
Section F

The engine

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Description

The 750cc engine is a four cylinder in line unit having a diecast aluminium cylinder head with cast iron valve guides and sintered iron seats. Diecast aluminium is also used for the cylinder block which incorporates removable wet liners. The forged steel crankshaft is mounted on three steel backed main bearings.

Routine maintenance

The engine oil level should be checked weekly and topped up if necessary to keep the oil capacity at 3-13 litres (5-50 pints). It is important that this capacity is kept constant for any appreciable drop in the level will result in poor lubrication and possible engine damage.

To ensure the lubrication system is kept clean and free from impurities the engine oil should be changed and a new oil filter fitted, every 6,000 miles (10,000km).

Engine service operations

The following service operations give detailed instructions for servicing and dismantling all the major engine assemblies. Where it is necessary to remove ancillary components and parts refer to the appropriate sections.

Before reassembly during any operation, all components should be thoroughly cleaned, paying particular attention to joint faces and bearing surfaces. Any local high spot or burrs on the joint faces should be carefully removed with a fine file. Ensure that any piece of gasket or dirt in a blind tapped hole is removed during cleaning, as the bolt may bottom before the bolt head abuts the mating part. When tightening a bolt which bottoms a characteristic springiness may be felt. If this occurs the bolt should be removed and the hole cleaned out.

Operation 1 – Engine removal and installation

The engine should be removed complete with gearbox.

To remove

- 1 Disconnect battery
- 2 Drain cooling system
- 3 Drain engine oil.
- 4 Disconnect alternator lead and remove alternator.
- 5 Disconnect starter motor lead

6 Disconnect temperature gauge sender unit lead at thermostat housing.

7 Disconnect oil pressure indicator lead at cylinder block

8 Disconnect high and low tension leads from coil

9 Remove air cleaner.

10 Disconnect throttle cable at pedal and choke cable at carburettor

11 Disconnect petrol supply pipe at fuel pump and plug to prevent loss of fuel and ingress of dirt

12 Disconnect clutch cable at clutch operating arm.

13 Disconnect heater hose at water pump

14 Disconnect exhaust down pipe at manifold.

15 Remove starter motor.

16 Disconnect speedometer cable at gearbox rear cover.

17 Press in retaining lugs, remove heater and choke knobs from centre console, remove locking nuts and disconnect heater and choke cables

18 Unscrew gear lever knob.

19 Remove two No. 8 screws securing rear of centre console to driveshaft tunnel. Then lift centre console complete with gaiter over gear lever.

20 Remove gear lever.

21 Unscrew six No. 8 self tapping screws and remove engine rear access panel

22 Disconnect heater hose at water valve on heater

23 Disconnect driveshaft from gearbox rear coupling.

24 Remove two $\frac{3}{8}$ UNF self locking nuts and washers, securing engine front mounting rubbers to chassis mounting brackets.

25 Before removing gearbox rear mounting support engine and gearbox assembly by means of a suitable jack from underneath the vehicle or lifting gear through bonnet aperture

26 Remove four $\frac{7}{8}$ UNF set screws and self locking nuts to detach gearbox support bracket from chassis mounting.

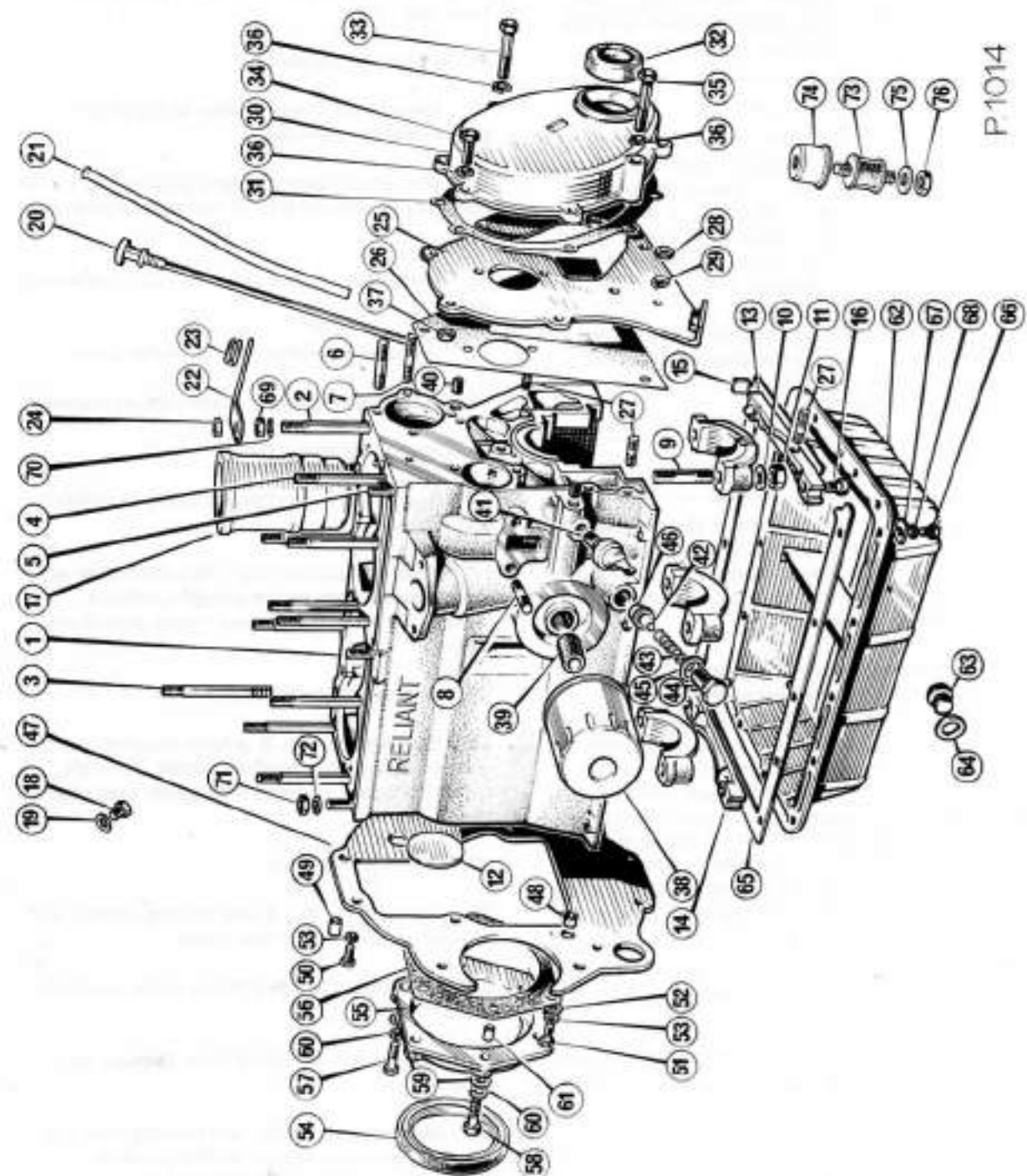


Figure 1 Engine exterior

27 Pull engine and gearbox assembly slightly forward, lift to clear engine front mounting brackets and then carefully lower assembly onto a suitable base.

28 Unscrew two $\frac{1}{2}$ UNC bolts and six $\frac{1}{8}$ UNF nuts, complete with lockwashers and separate engine and gearbox assemblies.

29 Remove ancillary components (see appropriate section) and carry out the necessary service operations.

To replace

1 Refit ancillary components.

2 Secure engine and gearbox assemblies together using six $\frac{1}{2}$ UNF nuts, two $\frac{1}{2}$ UNF bolts and lockwashers.

3 Support the engine and gearbox with lifting gear or a suitable jack and offer up to the vehicle chassis.

4 Carefully raise the assembly and locate engine mounting rubbers in front chassis mounting brackets.

5 Raise the gearbox and position gearbox support bracket in line with its chassis mounting, and secure with four $\frac{1}{2}$ UNF set screws and self locking nuts.

6 Reconnect drive shaft to gearbox rear coupling with four $\frac{1}{2}$ UNF bolts, nuts and lockwashers.

7 Secure engine front mounting rubbers to chassis with two $\frac{1}{2}$ UNF self locking nuts and washers.

Note: Ensure mounting rubber restrictor cups are correctly fitted if removed when dismantling engine.

8 Reconnect heater hose to heater water valve.

9 Fit engine rear access panel to bulkhead with six No. 8 self tapping screws.

10 Locate gear lever in gearbox top cover and secure in position with cap and retaining clip.

11 Lower centre console, including rubber gaiter over gear lever, and fit to driveshaft tunnel with two No. 8 screws.

12 Replace gear lever knob and check that the rubber gaiter is correctly seated.

13 Fit locking nuts and press choke and heater knobs onto control cables on centre console.

14 Reconnect speedometer cable at gearbox rear cover.

15 Refit starter motor to gearbox casing.

16 Reconnect exhaust downpipe to manifold.

17 Reconnect heater hose at water pump.

18 Reconnect clutch cable at clutch operating arm.

Figure 1 Cylinder block

1. Crankcase base	17. Stud plate to block	64. Lockwasher, plate to block
2. Stud, cylinder head	18. Nut, plate to block	65. Oil seal, crankshaft end
3. Stud, cylinder head	19. Lockwasher, plate to block	66. Hour cover, oil seal nut
4. Stud, cylinder head	20. Cover, timing chain	67. Gasket, rear cover
5. Stud, cylinder head	21. Gasket cover	68. Set screw, cover timing
6. Stud, water pump	22. Oil seal, cover	69. Set screw, cover timing
7. Stud, alternator drive	23. Bolt, cover	70. Washer, cover timing
8. Stud, fuel pump	24. Bolt, cover	71. Lockwasher, cover timing
9. Stud, main bearing housing cap	25. Bolt, main	72. Dowel, crankshaft cover
10. Washer, main bearing housing cap	26. Lockwasher, cover	73. Pump
11. Nut, main bearing housing cap	27. Nut, cover	74. Plug, pump drain
12. Core plug, crankshaft	28. Oil filter	75. Washer, plug
13. Bridge piece, crank liner	29. Adapter, oil filter	76. Casket, pump
14. Bridge piece, block head	30. Plug, oilway end	77. Set screw, pump to block
15. Flange, bridge piece	31. Switch, oil pressure	78. Washer, pump to block
16. Screw, bridge piece	32. Plunger, oil pressure release	79. Lockwasher, pump to block
17. Cylinder head	33. Spring, oil pressure release	80. Nut, cylinder head
18. Plug, water drain	34. Retainer, oil pressure release	81. Washer, cylinder head
19. Washer, plug	35. Washer, oil pressure release	82. Nut, cylinder head
20. Dipstick	36. Insert, oil pressure release	83. Lockwasher, cylinder head
21. Tube, dipstick	37. Mounting plate, rear	84. Nut, dipstick tube
	38. Dipstick	85. Cap, main bearing housing

- 19 Remove plug and connect petrol supply pipe at fuel pump.
- 20 Reconnect choke cable at carburettor and throttle cable at pedal.
- 21 Refit air cleaner.
- 22 Reconnect coil high and low tension leads.
- 23 Reconnect oil pressure indicator lead at cylinder block.
- 24 Reconnect temperature gauge sender unit lead at thermostat housing.
- 25 Reconnect starter motor lead.
- 26 Refit alternator and connect leads.
- 27 Refill engine and gearbox with recommended oil.
- 28 Refill the cooling system.
- 29 Reconnect battery.

Operation 2 – Flywheel and ring gear removal and replacement

- 1 Remove gearbox (see Section G – The Gearbox).
- 2 Unscrew six set screws, complete with lockwashers, and remove clutch assembly from the flywheel.
- 3 Release tab washer, unscrew three set screws and remove flywheel assembly from the crankshaft.
- 4 Drill or cut ring gear and prise from flywheel.
- 5 Heat new ring gear evenly and fit to flywheel.
- 6 Using a 0.038mm (0.0015in) feeler gauge check that no clearance exists between ring gear and flywheel over the complete circumference.
- 7 Check the flywheel needle bearing for wear. If wear is evident knock out bearing and fit a new one using tool No. RT7485 (see Figure 2).
- 8 Secure flywheel assembly to crankshaft with three $\frac{3}{8}$ UNF set screws, and tab washer, tightening to a torque of 4.03kg m (29lb ft). The tabs of the washer should then be bent over to lock the set screws.
- 9 Check flywheel for misalignment using a clock indicator. A 0.06–0.13mm (0.003–0.005in)

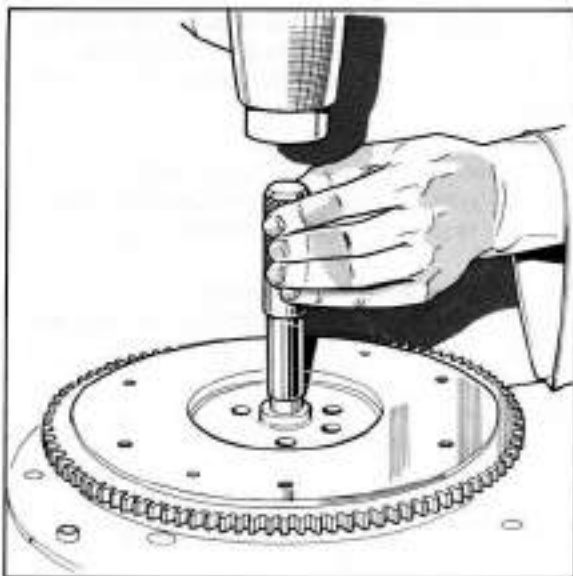


Figure 2 Fitting flywheel bearing

run-out is permitted, but if this is exceeded the flywheel must be replaced with a new assembly.

10 Using tool No. RT7485 as a centraliser, or primary gear from a gearbox, replace clutch disc and pressure plate assembly on the flywheel securing evenly with six $\frac{5}{16}$ UNF set screws and lockwashers to a torque of 1.66–2.07kg m (12–15lb ft) (see Figure 3).

