn beyond the service limit, they must be replaced.

4 Check that the forks fit correctly on their shaft. They should move freely with a light fit but no appreciable freeplay. Measure the internal diameter of each fork bore and the diameter of the fork shaft where each fork fits on it (see illustrations). Compare the readings to the specifications, and replace any components that are worn beyond the service limit. Check that the fork shaft holes in the crankcases are not worn or damaged.

5 The selector fork shaft can be checked for trueness by rolling it along a flat surface. A bent shaft will cause difficulty in selecting



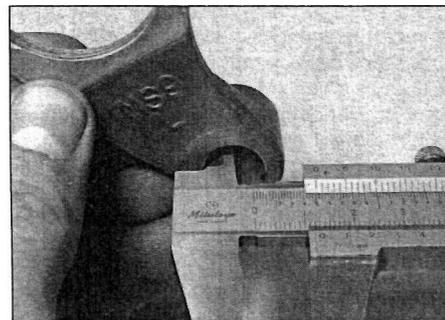
**26.2a** Note the identification letter on the fork (arrow)



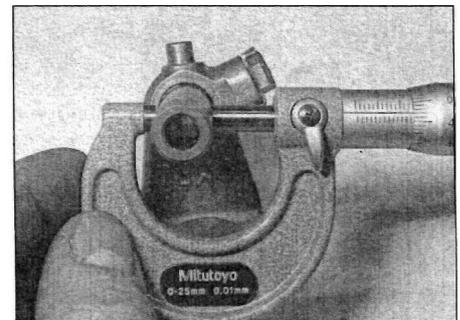
**26.2b** Bend back the lockwasher tabs (A) and remove the bolt (B)



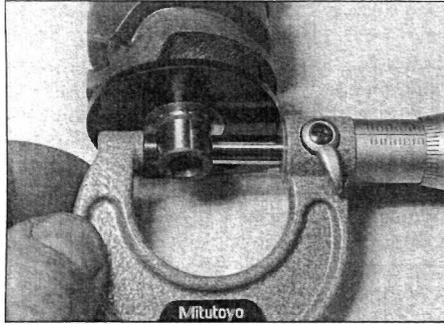
**26.3** Measure the selector fork end thickness



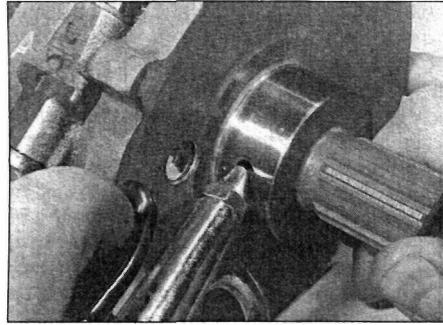
**26.4a** Measure the internal diameter of each fork bore . . .



**26.4b** . . . and the external diameter of its location on the shaft



**26.7 Measure the selector drum journal diameter**



**28.4 Blow through the crank oil passages with compressed air**

gears and make the gearshift action heavy. Replace the shaft if it is bent.

6 Inspect the selector drum grooves and selector fork guide pins for signs of wear or damage. If either component shows signs of wear or damage the gearshift fork(s) and drum must be replaced.

7 Check that the selector drum bearing rotates freely and has no sign of freeplay between its inner and outer race. Replace the bearing if necessary. It is retained by the stopper plate which is secured by a single central screw. Measure the diameter of the journal on the left-hand end of the drum and compare the measurement to the specifications (**see illustration**). If it is worn beyond the service limit, replace the selector drum. Also check the drum journal hole in the crankcase for wear or damage.

### Installation

8 Install the middle selector fork marked "C" on the fork shaft so that the "C" faces the right-hand end of the shaft. Install the lockwasher and bolt, then tighten the bolt securely and bend back the tabs of the lockwasher to secure it in place.

9 Install the selector fork marked "L" onto the left-hand end of the shaft so that the "L" faces right. Install the fork marked "R" onto the right-hand end of the shaft so that the "R" faces right.

10 Install the transmission shafts (see Section 24).

### 27 Main and connecting rod bearings - general information

1 Even though main and connecting rod bearings are generally replaced with new ones 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.

2 Bearing failure occurs mainly because of lack of lubrication, the presence of dirt or other foreign particles, overloading the engine and/or corrosion. Regardless of the cause of bearing failure, it must be corrected before the

engine is reassembled to prevent it from happening again.

3 When examining the connecting rod bearings, remove them from the connecting rods and caps and lay them out on a clean surface in the same general position as their location on the crankshaft journals. This will enable you to match any noted bearing problems with the corresponding crankshaft journal.