- 11 Refit gearbox.

Operation 3 – Sump removal and replacement

- 1 Drain engine oil.
- 2 Unscrew fifteen $\frac{1}{2}$ UNC set screws and remove spacers, lockwashers, sump and gasket.

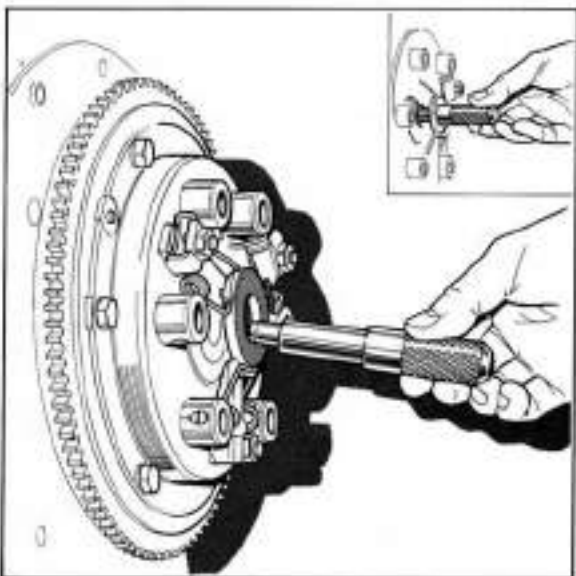


Figure 3 Centralising clutch

- 3 Clean the sump and its seating on the cylinder block face.
- 4 To eliminate possible oil leakage the two centre front and rear fixing screw threads should

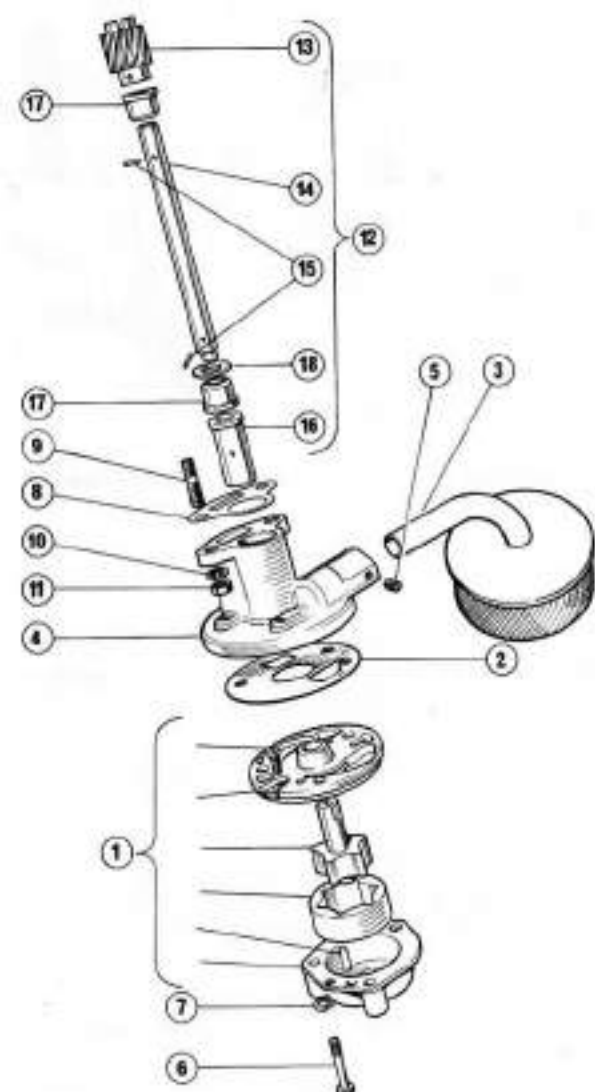


Figure 4 Oil Pump

- 1 Oil pump
- 2 Gasket, oil pump
- 3 Filter, sump oil
- 4 Extension, oil pump
- 5 Socket set screw
- 6 Bolt, extension to pump
- 7 Lockwasher, extension to pump
- 8 Gasket, extension to block
- 9 Stud, extension
- 10 Lockwasher, extension to block
- 11 Nut, extension to block
- 12 Oil pump driving shaft
- 13 Gear
- 14 Shaft
- 15 Pin thrust muff and gear
- 16 Thrust muff
- 17 Bush shaft
- 18 Shim, bush to block

be thoroughly cleaned with petrol and coated with Hylomar sealant before refitting.

- 5 Fit new gasket, replace sump and tighten the fifteen set screws, spacers and lockwashers evenly.

Operation 4 – Oil pump removal and replacement (with sump removed)

- 1 Rotate engine until on TDC (see page 3 Section T).
- 2 Remove distributor.
- 3 Unscrew two $\frac{1}{8}$ UNF nuts, complete with lockwashers and remove oil pump assembly, including filter, from the cylinder block (see Figure 4).
- 4 Drift out the pin securing thrust muff to distributor/oil pump drive shaft which can then be withdrawn upwards through the distributor housing.
- 5 Inspect oil pump and drive shaft assemblies and renew if necessary.

Note: In production it has sometimes been necessary to fit one or two 0.127mm (0.005in) shims between the oil pump drive shaft bush and the cylinder block (see Figure 5).

It is not necessary, when dismantling the oil pump, to remove the drive bush or shim, if fitted. However, if the bush and shim are removed, it is important that they are both replaced when reassembling the pump.

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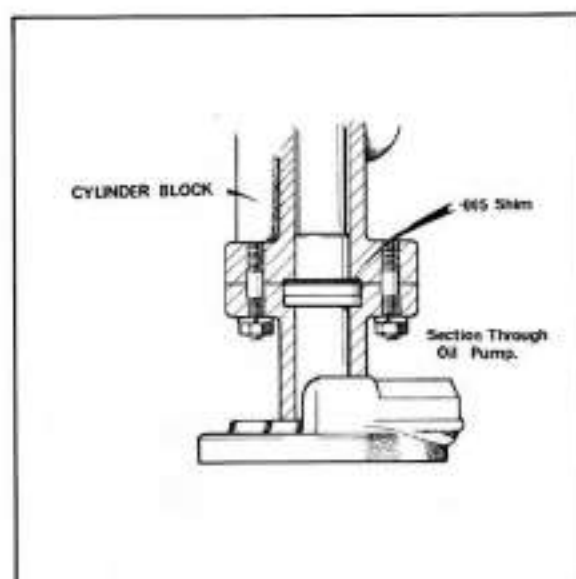


Figure 5 Oil pump drive shaft shim

Failure to replace the shim or shims will cause excessive end float of the distributor drive shaft, resulting in poor meshing of the drive gear and engine noise.

The backlash between camshaft gear and driveshaft gear must not exceed 0.0762mm (0.003in).

6 Reassemble components in reverse order.

7 Ensuring the engine is on TDC refit oil pump and new gasket to cylinder block with two $\frac{1}{8}$ UNF nuts and lockwashers.

Operation 5 – Crankshaft rear cover and oil seal (with flywheel removed)

1 Unscrew six set screws and remove oil seal cover, complete with oil seal and gasket from the cylinder block.

2 Using a suitable tool press the oil seal from the rear cover.

Note: Do not use a screwdriver as this will damage the oil seal seating.

3 Carefully press a new oil seal into the rear cover. To ensure the seal is seated firmly and squarely use a press tool, similar to that shown in Figure 6.

4 Locate the two dowels of the rear cover in the cylinder block and then secure cover with six $\frac{1}{4}$ UNC set screws and lockwashers (see Figure 7).

Operation 6 – Timing chain cover, oil seal and gasket

1 Drain the cooling system.

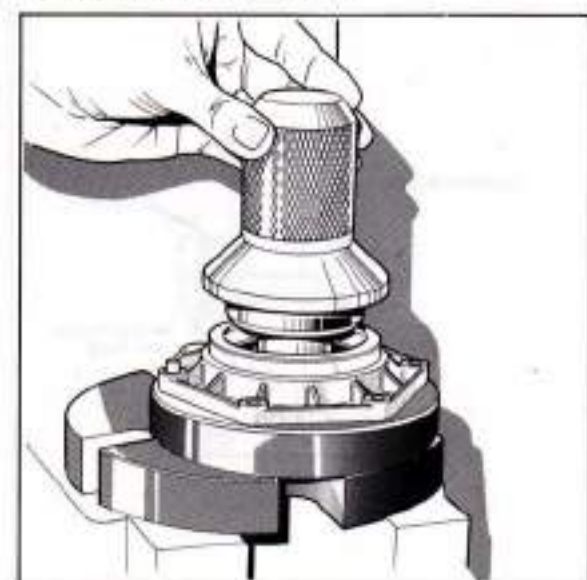


Figure 6 Replacing rear cover oil seal

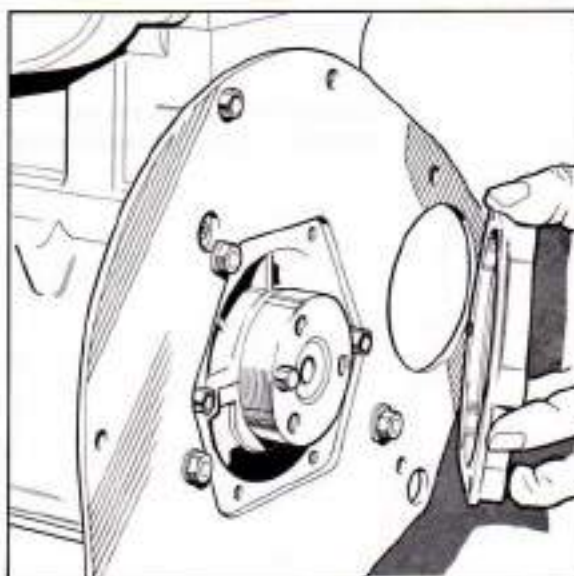


Figure 7 Fitting rear cover

2 Remove the radiator, complete with hoses, from the vehicle.

3 Slacken alternator mountings and remove fan belt.

4 Unscrew four $\frac{1}{8}$ UNF nuts and lockwashers and remove waterpump from cylinder block.

5 Unscrew $\frac{3}{8}$ UNF bolt and withdraw crankshaft pulley.

6 Remove seven $\frac{1}{2}$ UNC bolts and two $\frac{1}{2}$ UNC nuts, complete with lockwashers, and detach timing chain cover from cylinder block.

7 Extract oil seal from cover using Tool No. RT7480 and drive handle Part No. 550 (see Figure 8).



Figure 8 Extracting front cover oil seal

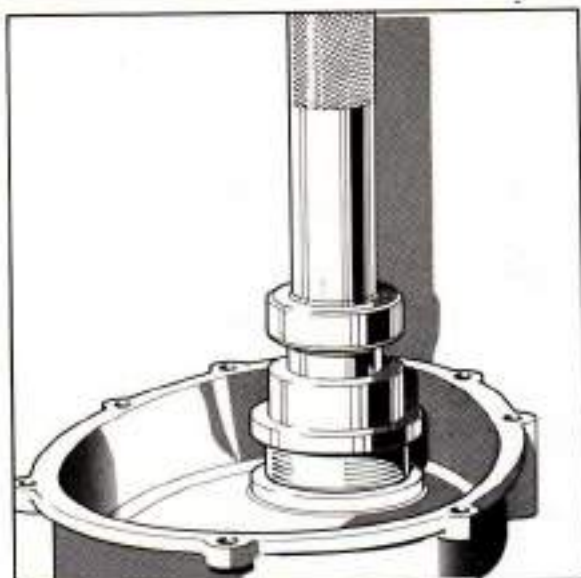


Figure 9 Replacing front cover oil seal

8 Fit new oil seal, using Tool No. RT7480 and drive handle, locating as shown in Figure 9.

9 With the aid of centralising tool Part No. RT7481 fit timing chain cover complete with gasket, to cylinder block, securing with seven $\frac{1}{2}$ UNC bolts, two $\frac{1}{4}$ UNC nuts and lockwashers (see Figure 10).

10 Replace crankshaft pulley, water pump, refit fan belt, and secure alternator.

11 Replace radiator, reconnect hoses and refill the cooling system.

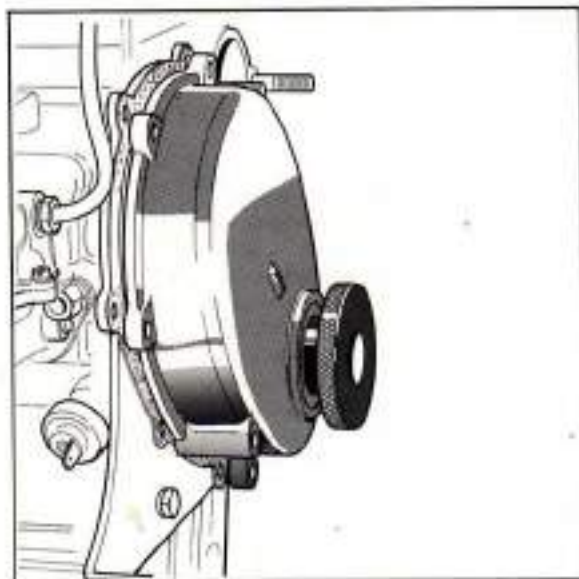


Figure 10 Centralising front cover

Operation 7 – Timing chain (with timing chain cover removed)

1 Release locking plate, unscrew two $\frac{3}{8}$ UNC

bolts, remove camshaft sprocket and lift off timing chain. Retain camshaft sprocket locking plate.

2 Fit new timing chain to crankshaft and camshaft sprocket which can be secured to the camshaft using the locking plate and $\frac{3}{8}$ UNC bolts.

3 Check valve timing, ensuring that the timing mark on the camshaft sprocket aligns with the Woodruff key and on the crankshaft (see Figure 11).

4 Check the timing chain tensioner for wear and replace if necessary.

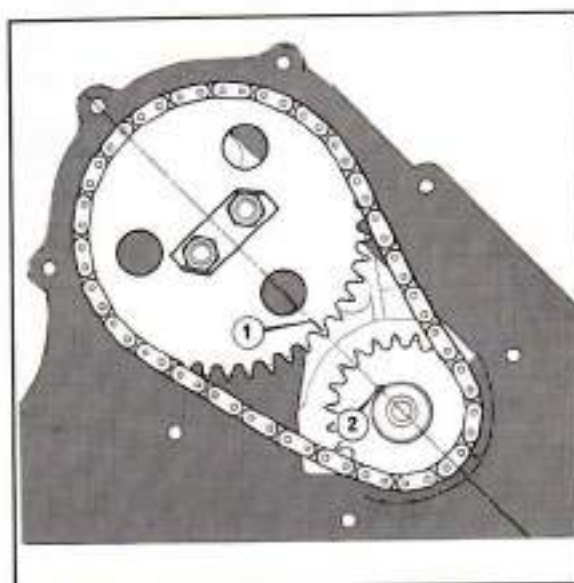


Figure 11 Alignment of camshaft sprocket and Woodruff key

Operation 8 – Camshaft sprocket (timing chain cover and timing chain removed)

1 First ensure the timing mark on the camshaft sprocket aligns with the Woodruff key on the crankshaft to align No. 1 or No. 4 piston on TDC.

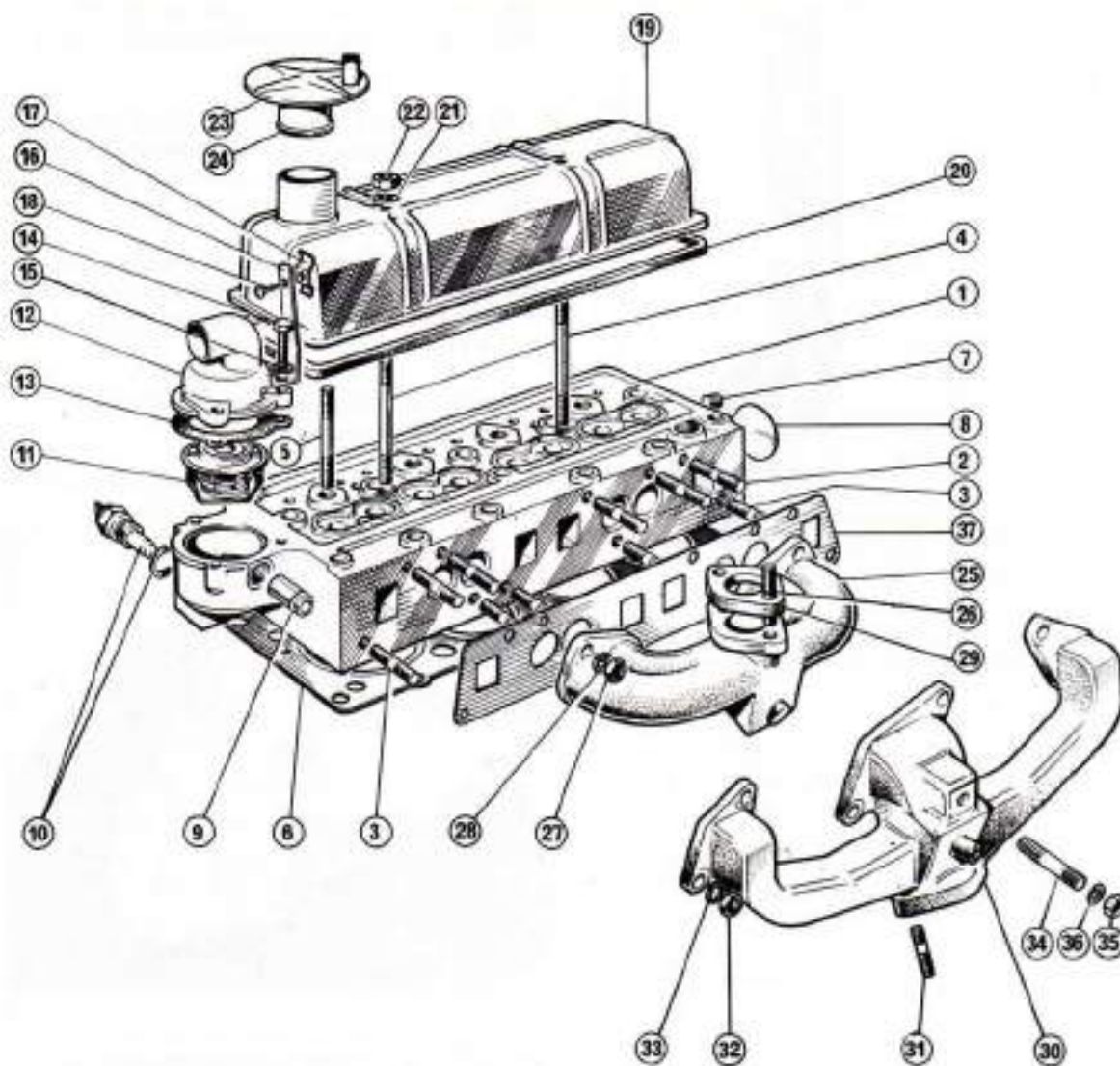
2 Release locking plate, unscrew two $\frac{3}{8}$ UNC bolts and locking plate.

3 Ensure that the timing mark on the camshaft sprocket aligns with the Woodruff key on the crankshaft (see Figure 11).

Operation 9 – Cylinder head removal

1 Disconnect battery.

2 Unscrew two $\frac{3}{8}$ UNF nuts and disconnect exhaust downpipe from manifold.



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Figure 12 Cylinder head

- | | | |
|------------------------------|---------------------------------|---------------------------|
| 1 Cylinder head | 14 Set screw | 27 Nut, manifold |
| 2 Stud, manifold | 15 Lockwasher | 28 Lockwasher, manifold |
| 3 Stud, manifold | 16 Bracket, petrol pipe support | 29 Gasket, manifold |
| 4 Stud, rocker cover | 17 Clip, pipe to bracket | 30 Manifold, exhaust |
| 5 Stud, rocker shaft bracket | 18 Screw, clip to bracket | 31 Stud, exhaust downpipe |
| 6 Gasket, cylinder head | 19 Rocker cover | 32 Nut, manifold |
| 7 Plug, oilway end | 20 Gasket, rocker cover | 33 Lockwasher, manifold |
| 8 Core plug | 21 Washer, cover to head | 34 Stud, manifold |
| 9 Connection, by-pass hose | 22 Nut, cover to head | 35 Nut, manifold |
| 10 Temperature transmitter | 23 Cap, oil filler | 36 Washer, manifold |
| 11 Thermostat | 24 Seal, cap | 37 Gasket, manifold |
| 12 Water outlet branch | 25 Manifold, inlet | |
| 13 Gasket | 26 Stud, carb to manifold | |

- 3 Remove oil filler cap from rocker cover unscrew retaining screw and lift air cleaner body from base plate.
- 4 Disconnect throttle and choke cables at carburettor.
- 5 Unscrew two $\frac{5}{16}$ UNF self locking nuts, complete with fibre washers and remove rocker cover.
- 6 Remove two $\frac{5}{16}$ UNF nuts and lockwashers and lift carburettor from inlet manifold studs.
- 7 Disconnect temperature gauge sender unit lead at thermostat housing.
- 8 Drain radiator and disconnect top hose and by-pass hose from thermostat housing.
- 9 Disconnect heater hose from adaptor at rear of cylinder head.
- 10 Disconnect cool air hose from heater and engine bulkhead.
- 11 Disconnect high and low tension leads at coil.
- 12 Disconnect spark plug leads and remove distributor cap.
- 13 Unscrew $\frac{1}{2}$ UNC bolt, complete with plain washer and lockwasher securing distributor. Do not disturb clamping bolt securing distributor unless the ignition timing is to be adjusted on reassembly.
- 14 Remove twelve $\frac{3}{8}$ UNF and three $\frac{5}{8}$ UNF nuts and washers from cylinder head.
- 15 Withdraw the push rods keeping them in their correct order.
- 16 Carefully lift cylinder head from the cylinder block.
- 17 Replace in reverse order after cleaning the cylinder head and block faces and fitting a new gasket. To ensure a good seal when replacing head, smear grease around the metal edges of the gasket bore eyelets. Tighten the cylinder head nuts to a torque of 3.46kg m (25lb ft) in the sequence shown in Figure 13. The three $\frac{5}{8}$ UNF nuts must be fitted to the spark plug side of the cylinder head and tightened to a torque of 2.07kg m (15lb ft).

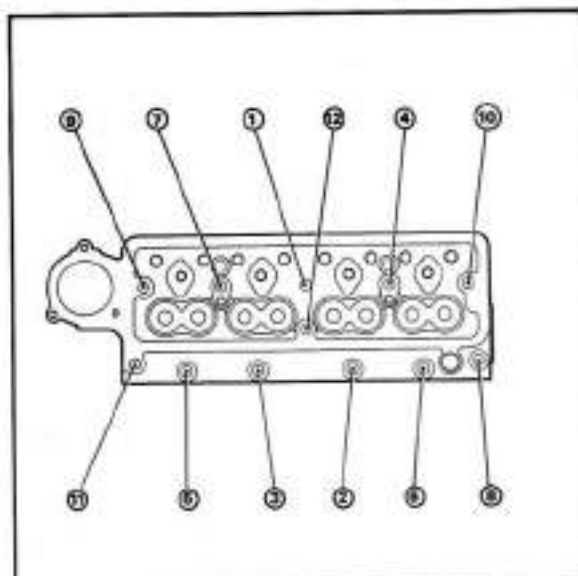


Figure 13 Cylinder head nut tightening sequence

- 2 Remove valves from cylinder head using valve spring compression tool keeping in correct order. Retain valve springs, covers, cups and cotters for inspection.
- 3 If valve guides are worn remove them using Tool No. RT7478 (see Figure 14).
- 4 Use a piece of sharpened wood to break up the carbon deposits on the piston faces of the cylinder head and then polish with wire wool.
- 5 Reface all valves or replace if badly burnt or the stems are unduly worn.
- 6 Replace valve guides in cylinder head using Tool No. RT7478 (see Figure 14).

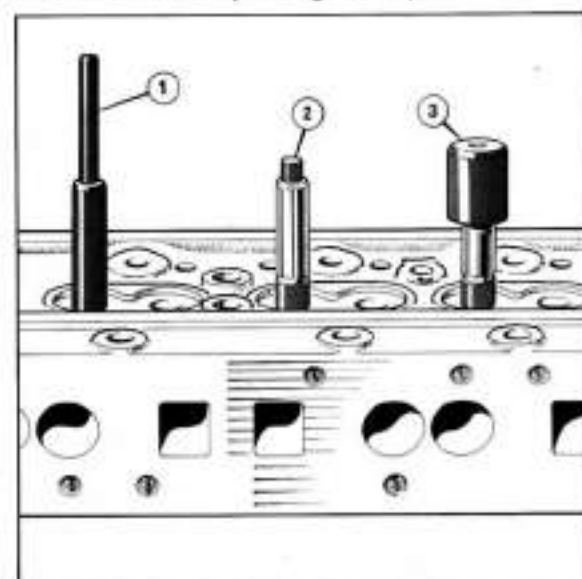
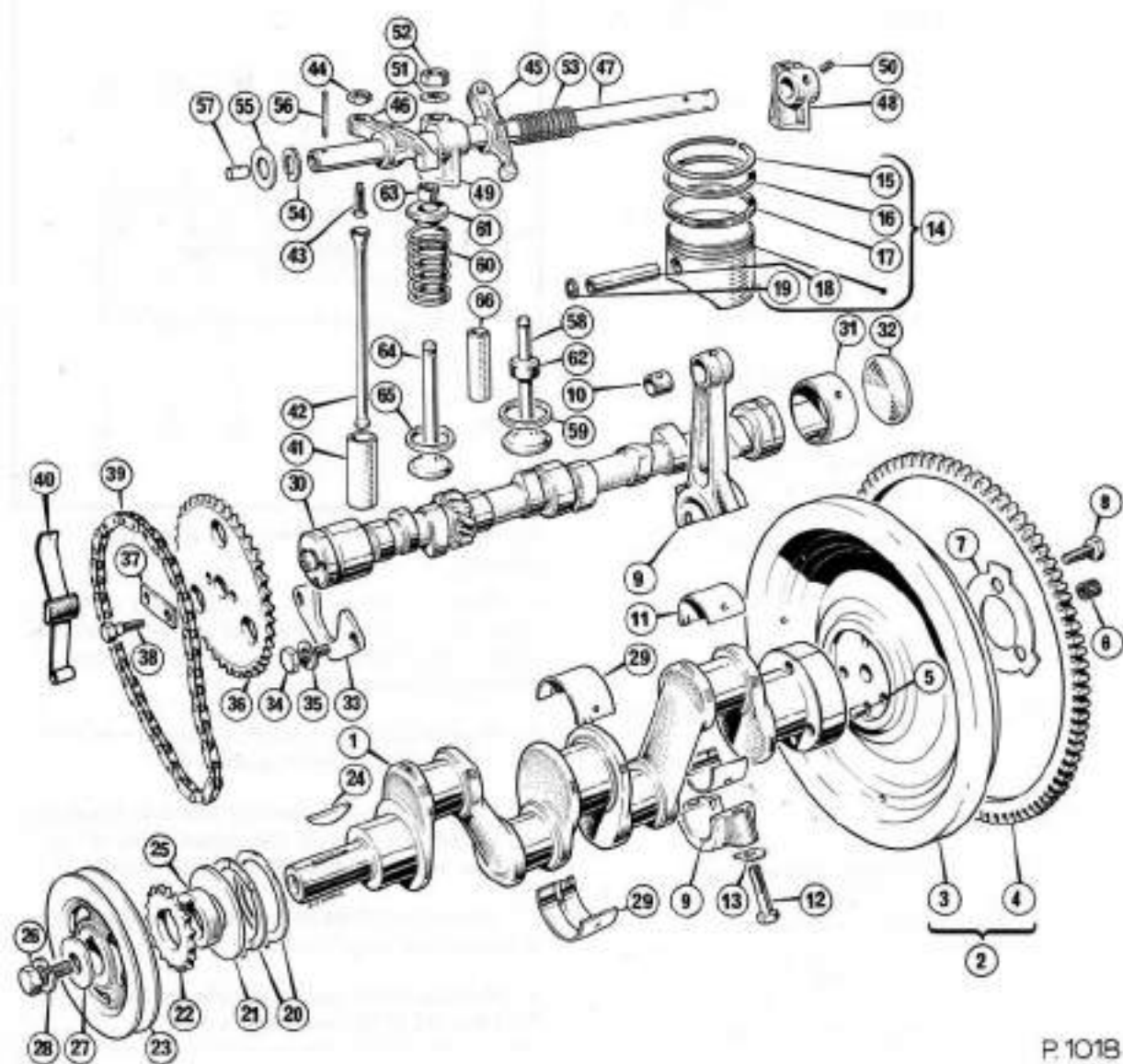


Figure 14 Valve guide removal and replacement

- 1 Valve guide removal
- 2 Valve guide replacement
- 3 Valve guide protection sleeve

Operation 10 – Cylinder head decarbonise (with cylinder head removed)

- 1 Unscrew the four spark plugs.