4 Dirt and other foreign particles get into the engine in a variety of ways. It may be left in the engine during assembly or it may pass through filters or breathers. 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 operations, especially when parts are not thoroughly cleaned using the proper cleaning methods. Whatever the source, these foreign objects often end up imbedded in the soft bearing material and are easily recognised. Large particles will not imbed 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 reassembly. Frequent and regular oil and filter changes are also recommended.

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

6 Riding habits can have a definite effect on bearing life. Full throttle low speed operation, or labouring the engine, puts very high loads on bearings, which tend 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. Short trip riding leads to corrosion of bearings, as insufficient engine heat is produced to drive off the condensed water and corrosive gases produced. 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.

7 Incorrect bearing installation during engine assembly will lead to bearing failure as well. Tight fitting bearings which leave insufficient bearing oil clearances result in oil starvation. Dirt or foreign particles trapped behind a bearing insert result in high spots on the bearing which lead to failure.

8 To avoid bearing problems, clean all parts thoroughly before reassembly, double check all bearing clearance measurements and lubricate the new bearings with clean engine oil during installation.

### 28 Crankshaft and main bearings - removal, inspection and installation



#### Removal

1 Separate the crankcase halves (refer to Section 21).

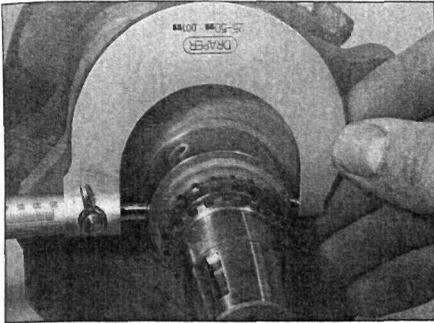
2 Lift the crankshaft out of the left-hand crankcase half. If it appears stuck, tap it gently using a soft-faced mallet.

3 If required, remove the connecting rods from the crankshaft (see Section 29).

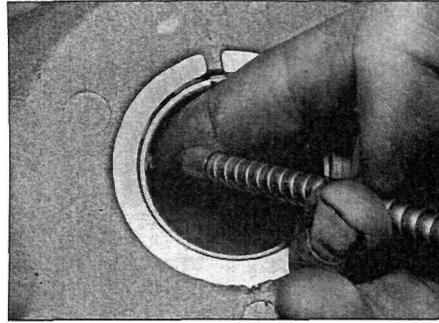
#### Inspection

4 Clean the crankshaft with solvent, using a rifle-cleaning brush to scrub out the oil passages. If available, blow the crank dry with compressed air, and also blow through the oil passages (**see illustration**). Check the cam chain sprockets for wear or damage. If any of the sprocket teeth are excessively worn, chipped or broken, the crankshaft must be replaced.

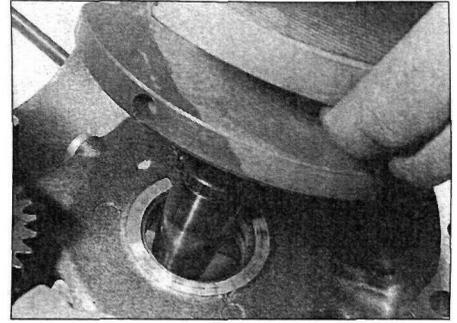
5 Refer to Section 27 and examine the main bearings. If they are scored, badly scuffed or



**28.9 Measure the crankshaft main bearing journal OD**



**28.13a Apply oil to the main bearings . . .**



**28.13b . . . then install the crankshaft**

appear to have been seized, new bearings must be installed. Always replace the main bearings as a set. If they are badly damaged, check the corresponding crankshaft journal. Evidence of extreme heat, such as discoloration, indicates that lubrication failure has occurred. Be sure to thoroughly check the oil pump and pressure relief valve as well as all oil holes and passages before reassembling the engine.

6 The crankshaft journals should be given a close visual examination, paying particular attention where damaged bearings have been discovered. If the journals are scored or pitted in any way a new crankshaft will be required. Note that undersizes are not available, precluding the option of re-grinding the crankshaft.

7 Place the crankshaft on V-blocks and check the runout at the main bearing journals using a dial gauge. Compare the reading to the maximum specified at the beginning of the Chapter. If the runout exceeds the limit, the crankshaft must be replaced.

### **Oil clearance check**

8 Whether new bearing shells are being fitted or the original ones are being re-used, the main bearing oil clearance should be checked prior to reassembly.