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Figure 15 Engine interior

- | | | |
|------------------------------|--------------------------------|-----------------------------|
| 1 Crankshaft | 23 Pulley, crankshaft | 45 Rocker, L.H. |
| 2 Flywheel assembly | 24 Key, pulley | 46 Rocket, R.H. |
| 3 Flywheel | 25 Spacer, crankshaft sprocket | 47 Rocker shaft |
| 4 Gear, flywheel | 26 Bolt, pulley | 48 Bracket, rocker shaft |
| 5 Dowel, flywheel | 27 Washer, pulley | 49 Bracket, rocker shaft |
| 6 Bearing, crankshaft | 28 Lockwasher, pulley | 50 Screw, rocker shaft |
| 7 Tabwasher, flywheel | 29 Main bearing crankshaft | 51 Washer, bracket |
| 8 Set screw, flywheel | 30 Camshaft | 52 Nut, bracket |
| 9 Connecting rod | 31 Bearing, camshaft | 53 Spring, rocker shaft |
| 10 Small end bearing | 32 Core plug | 54 Spring, rocker shaft end |
| 11 Big end bearing | 33 Plate, camshaft | 55 Washer, spring |
| 12 Bolt, connecting rod | 34 Bolt, plate | 56 Split pin, spring |
| 13 Plate, connecting rod | 35 Lockwasher, plate | 57 Plug, rocker shaft |
| 14 Piston assembly | 36 Sprocket, camshaft | 58 Valve, inlet |
| 15 Compression ring | 37 Plate, sprocket | 59 Insert, inlet valve |
| 16 Taper ring | 38 Screw, sprocket | 60 Spring valve |
| 17 Scraper ring | 39 Timing chain | 61 Cup, valve spring |
| 18 Gudgeon pin | 40 Tensioner, timing chain | 62 Seal, valve stem |
| 19 Circlip | 41 Tappet | 63 Cotter, valve |
| 20 Thrust washer, crankshaft | 42 Push rod | 64 Valve, exhaust |
| 21 Thrust washer, crankshaft | 43 Screw, tappet adjustment | 65 Insert, valve outlet |
| 22 Sprocket, crankshaft | 44 Locknut, tappet adjustment | 66 Guide, valves |

- 7 Recut the valve seats to ensure that the seats are concentric with the valve stem bore.
- 8 Relap valves to cylinder head seats, after this operation carefully check valve seats to ensure that no grinding paste particles are present.
- 9 Fit new valve springs and new cotters if necessary.
- 10 Replace cylinder head.

Operation 11 – Pistons, connecting rods and bearings (with cylinder head and sump removed)

- 1 Remove oil pump assembly (see Operation 4).
- 2 Release locking plates, unscrew eight bolts and remove the four big end bearing caps (see Figure 15).
- 3 Remove the bearing shells from the caps and con rods.
- 4 Carefully push the pistons, complete with con rods from the cylinder liners.
- 5 Immerse piston and con rod assemblies in hot water for a few minutes then release gudgeon pin retaining circlips.
- 6 Using a suitable drift remove the gudgeon pins and disconnect the con rods from the pistons.
- 7 Remove the small end bushes from the con rods, and press in new ones.
- 8 Having pressed in new small end bushes check that they will accept new gudgeon pins for it may be necessary to ream out the bushes with an expanding reamer until a tight push fit is obtained.

Note: It is important during this operation that the bush is reamed squarely to the con rod to ensure correct alignment.

- 9 Assemble new pistons to the connecting rods, securing in position with the gudgeon pins and circlips. It may be necessary to heat the pistons in hot water to facilitate the operation. Ensure the 'front' mark on the piston crowns are facing forward.

- 10 Before fitting the piston rings, position in appropriate liners for gapping, which should be 0.17–0.30mm (0.007–0.012in).

- 11 Fit the piston rings, fitting the scraper ring first, followed by the lower and then the upper compression rings. The 'top' mark on the compression rings must face uppermost.

- 12 Insert the piston and connecting rod assemblies into the appropriate bores, positioning the scraper ring gaps to the rear, and the top and lower compression ring gaps at 180° and 90° to this. Compress the rings using a tool similar to that shown in Figure 16.

- 13 Fit new big end bearings in the connecting rods and caps.

- 14 Locate the connecting rods and caps on the crankshaft and secure in position with eight .437 AF bolts and locking plates, tightening to a torque of 2.90kg m (21lb ft). Ensure the numbers on the con rods and caps correspond, on the camshaft side.

- 15 Replace oil pump assembly, sump and cylinder head.

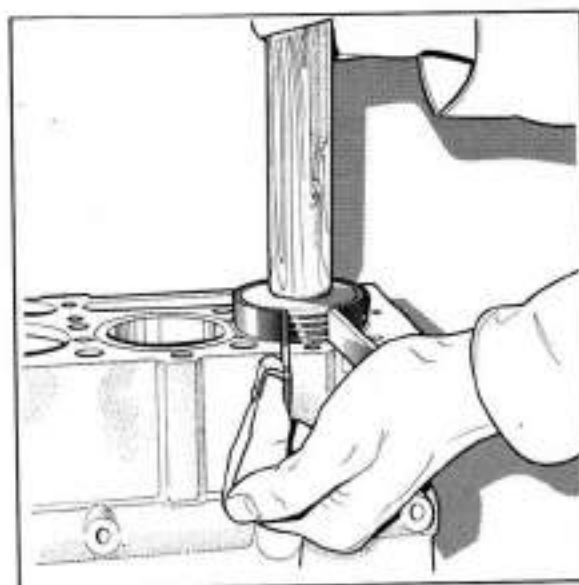


Figure 16 Compressing rings for refitting pistons

Operation 12 – Crankshaft removal and installation (with sump, front cover, flywheel, rear oil seal cover, connection rods and camshaft sprocket removed)

- 1 Remove two $\frac{5}{8}$ UNC bolts and lockwashers and detach camshaft retaining plate.
- 2 Unscrew two $\frac{1}{2}$ UNC nuts, complete with lockwashers, and remove front engine plate and gaskets from cylinder block.

3 Unscrew four $\frac{5}{16}$ UNC set screws and remove rear engine plate from cylinder block.

4 Remove four screws and detach the front and rear bridge pieces from the cylinder block.

5 Disconnect all three main bearing caps, after removing six $\frac{3}{8}$ UNF nuts and washers, two each cap (see **Figure 15**).

6 The crankshaft can now be withdrawn from the cylinder block.

7 Check crankshaft main bearing journals (see engine specification for details).

8 Fit new main bearings to crankshaft and bearing caps.

9 Fit new thrust washers to the crankshaft ensuring that the thrust face of the first washer makes good contact with the ground face of the crankshaft.

10 Replace crankshaft to cylinder block, fit main bearing caps in order, rear, centre, front, and secure to block with six $\frac{3}{8}$ UNF nuts. Always fit new main bearing cap nuts and tighten to a torque of 3.316kg m (24 lb ft).

11 Permitted end float of crankshaft is 0.0254–0.1524mm (0.001–0.006in).

12 Replace components in reverse order, taking note of the following. When refitting front and rear bridge pieces care should be taken to ensure that their faces mate flush with the cylinder block face.

Operation 13 – Camshaft removal and installation (with timing chain and sprocket removed)

1 Remove engine assembly (see **Operation 1**).

2 Unscrew two $\frac{5}{16}$ UNF nuts and lift off rocker cover and sealing gasket.

3 Unscrew four $\frac{3}{8}$ UNF nuts and washers from the rocker shaft support brackets and remove the complete rocker assembly.

4 Withdraw the eight push rods keeping them in their correct order.

5 Remove sump (see **Operation 3**).

6 Unscrew two $\frac{5}{16}$ nuts, complete with lockwashers, and remove oil pump assembly, complete with filter, from cylinder block.

7 Knock out the pin securing thrust muff to distributor and oil pump drive shaft which can then be removed upwards through the distributor location.

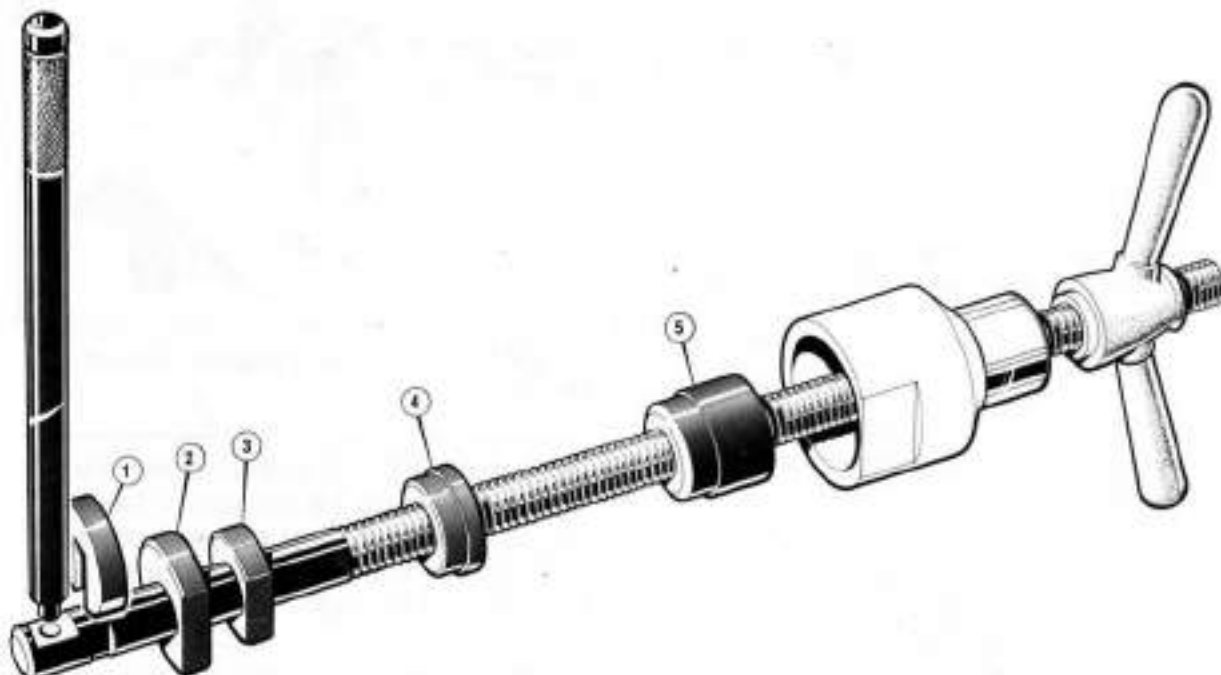


Figure 17 Camshaft bearing removal replacement tool

1 Horseshoe

3 Small 'D' washer

5 Pilot

8 Remove two $\frac{3}{8}$ UNC bolts, and lockwashers, and remove camshaft retaining plate.

9 Unscrew two $\frac{1}{2}$ UNC set screws and remove front engine mounting plate from cylinder block, including gasket.

10 Push the tappets in turn up through the cylinder block and carefully withdraw the camshaft.

11 Replace in reverse order, fitting new gaskets where applicable.

Note: When refitting distributor drive shaft ensure the large 'D' of the driving gear offset dog is facing towards the block at No. 1 piston. The camshaft retaining plate, fitted as original equipment is 4.621mm (0.182in) thick. A service plate 5.258mm (0.207in) thick is available to counteract any end float.

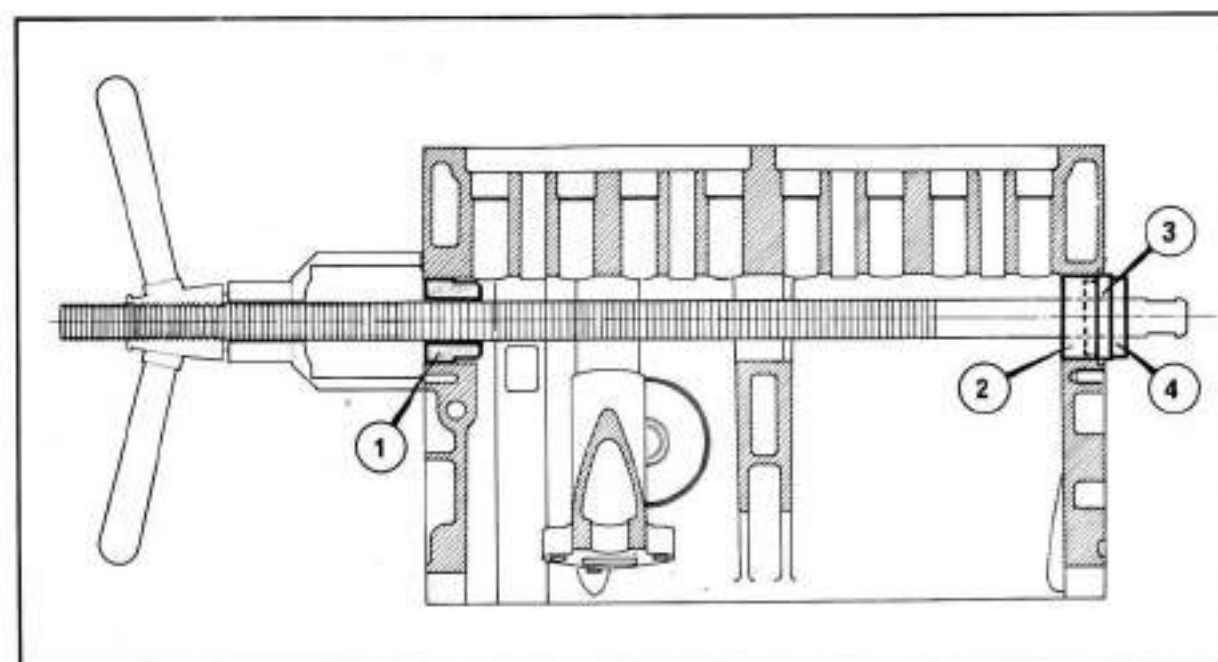


Figure 18 Removing camshaft rear bearing

1 Pilot	3 Mandrel
2 Bearing	4 Horseshoe

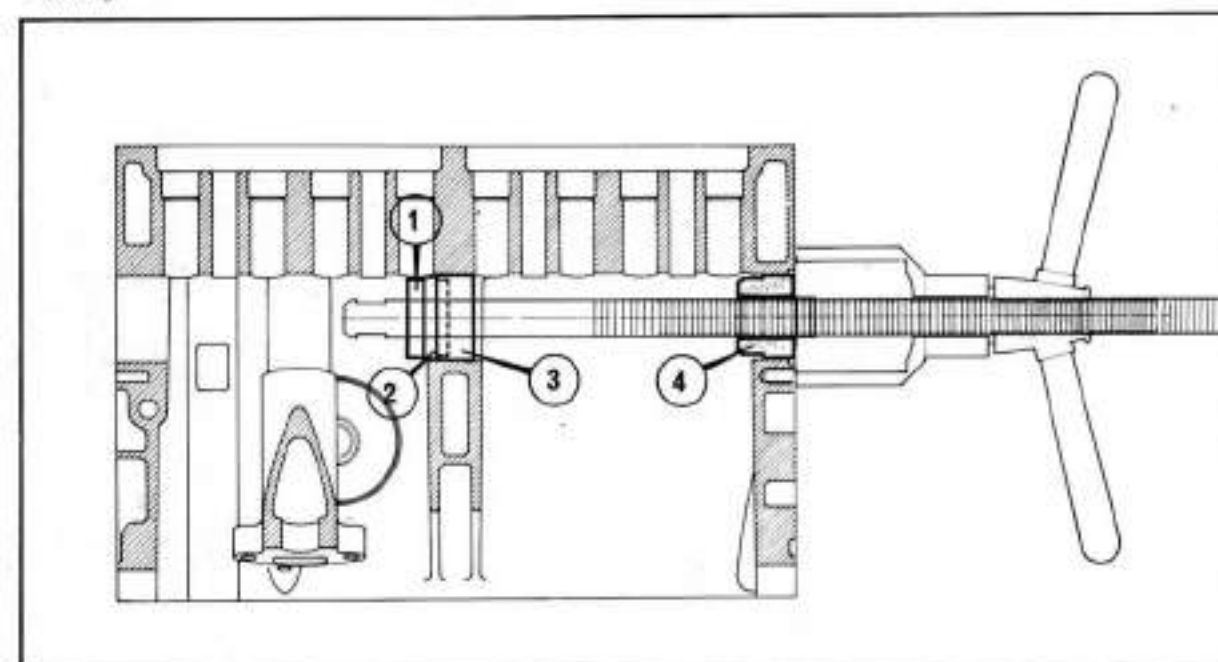


Figure 19 Removing camshaft centre bearing

Operation 14 – Camshaft bearing removal and replacement (with camshaft removed)

1 Remove flywheel (see **Operation 2**).

2 Unscrew four $\frac{5}{16}$ UNC set screws and remove rear engine plate from the cylinder block.

3 Drill a hole in the camshaft core plug and prise from cylinder block.

4 Press out the rear, centre and front camshaft bearings using general tool No. 18G 124A and Tool No. 7482 (see **Figure 17**) as follows:

(a) Insert general tool and position pilot, mandrel and horseshoe as shown in **Figure 18**.

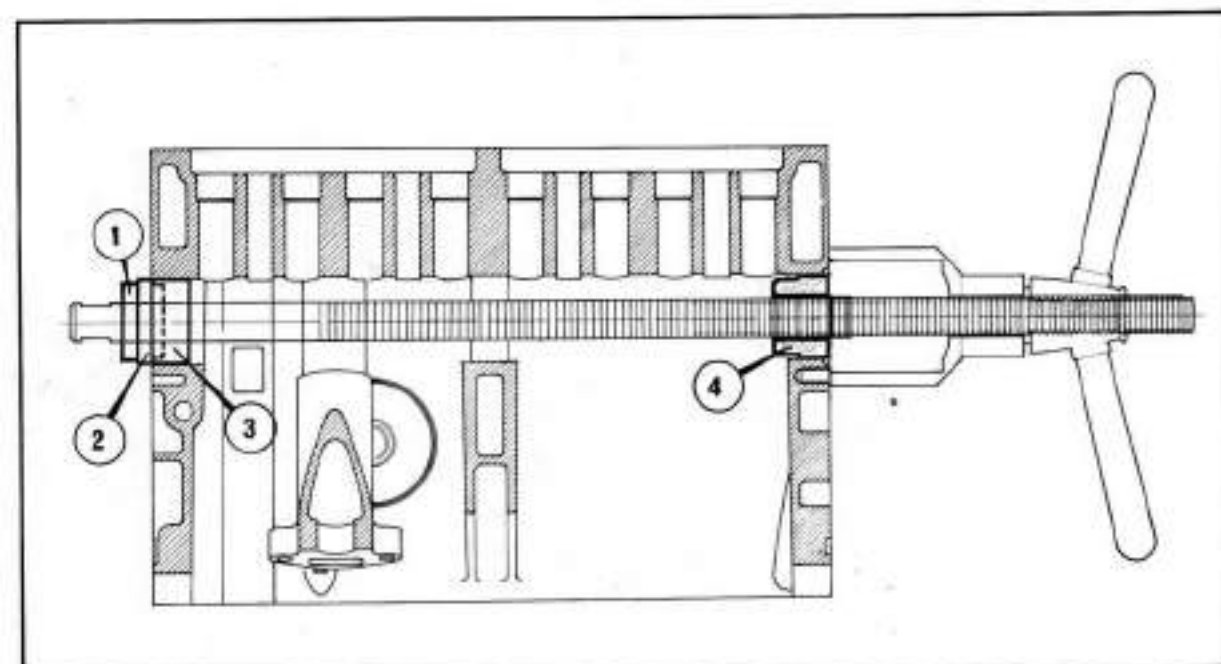


Figure 20 Removing camshaft front bearing

1 Horseshoe
2 Mandrel

3 Bearing
4 Pilot

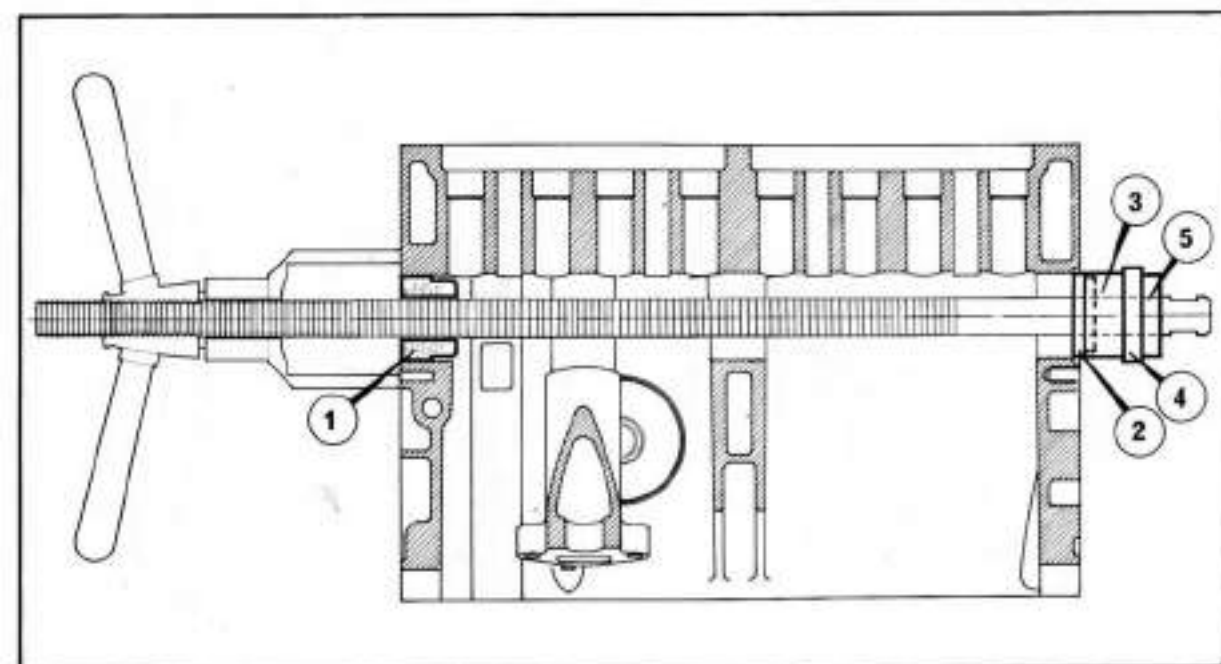


Figure 21 Replacing camshaft rear bearing

1 Pilot
2 Mandrel

3 Bearing
4 Small 'D' washer

5 Horseshoe

(b) Applying firm pressure rotate the general tool handle until the camshaft rear bearing is removed completely from its location.

(c) To remove centre and front camshaft bearings position the general tool and components as shown in **Figure 19** and **Figure 20**.

(d) To replace camshaft bearings position general tool and components as shown in

Figures 21, 22 and 23. Ensure the oil holes in the bearings correspond to those in the cylinder block.