9 Using a vernier caliper, measure the diameter of the crankshaft main bearing journals and the corresponding internal diameter of the main bearing (see illustration). Calculate the difference between the two to determine the main bearing oil

clearance and compare the results to the specifications at the beginning of the Chapter. If the oil clearance exceeds the service limit, new main bearings must be selected and installed.

### **Bearing selection**

10 Replacement main bearings are supplied on a selected fit basis. Selection of the bearings requires very accurate measurements to be taken using specialist measuring equipment. As the old bearings will have to be removed and the new ones installed by a Honda dealer using specialist tools, it is advised that bearing selection is also entrusted to the dealer.

### **Bearing replacement**

11 Replacement of the main bearings requires the use of specialist tools, equipment and skills in order to avoid damaging either the crankcase or the new bearings. It is therefore advised that replacement is undertaken by a Honda dealer.

### **Installation**

12 If removed, install the connecting rods onto the crankshaft (see Section 29).

13 Apply clean engine oil to the main bearings, then lower the crankshaft into position in the left-hand crankcase (see illustrations).

14 Reassemble the crankcase halves (see Section 21).

## **29 Connecting rods - removal, inspection and installation**



### **Removal**

1 Remove the crankshaft (see Section 28).

2 Before removing the rods from the crankshaft, measure the side clearance on each rod with a feeler gauge (see illustration). If the clearance on any rod is greater than the service limit listed in this Chapter's Specifications, that rod will have to be replaced with a new one.

3 Using paint or a felt marker pen, mark the relevant cylinder identity on each connecting rod and bearing. Mark across the cap-to-connecting rod join to ensure that the cap is fitted the correct way around on reassembly.

4 Unscrew the big-end cap nuts and separate the connecting rod, cap and both bearing shells from the crankpin (see illustration). Keep the rod, cap, nuts and (if they are to be re-used) the bearing shells together in their correct positions to ensure correct installation.

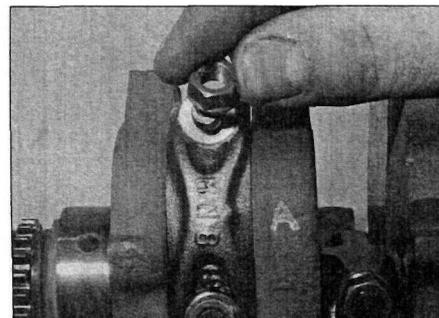
### **Inspection**

5 Check the connecting rods for cracks and other obvious damage.

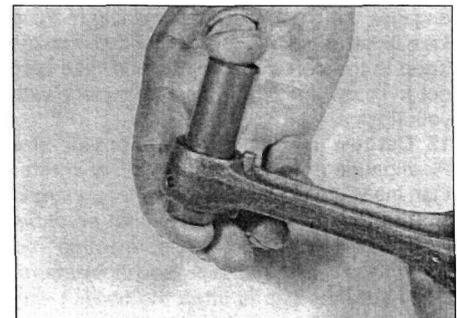
6 If not already done (see Section 15), apply clean engine oil to the piston pin, insert it into the connecting rod small-end and check for any freeplay between the two (see illustration). Measure the pin OD and the



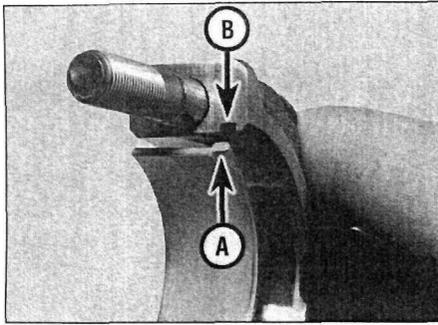
**29.2 Measure the connecting rod side clearance**



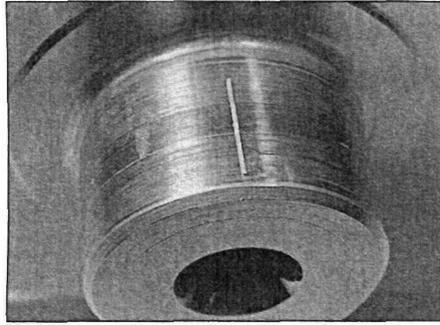
**29.4 Unscrew the connecting rod big-end cap nuts**



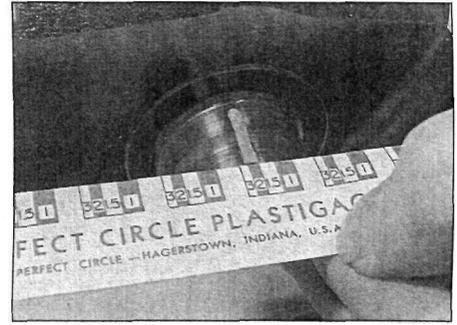
**29.6 Slip the piston pin into the rod's small-end and rock it back and forth to check for looseness**



29.11 Make sure the tab (A) locates in the notch (B)



29.12 Place a strip of Plastigauge on each bearing journal



29.13 Measure the crushed Plastigauge using the scale on the pack to obtain the oil clearance

small-end bore ID and compare the measurements to the specifications at the beginning of the Chapter (see illustrations 15.13b and 15.13d). Calculate the difference between the measurements taken to obtain the piston pin-to-small end clearance and compare the result to the specifications. Replace components that are worn beyond the specified limits.

7 Refer to Section 27 and examine the connecting rod bearing shells. If they are scored, badly scuffed or appear to have seized, new shells must be installed. Always replace the shells in the connecting rods as a set. If they are badly damaged, check the corresponding crankpin. Evidence of extreme heat, such as discoloration, indicates that lubrication failure has occurred. Be sure to thoroughly check the oil pump and pressure relief valve as well as all oil holes and passages before reassembling the engine.

8 Have the rods checked for twist and bend by a Honda dealer if you are in doubt about their straightness.

### Oil clearance check

9 Whether new bearing shells are being fitted or the original ones are being re-used, the connecting rod bearing oil clearance should be checked prior to reassembly.

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

11 Press the bearing shells into their locations, ensuring that the tab on each shell engages the notch in the connecting rod/cap (see illustration). Make sure the bearings are fitted in the correct locations and take care not to touch any shell's bearing surface with your fingers.

12 Cut two lengths of the appropriate size Plastigauge (they should be slightly shorter than the width of the crankpin). Place a strand of Plastigauge on each (cleaned) crankpin journal and fit the (clean) connecting rod assemblies, shells and caps (see illustration). Make sure the cap is fitted the correct way around so the previously made markings align and tighten the bearing cap nuts to the torque setting specified at the beginning of the Chapter whilst ensuring that the connecting

rod does not rotate. Slacken the cap nuts and remove the connecting rod assemblies, again taking great care not to rotate the crankshaft.

13 Compare the width of the crushed Plastigauge on each crankpin to the scale printed on the Plastigauge envelope to obtain the connecting rod bearing oil clearance (see illustration).

14 If the clearance is not within the specified limits, the bearing shells may be the wrong grade (or excessively worn if the original shells are being re-used). Before deciding that different grade shells are needed, make sure that no dirt or oil was trapped between the bearing shells and the connecting rod or cap when the clearance was measured. If the clearance is excessive, even with new shells (of the correct size), the crankpin is worn and the crankshaft should be replaced.

15 On completion carefully scrape away all traces of the Plastigauge material from the crankpin and bearing shells using a fingernail or other object which is unlikely to score the shells.

### Bearing shell selection

16 Replacement bearing shells for the big-end bearings are supplied on a selected fit basis. Codes stamped on the crankshaft and rod are used to identify the correct replacement bearings. The crankpin journal size number is stamped on the crankshaft middle web adjacent to the crankpin and will be either an A or a B (see illustration). The

connecting rod size code is marked on the flat face of the connecting rod and cap and will be either a 1 or a 2.

17 A range of bearing shells is available. Select the correct bearing shells for a particular connecting rod in accordance with the table below. The bearings themselves are identified by a letter and a corresponding colour (see table). The dimensions relating to the particular codes are given in the specifications at the beginning of the Chapter.

Crankpin journal code	Connecting rod code	Replacement bearing code
1	A	C - Brown
1	B	B - Black
2	A	B - Black
2	B	A - Blue

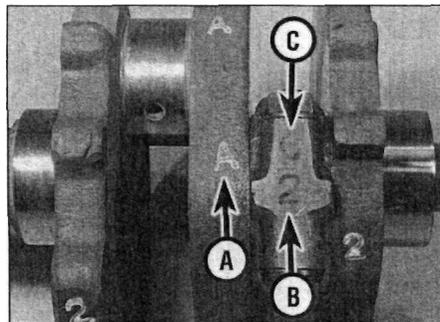
### Connecting rod selection

18 If a connecting rod needs to be replaced, the weight of the replacement rod needs to be matched to the other rod being re-used. If both rods are being replaced, they need to be matched together. The connecting rod weight code is marked on the flat face of the connecting rod and cap and will be either an A, B, C or a D (650 cc engines only) (see illustration 29.16).