Operation 15 – Cylinder liner rebore replacement

1 Carry out operations 1–14 and then continue as follows:

2 Extract the four liners from the cylinder

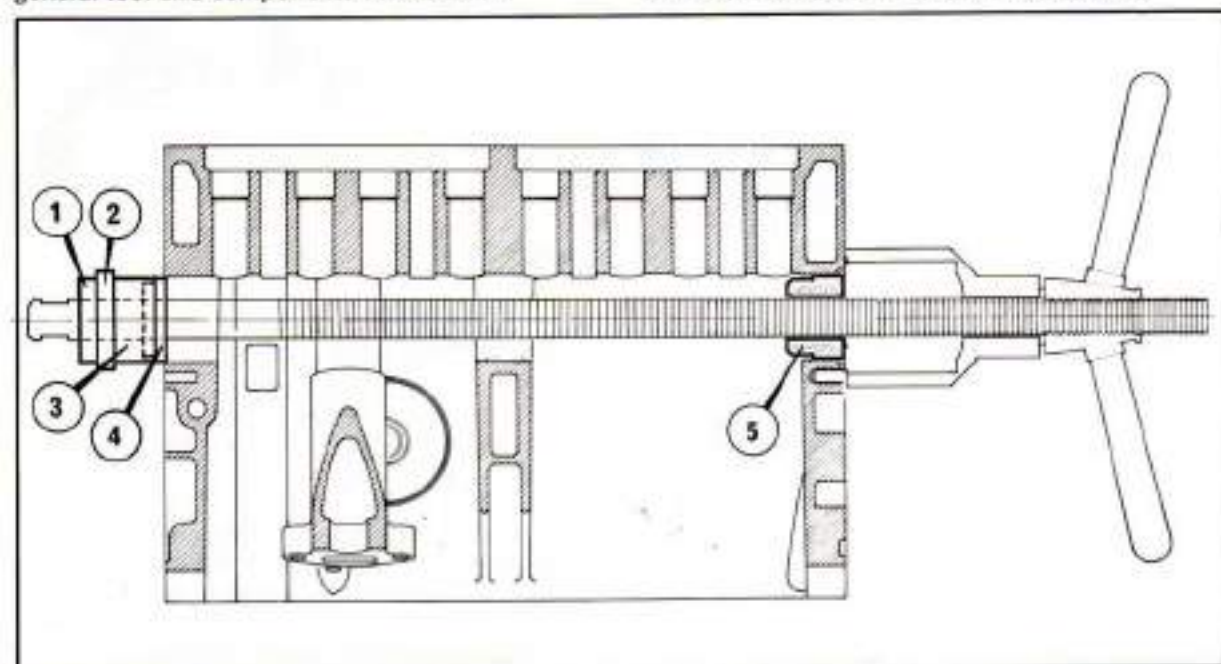


Figure 22 Replacing camshaft centre bearing

1 Horseshoe
2 Large 'D' washer

3 Bearing
4 Mandrel

5 Pilot

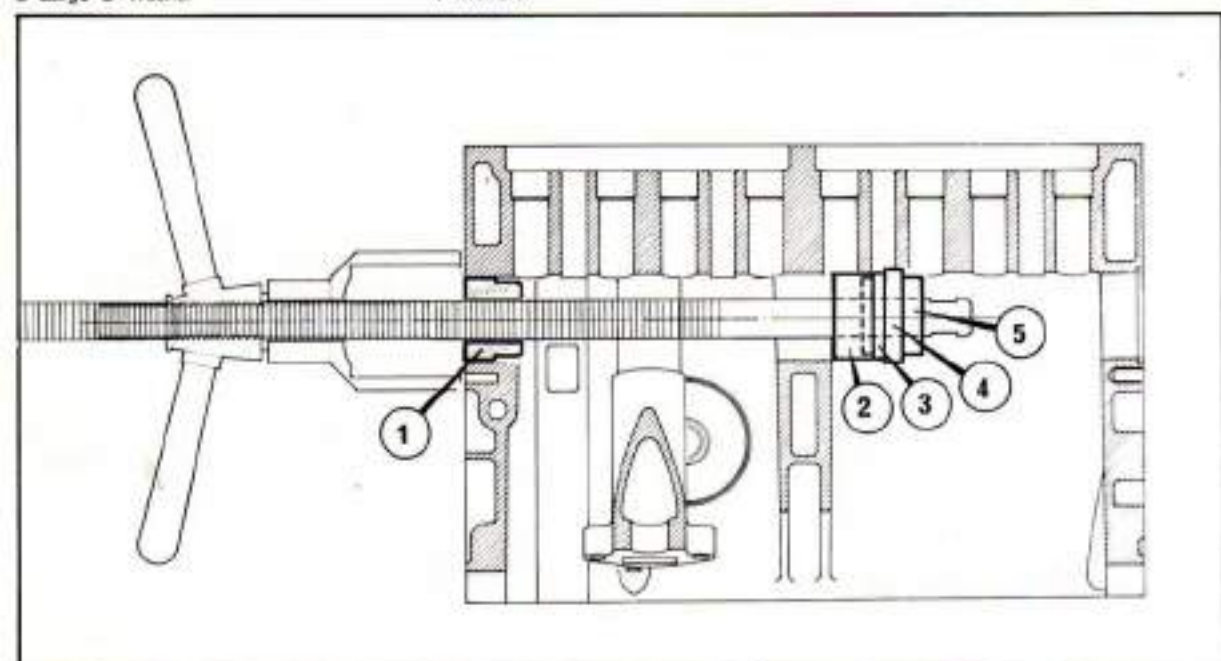


Figure 23 Replacing camshaft front bearing

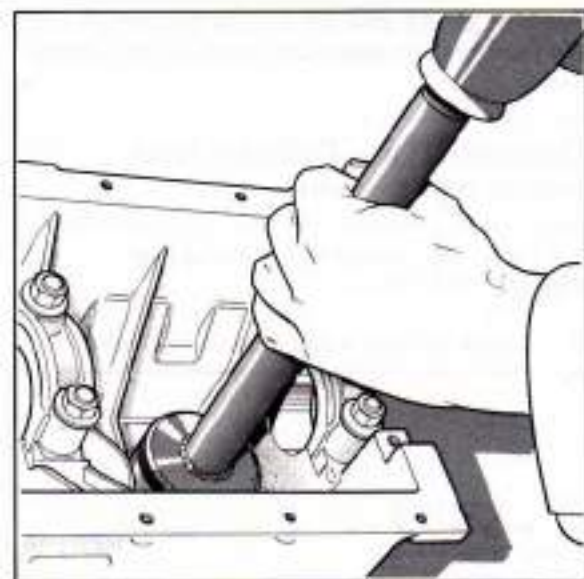


Figure 24 Removing cylinder liners

block using a tool similar to that shown in Figure 24.

3 Remove all signs of sealing compound from both the liners and their seats in the cylinder block.

4 Machine the liners 0.254mm (0.010in).

Note: Pistons 0.254mm (0.010in) oversize must be fitted.

Alternatively the four liners should be replaced and standard pistons fitted.

5 Smear ICI 'Silcoset 152' sealing compound around the seating face of the liner and its location in the cylinder block, making a complete 360° seal (see Figure 25).

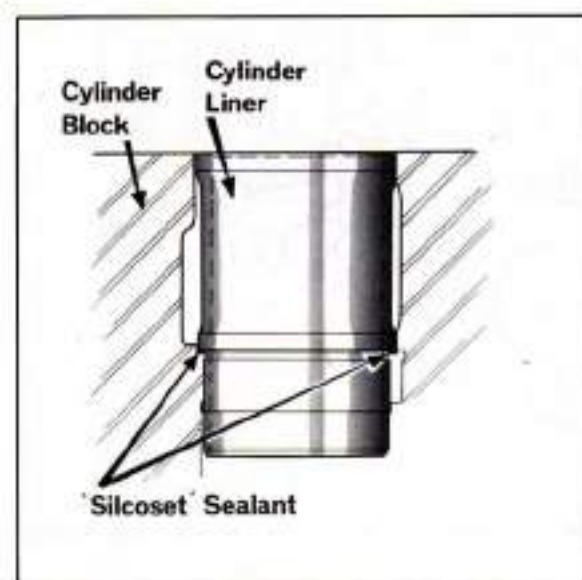


Figure 25 Sealing cylinder liners



Figure 26 Fitting cylinder liners

6 Using a tool similar to that shown in Figure 26 insert the liners into the block and ensure they stand proud 0.050–0.152mm (0.002–0.006in) from the cylinder block face. Check that there is a 0.381mm (0.015in) clearance between liners.

7 Assemble new pistons to the connecting rods, securing in position with the gudgeon pins and circlips. To facilitate this operation heat the pistons in hot water. Ensure the 'front' mark on the piston crowns are facing forward.

8 Before fitting the piston rings position in appropriate liners for gapping, which should be 0.17–0.30mm (0.007–0.012in).

9 Fit the piston rings, the scraper ring first, followed by the lower and then the upper compression rings. The 'TOP' mark on the compression rings must face uppermost.

10 Insert the piston and connecting rod assemblies into the cylinder liners, positioning the scraper ring gaps to the rear and the top and lower compression ring gaps at 180° and 90° to this. Compress the rings for installation using a compression tool similar to that shown in Figure 16.

11 Fit new big end bearings in the connecting rods and caps. Ensure the correct bearing sizes are used, see **Engine Specification**.

12 Check crankshaft main bearing journals, see **Engine Specification**.

13 Fit new main bearings to crankshaft and bearings caps.

14 Fit new thrust washers to the crankshaft ensuring the thrust face of the first washer.

makes good contact with the ground face of the crankshaft

15 Replace crankshaft to cylinder block. fit main bearing caps in correct order, rear, centre, front and secure with six $\frac{3}{8}$ UNF nuts and plain washers. Always fit new bearing cap nuts and tighten to a torque of 3.316kg m (24lb ft)

16 Fit a new oil seal into the rear cover, position a new gasket and secure rear cover to the cylinder block ensuring the dowels are firmly seated in their locations.

17 Fit front and rear bridge pieces and cork packing ensuring the end faces are flush with the cylinder block and secure with four $\frac{1}{8}$ UNC screws

18 Replace rear engine plate, fixing with four $\frac{1}{8}$ UNC set screws and lockwashers

19 Fit flywheel assembly to crankshaft and secure with three $\frac{3}{8}$ UNF bolts and 1sh washers, tightening to a torque of 1.66-2.07kg m (12-15lb ft). Check flywheel run out (see Operation 2)

20 Replace front engine plate and new gasket to the cylinder block and secure with two $\frac{1}{8}$ UNC set screws and lockwashers.

21 Fit crankshaft bi-metal thrust washers with oil slots facing forward, and steel thrust washer with its countersunk aperture facing rearwards.

22 Fit Woodruff key, sprocket spacer and crankshaft sprocket

23 Using the crankshaft pulley or flywheel turn the crankshaft until the woodruff key is pointing to eleven o'clock

24 Turn camshaft so that the groove in the end of the camshaft is in alignment with the woodruff key on the crankshaft.

25 Replace camshaft sprocket along with timing chain and secure with two $\frac{1}{8}$ UNC bolts and locking plate.

26 Using a straight edge, check the camshaft sprocket is in alignment with the crankshaft sprocket. The valve timing mark on camshaft sprocket should now be pointing to Woodruff key on crankshaft.

27 Check timing chain tensioner for wear, renewing if necessary, and locate on the lug in the timing chain cover

28 Fit timing chain cover and new gasket to front engine plate, using centralising tool

No. RT74B1, and secure with seven $\frac{1}{8}$ UNC bolts, two $\frac{1}{8}$ UNC nuts and lockwashers (see Figure 10).

29 Replace crankshaft pulley and secure with $\frac{3}{8}$ UNF bolt, plain washer and lockwasher

30 Locate a new gasket and then fit the oil pump assembly, complete with filter, securing to the cylinder block with two $\frac{1}{8}$ UNF nut and lockwashers.

31 Fit a new gasket and replace sump, tightening the fifteen $\frac{1}{8}$ UNC set screws, spacing washers and lockwashers evenly.

32 Clean the cylinder head and block faces and fit a new gasket. Smear grease around the metal edges of the gasket bore eyelets.

33 Carefully position the cylinder head squarely on the cylinder block and secure with three $\frac{1}{8}$ UNF and twelve $\frac{3}{8}$ UNF nuts, plain washers and lockwashers. The three $\frac{1}{8}$ UNF nuts must be fitted to the spark plug side of the cylinder head. Check that all cylinder head nuts indicated in Figure 13 are tightened in the order shown to a torque of 3.46kg m (25lb ft). The three remaining nuts should be tightened to a torque of 2.07kg m (15lb ft).

34 Replace the push rods keeping them in their correct order.

35 Locate rockershaft assembly on the four studs and secure firmly with two $\frac{3}{8}$ UNF nuts and washers to a torque of 2.35-3.04kg m (17-22lb ft). Check tappet clearance (see Operation 16).

36 Fit a new gasket and replace rocker cover securing in position with two $\frac{1}{8}$ UNF nuts and washers.

37 Replace ancillaries

38 Install the engine and gearbox assembly (see Operation 1)

Operation 16 – Tappet adjustment

Tappet clearances are 0.152mm (0.006in) cold
0.254mm (0.010in) hot.

Remove the rocker cover and adjust in the following order, with each valve in the fully closed position, using general tool No. 6500A (see Figure 27)

No. 1 valve with No. 6 valve fully open.
No. 2 valve with No. 7 valve fully open.
No. 3 valve with No. 6 valve fully open.
No. 4 valve with No. 5 valve fully open

No. 5 valve with No. 4 valve fully open.
 No. 6 valve with No. 3 valve fully open.
 No. 7 valve with No. 2 valve fully open.
 No. 8 valve with No. 1 valve fully open.



Figure 27 Tappet adjustment

Stud removal

Damaged studs should be removed with extractor tool, Part No. 450A, in conjunction with tappet adjustment wrench, Part No. 6500A, as shown in Figure 28.

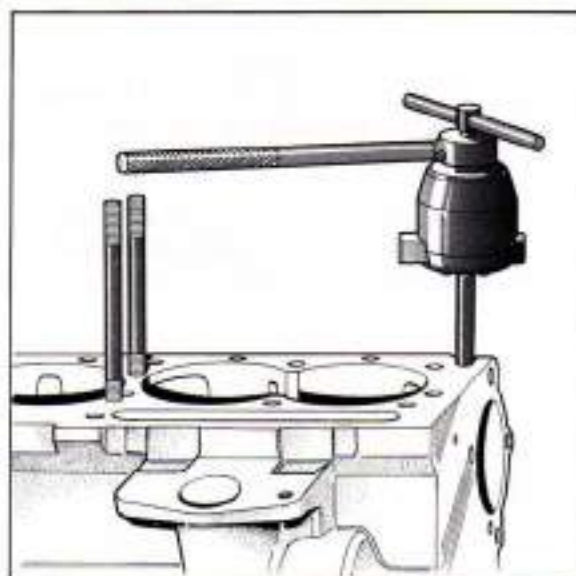


Figure 28 Stud removal

Engine specification

Cylinder head

Material Aluminium alloy
 Joint washer thickness 1.02mm (0.040in)

Cylinder block

Material Aluminium alloy with cast iron liners

Crankshaft

Material Forged high tensile steel
 Main bearing journals 44.44–44.45mm (1.7495–1.7500in)
 Crankpin journals 33.32–33.33mm (1.3120–1.3125in)
 End float 0.0254mm (0.001in) Min
 0.1524mm (0.006in) Max

Crankshaft regrinding size

1st undersize 0.254mm (0.010in)
 Main bearing journals 44.18–44.19mm (1.7395–1.7400in)
 Crankpin journals 33.07–33.08mm (1.3020–1.3025in)
 2nd undersize 0.508mm (0.020in)
 Main bearing journals 43.93–43.94mm (1.7295–1.7300in)
 Crankpin journals 32.81–32.82mm (1.2920–1.2925in)
 3rd undersize 1.016mm (0.040in)
 Main bearing journals 43.42–43.43mm (1.7095–1.710in)
 Crankpin journals 32.31–32.32mm (1.2720–1.2725in)
 Note: Connecting-rod, big-end main bearing shells are available to suit crankshafts reground to the above sizes.

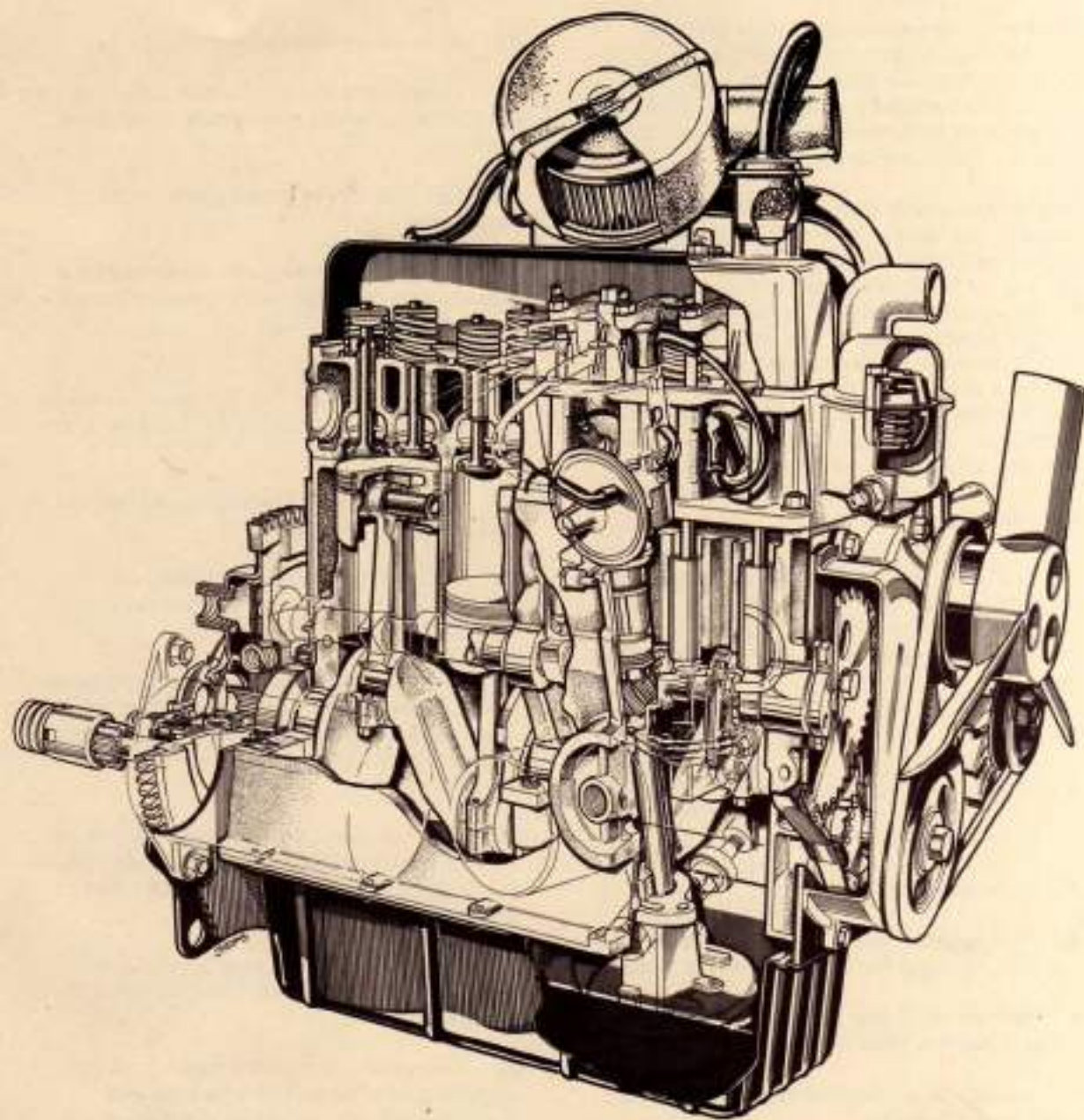
Pistons

Material Low expansion aluminium alloy
 Size 62.53mm (2.462in)
 All lands 62.17–62.26mm (2.448–2.451in)
 At skirt 62.47–62.50mm (2.459–2.638in)

Piston rings	
Gap	0.17–0.31mm (0.007–0.012in)
Width (compression)	1.245–1.250mm (0.049–0.060in) Groove clearance 0.038–0.089mm (0.0015–0.0035in)
Width (scraper)	3.150–3.175mm (0.124–0.125in) Groove clearance 0.038–0.089mm (0.0015–0.0035in)
Gudgeon pin	
Diameter	14.283–14.288mm (0.5623–0.5625in)
Small end bush	
Bore	14.22–14.298mm (0.5627–0.5630in)
Camshaft	
Bearing diameter	39.673–39.674mm (1.562–1.5625in)
Bearing clearances	0.012–0.0151mm (0.0005–0.002in)
End float	0.064–0.16mm (0.0025–0.0065in)
Chain pitch	9.525mm (0.375in)
Number of pitches	50
Valves	
Seat angle	45
Seat width:	
Inlet	1.397–1.524mm (0.055–0.060in)
Exhaust	1.397–1.524mm (0.055–0.060in)
Valve lift	7.34mm (0.289in)
Valve guide lengths (inlet and exhaust)	41.4–41.66mm (1.630–1.640in)
Valve guide clearance	0.0381–0.0889mm (0.0015–0.0035in)
Springs	
Free length	38.00mm (1.496in)
Fitted length and load	34.11mm (1.343in) at 14.855kg (32.76lb)
Length and load valve open	28.60mm (1.125in) at 27.216kg (60.00lb)
Flywheel	
Material	Chromium cast iron
Diameter	246.126mm (9.69in)
Starter ring	
Number of teeth	100
Diameter over teeth	257.81mm (10.15in)
Crankshaft identification	
Colour code	0.254mm (–0.010in) red 0.508mm (–0.020in) blue 1.016mm (–0.040in) green

The engine Section F

1



Engine—Cutaway

Description

The 850 cc engine is a four-cylinder in-line unit having a diecast aluminium cylinder head with cast iron valve guides and sintered iron seats. Diecast aluminium is also used for the cylinder block which incorporates removable wet liners. The forged steel crankshaft is mounted on three steel backed main bearings.

Routine maintenance

The engine oil level should be checked weekly and topped-up if necessary to keep the oil capacity at 3.13 litres (5.50 pints). It is important that this capacity is kept constant for any appreciable drop in the level will result in poor lubrication and possible engine damage.

To ensure the lubrication system is kept clean and free from impurities, the engine oil should be changed and a new oil filter fitted every 6,000 miles.

Engine service operations

The following service operations give detailed instructions for servicing and dismantling all the major engine assemblies. Where it is necessary to remove ancillary components and parts refer to the appropriate sections of the workshop manual.

Before reassembly during any operation, all components should be thoroughly cleaned, paying particular attention to joint faces and bearing surfaces. Any local high spots or burrs on the joint faces should be carefully removed using a fine file. Ensure that any piece of gasket or dirt in a blind tapped hole is removed during cleaning, as the bolt or screw may bottom before the bolt head abuts the mating part. When tightening a bolt which bottoms a characteristic springiness may be felt. If this occurs the bolt should be removed and the hole cleaned out.

Operation 1 – Engine removal and installation

The engine should be removed complete with gearbox.

To remove

- 1 Disconnect battery.
- 2 Drain cooling system.
- 3 Drain engine oil.
- 4 Slacken hose clip and disconnect the radiator top hose from the thermostat housing.
- 5 Slacken hose clip and disconnect the radiator bottom hose from the water pump.
- 6 Slacken hose clip and disconnect heater hose at water pump.
- 7 Slacken hose clip and disconnect heater hose from cylinder head adaptor and unclip from mounting bracket attached to rocker cover stud.
- 8 Disconnect alternator lead and remove alternator.
- 9 Disconnect starter motor lead.
- 10 Disconnect temperature gauge sender unit lead at thermostat housing.
- 11 Disconnect the oil pressure warning light lead from the sender on the cylinder block, or disconnect the oil pressure pipe if a gauge is fitted.
- 12 Disconnect high and low tension leads from the coil.
- 13 Remove air cleaner.
- 14 Disconnect the accelerator cable from the carburettor bracket, and release cable from trunnion.
- 15 Disconnect the choke cable at the carburettor.
- 16 Slacken hose clips and disconnect the water pump and thermostat housing hoses at the manifold adaptor.
- 17 Disconnect fuel trap reduction sleeve at the carburettor and unclip the fuel trap from mounting bracket.
- 18 Disconnect the breather pipe from the carburettor to the filler cap.
- 19 Release the accelerator cable return spring from the abutment bracket on the cylinder head.
- 20 Disconnect the fuel pipe, carburettor to pump, taking care not to damage the pipe when removing the retaining clips. Remove fuel pipe supporting 'P' clip from the rocker cover stud.
- 21 Remove two nuts and lockwashers securing the manifold adaptor and drip tray to the manifold and remove complete with carburettor.
- 22 Disconnect petrol supply pipe at fuel pump and plug to prevent loss of fuel and ingress of dirt.
- 23 Disconnect the clutch cable from the operating arm, remove the locknut and adjusting nut and withdraw the cable from the trunnion.
- 24 Pull the clutch cable outer sleeve from the retaining hole in the engine backplate.
- 25 Disconnect exhaust downpipe at manifold.
- 26 Remove starter motor.
- 27 Disconnect speedometer cable at gearbox rear cover.
- 28 Remove heater and choke knobs from centre console, unscrew locking nuts and disconnect heater and choke cables.
- 29 Unscrew gear lever knob.

The engine

30 Remove two screws securing rear of centre console to driveshaft tunnel and lift console complete with gaiter over gear lever.

31 Prise out the spring retaining clip from the gear lever ball joint cap on the gearbox top cover to remove the gear lever.

32 Unscrew six self-tapping screws and remove engine rear access panel.

33 Disconnect driveshaft from gearbox rear coupling.

34 Remove two self-locking nuts and washers, securing the engine front mounting rubbers to chassis mounting brackets.

35 Before removing gearbox rear mounting, support engine and gearbox assembly by means of a suitable jack from underneath the vehicle or lifting gear through bonnet aperture.

36 Remove three set screws and self-locking nuts to detach gearbox support bracket from chassis mounting.

Note: One set screw and nut also secures earthing braid.

37 Pull engine and gearbox assembly slightly forward, lift to clear engine front mounting brackets and then carefully lower assembly onto a suitable base.

38 Remove two bolts, six nuts and six lockwashers and separate the engine and gearbox assembly.

39 Remove ancillary components (see appropriate section) and carry out the necessary service operations.

To replace

1 Refit ancillary components.

2 Secure the engine and gearbox assembly together with the two bolts, six nuts and six lockwashers.

3 Support the engine and gearbox with lifting gear or a suitable jack and offer up to the vehicle chassis.

4 Carefully raise the assembly and locate engine mounting rubbers in front chassis mounting bracket.

5 Raise the gearbox and position gearbox support bracket in line with its chassis mounting and secure with three set screws and self-locking nuts.

Note: Secure earthing braid at one fixing point.

6 Reconnect driveshaft to gearbox rear coupling with four bolts, nuts and lockwashers.

7 Secure engine front mounting rubbers to chassis with two self-locking nuts and washers.

Note: Ensure mounting rubber restrictor cups are correctly fitted if removed when dismantling engine.

8 Fit engine rear access panel to bulkhead with six self-tapping screws.

9 Locate gear lever in gearbox top cover and secure in position with cap and retaining clip.

10 Lower centre console, including rubber gaiter over gear lever, and fit to driveshaft tunnel with two screws.

11 Replace gear lever knob and check that the rubber gaiter is correctly seated.

12 Fit locking nuts and press choke and heater knobs onto control cables on centre console.

13 Reconnect speedometer cable at gearbox rear cover.

14 Refit starter motor.

15 Reconnect exhaust downpipe to manifold.

16 Feed the clutch cable outer sleeve through the retaining hole in the engine backplate.

17 Feed the clutch cable through the trunion on the clutch operating arm and secure with the locknut and adjusting nut.

18 Remove plug and connect petrol supply pipe at fuel pump.

19 Secure the manifold adaptor complete with carburettor and drip tray to the manifold.

20 Reconnect fuel pipe, carburettor to pump, and secure with retaining clips. Refit 'P' clip to rocker cover stud.

21 Refit accelerator cable return spring to abutment bracket.

22 Reconnect breather pipe from carburettor to filler cap.

23 Reconnect fuel trap reduction sleeve to carburettor and secure fuel trap to mounting bracket.

- 24 Reconnect water pump and thermostat housing hoses to manifold adaptor.
- 25 Reconnect choke cable and accelerator cable at carburettor.
- 26 Refit air cleaner.
- 27 Reconnect high and low tension leads at coil.
- 28 Reconnect oil pressure warning light lead, or oil pressure pipe if gauge is fitted.
- 29 Reconnect temperature gauge sender unit lead at thermostat housing.
- 30 Reconnect starter motor lead.
- 31 Refit alternator and connect leads.
- 32 Reconnect heater hose at cylinder head adaptor, refit jubilee clip and secure hose to mounting bracket attached to rocker cover stud.
- 33 Reconnect heater hose at water pump and secure with jubilee clip.
- 34 Reconnect radiator bottom hose at water pump.
- 35 Reconnect radiator top hose at thermostat housing.
- 36 Refill engine and gearbox with recommended oil.
- 37 Refill the cooling system.
- 38 Reconnect battery.

Operation 2 – Flywheel and ring gear removal and replacement

Flywheel removal

- 1 Remove the gearbox (see **Section G**).
- 2 Unscrew six set screws, complete with lockwashers, and remove the clutch assembly from the flywheel.
- 3 Release the tabwasher, unscrew three set screws, and remove the flywheel assembly from the crankshaft.

Starter ring gear removal

- 1 Drill a hole 6-35 mm (0.25 in) diameter at the point of intersection of a scribed line between any two teeth and a scribed line midway between the root diameter and the inside diameter of the ring gear. Ensure that the hole is not drilled through the ring gear into the flywheel, as this will interfere with the subsequent balance of the flywheel.

- 2 Hold the flywheel assembly in a soft-jawed vice.

- 3 Place a cloth of heavy material over the ring gear as a protection against flying fragments.