19 Select the rod in accordance with the table (see illustration).

### Installation

20 Install the bearing shells in the connecting rods and caps, aligning the notch in the bearing with the groove in the rod or cap (see illustration 29.11). Lubricate the shells with molybdenum disulphide grease and assemble

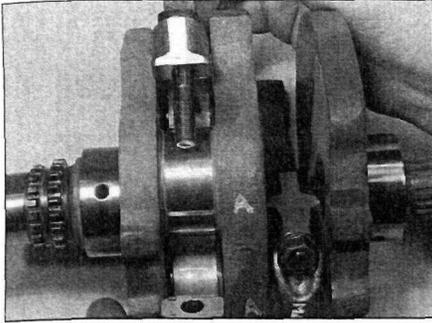


29.16 Crankpin journal size coding (A), connecting rod size coding (B), and connecting rod weight coding (C)

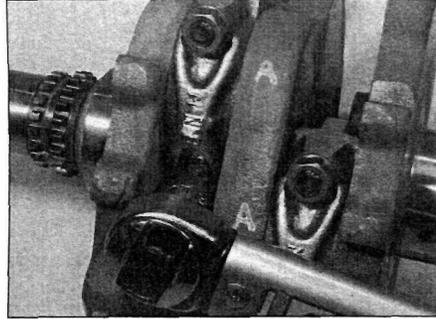
Rear cyl.	Front cyl.			
	A	B	C	D*
A	Yes	Yes	No	No
B	Yes	Yes	Yes	No
C	No	Yes	Yes	Yes
D*	No	No	Yes	Yes

*\*D marking only applies to 650 cc engine*

29.19 Connecting rod weight selection table



**29.20 Install the connecting rods onto the crankshaft**



**29.21 Tighten the connecting rod nuts to the specified torque setting**

the components on the crankpin (**see illustration**). Install the bolts and tighten the nuts finger-tight at this stage. Check to make sure that all components have been returned to their original locations using the marks made on disassembly.

21 The connecting rod nuts must be tightened evenly and in several stages to the torque setting specified at the beginning of the Chapter (**see illustration**).

22 Check that the rods rotate smoothly and freely on the crankpin. If there are any signs of roughness or tightness, remove the rods and re-check the bearing clearance.

23 Install the crankshaft (see Section 28).

### 30 Initial start-up after overhaul

1 Make sure the engine oil and coolant levels are correct (see *Daily (pre-ride) checks*), then remove the spark plugs from the engine. Place the engine kill switch in the OFF position.

2 Turn on the ignition switch and crank the engine over with the starter until the oil pressure indicator light goes off (which indicates that oil pressure exists). Reinstall the spark plugs, connect the plug caps and turn the kill switch to RUN.

3 Make sure there is fuel in the tank, then turn the fuel tap to the ON position and operate the choke.

4 Start the engine and allow it to run at a moderately fast idle until it reaches operating temperature.



**Warning: If the oil pressure light doesn't go off, or it comes on while the engine is running, stop the engine immediately.**

5 Check carefully for oil and coolant leaks and make sure the transmission and controls, especially the brakes, function properly before road testing the machine. Refer to Section 31 for the recommended running-in procedure.

6 Upon completion of the road test, and after the engine has cooled down completely, recheck the valve clearances and check the engine oil and coolant levels (see *Daily (pre-ride) checks*).

### 31 Recommended running-in procedure

1 Treat the machine gently for the first few miles to make sure oil has circulated throughout the engine and any new parts installed have started to seat.

2 Even greater care is necessary if the engine has been rebored or a new crankshaft has been installed. In the case of a rebore, the bike will have to be run in as when new. This means greater use of the transmission and a restraining hand on the throttle until at least 600 miles (1000 km) have been covered. There's no point in keeping to any set speed limit - the main idea is to keep from labouring the engine and to gradually increase performance up to the 600 mile (1000 km) mark. These recommendations can be lessened to an extent when only a new crankshaft is installed. Experience is the best guide, since it's easy to tell when an engine is running freely. The accompanying table of maximum engine speed limitations, which Honda provide for new motorcycles, can be used as a guide.

3 If a lubrication failure is suspected, stop the engine immediately and try to find the cause. If an engine is run without oil, even for a short period of time, severe damage will occur.

Mileage	Max engine speed	Considerations
Up to 600 miles (1000 km)	4000 rpm max	Vary throttle position/speed
600 to 1000 miles (1000 to 1600 km)	6000 rpm max	Vary throttle position/speed. Use full throttle for short bursts
Over 1000 miles (1600 km)	8500 rpm max	Do not exceed tachometer red line