Warning: Ensure adequate protection, particularly for the eyes, to prevent injury from the possibility of flying fragments when the ring gear is split.

- 4 Place a cold chisel immediately above the centre line of the drilled hole and strike sharply to split the ring gear.

Refitting

- 1 Heat the replacement ring gear uniformly to a maximum of 200°C.
- 2 Place the flywheel on a flat surface, clutch face side uppermost, and clean the ring gear locating surface.
- 3 Locate the ring gear and hold in position until it contracts sufficiently to grip the flywheel.
- 4 Allow the ring gear to cool gradually to avoid distortion.

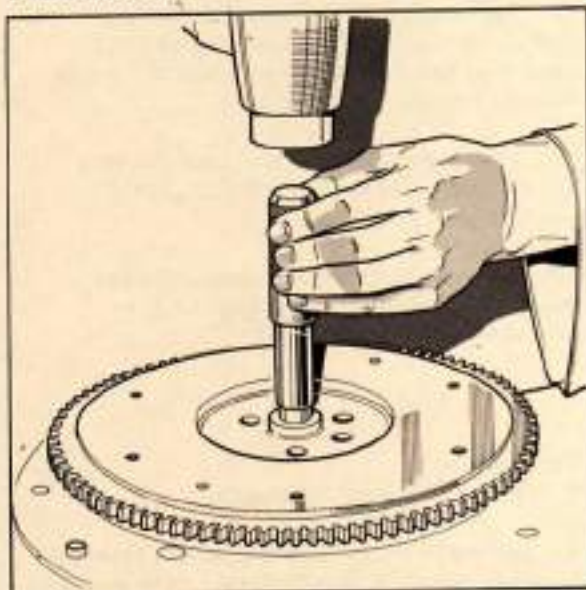


Figure 1 Fitting flywheel bearing

Refitting flywheel assembly

- 1 Clean the flywheel mating face with the crankshaft and crankshaft flange. Check the dowel for damage, and check that the crankshaft spigot bush is in position. Check the bush for wear. If wear is evident, knock out the bush and fit a new one using tool No. RT 7485 (see **Figure 1**). Needle roller bearings have been used as an alternative to the bush and care must be taken when replacing these. It is important to note that the

The engine

hardened, square end face of the bearing must face the tool used to press in the bearing. Use of the rolled end of the bearing will lead to shell distortion and needle failure. The manufacturer's name and designation number may be stamped on the hardened end face in some instances, enabling it to be easily identified. However, this does not apply with all manufacturers and care should be exercised to identify the correct end by its shape.

- 2 Fit the flywheel to the crankshaft, locating over the dowel in the crankshaft.
- 3 Secure the flywheel assembly to the crankshaft with three set screws, and a tabwasher, tightening to a torque of 4.03 kg m (29 lb ft). The tabs of the washer should then be bent over to lock the set screws.
- 4 Check the flywheel for misalignment using a clock indicator gauge. A 0.08-0.13 mm (0.003-0.005 in) run-out is permitted, but if this is exceeded the flywheel must be replaced with a new assembly.
- 5 Using tool No. RT 7485 as a centraliser, or a primary gear from a gearbox, replace the clutch disc and pressure plate assembly on the flywheel, securing evenly with six set screws and lockwashers to a torque of 1.66-2.07 kg m (12-15 lb ft) see **Figure 2**. The pressure plate assembly should be tapped with a hide mallet to ensure that it is square on the flywheel.
- 6 Check clutch run-out does not exceed 0.381 mm (0.015 in) on the steel thrust disc.
- 7 Refit gearbox.

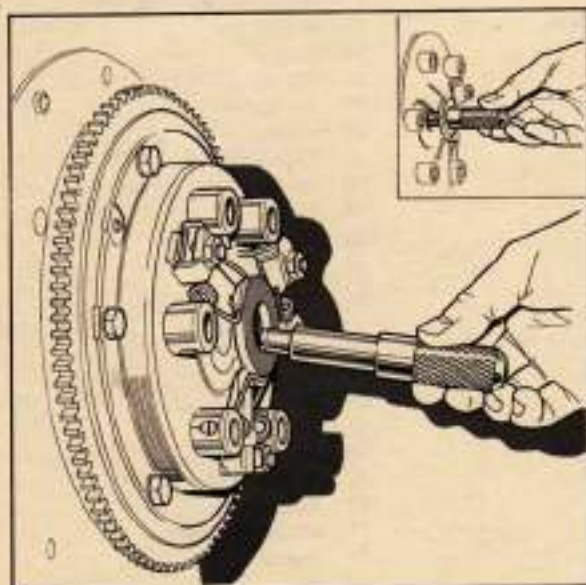


Figure 2 Centralising the clutch

Operation 3 – Sump removal and replacement

- 1 Drain engine oil.
- 2 Unscrew fifteen set screws and remove spacers, lockwashers, sump and gasket.
- 3 Clean the sump and its seating on the cylinder block face.
- 4 To eliminate possible oil leakage the two centre front and rear fixing screw threads should be thoroughly cleaned with petrol and coated with Hylomar sealant before refitting.
- 5 Fit new gasket, replace sump and tighten the fifteen set screws, spacers and lockwashers evenly.

Operation 4 – Oil pump removal and replacement (with sump removed)

- 1 Rotate engine until on TDC.
- 2 Disconnect spark plug leads from the plug terminals.
- 3 Remove the high and low tension leads from the coil.
- 4 Unscrew the single bolt, complete with washer and lockwasher, securing the distributor clamp to the cylinder block and remove the distributor. Do not disturb the clamping bolt securing the distributor unless the ignition timing is to be adjusted.
- 5 Unscrew two nuts, complete with lockwashers and remove oil pump assembly, including filter, from the cylinder block (**Figure 4**).
- 6 Drift out the pin securing the thrust muff to the distributor/oil pump driveshaft which can then be withdrawn upwards through the distributor housing.
- 7 Inspect oil pump and driveshaft assemblies for possible damage and renew if necessary. **Note:** In production it has sometimes been necessary to fit one or two 0.127 mm (0.005 in) shims between the oil pump driveshaft bush and the cylinder block (see **Figure 5**). It is not necessary, when dismantling the oil pump, to remove the drive bush or shim, if fitted. However, if the bush and shim are removed, it is important that they are both replaced when re-assembling the pump.

Failure to replace the shim or shims will cause excessive end float of distributor driveshaft, resulting in poor meshing of the drive gear and engine noise.

The backlash between camshaft gear and driveshaft gear must not exceed 0.0762 mm (0.003 in).

Reassemble components in reverse order.

Refit pump to cylinder block ensuring that the engine is on TDC.

When replacing the oil pump driveshaft ensure the large 'D' of the driving gear offset dog is facing towards the cylinder block with the slot aligned in a '5 minutes past 7 o'clock' position.

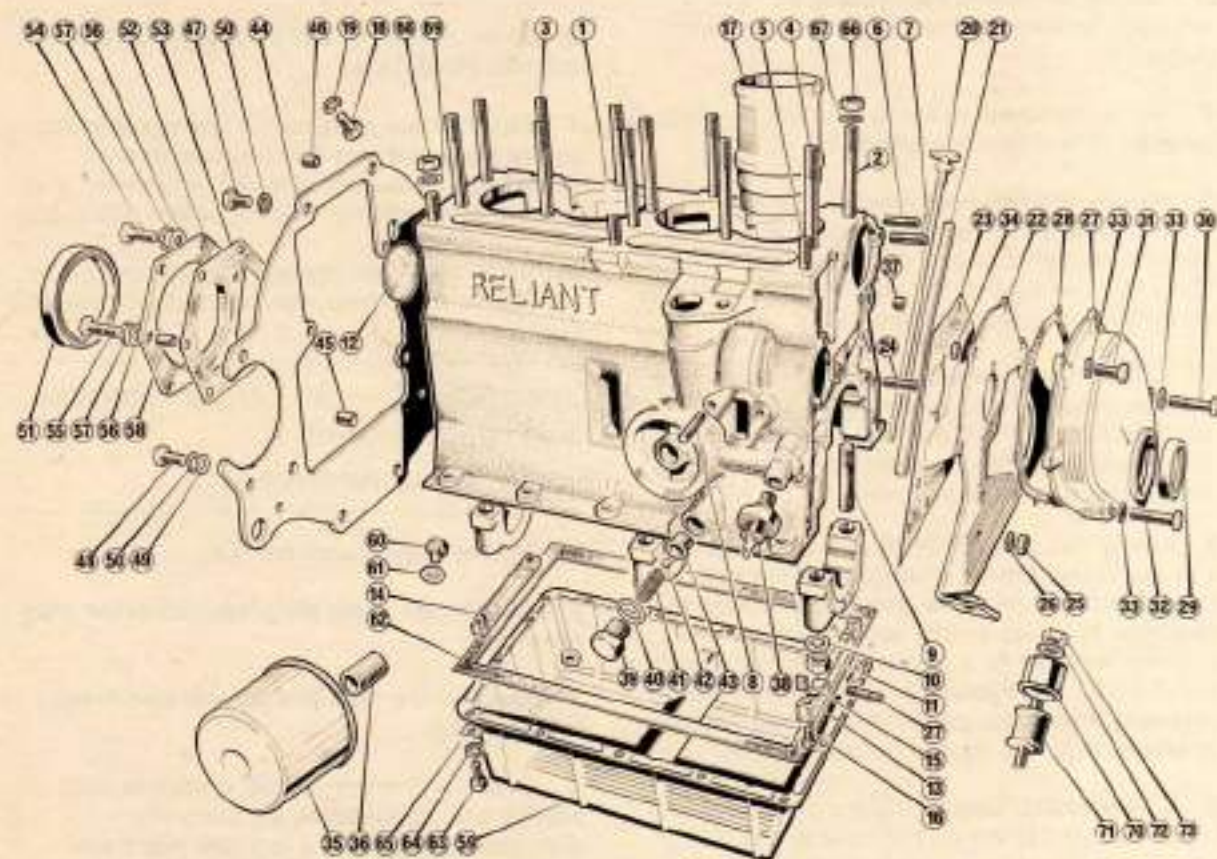


Figure 3 Engine, cylinder block – exploded

1	Cylinder block	26	Lockwasher	51	Oil seal, crankshaft rear
2	Stud, cylinder head	27	Cover, timing chain	52	Rear cover
3	Stud	28	Gasket	53	Gasket
4	Stud	29	Oil seal, cover	54	Set screw
5	Stud	30	Bolt	55	Set screw
6	Stud, water pump	31	Bolt	56	Washer
7	Stud, alternator strap	32	Bolt	57	Lockwasher
8	Stud, fuel pump	33	Lockwasher	58	Dowel
9	Stud, main bearing housing cap	34	Nut	59	Sump
10	Washer	35	Oil filter	60	Plug, sump drain
11	Nut	36	Adaptor, oil filter	61	Washer
12	Core plug, camshaft	37	Plug	62	Gasket
13	Bridge piece front	38	Switch, oil pressure	63	Set screw
14	Bridge piece, rear	39	Retainer oil pressure relief valve	64	Lockwasher
15	Packing, bridge piece	40	Washer	65	Washer
16	Screw	41	Spring	66	Nut
17	Cylinder liner	42	Ball	67	Washer
18	Plug, water drain	43	Insert	68	Nut
19	Washer, plug	44	Mounting plate	69	Lockwasher
20	Dipstick	45	Dowel	70	Restrictor cup
21	Tube, dipstick	46	Dowel	71	Mounting rubber
22	Mounting plate	47	Set screw	72	Washer
23	Gasket	48	Set screw	73	Nut
24	Stud, plate to block	49	Washer		
25	Nut, plate to block	50	Lockwasher		

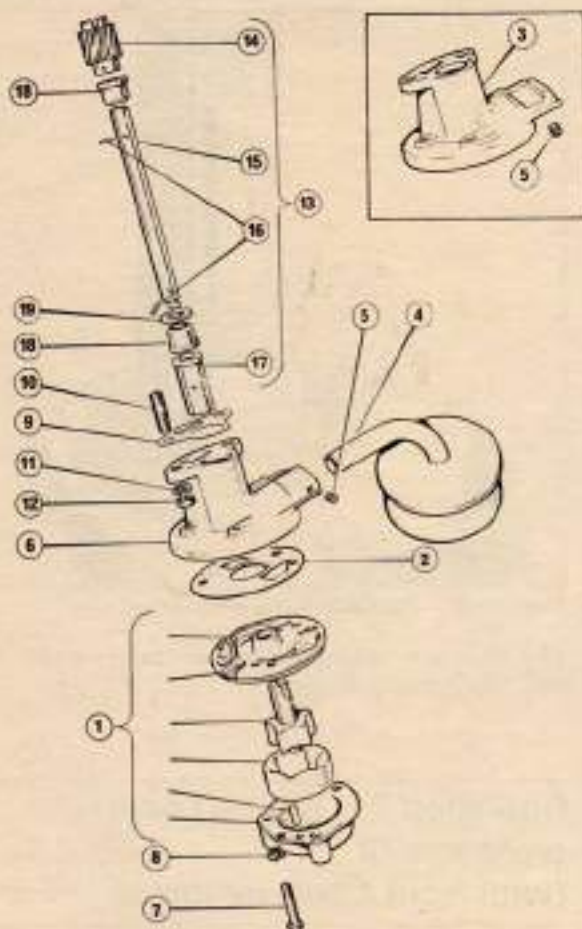


Figure 4 Oil pump – exploded

- | | |
|-----------------------------|-----------------------------|
| 1 Oil pump | 11 Lockwasher |
| 2 Gasket | 12 Nut |
| 3 Extension – Early engines | 13 Oil pump driving shaft |
| 4 Filter | 14 Gear |
| 5 Set screw | 15 Shaft |
| 6 Extension – Later engines | 16 Pin thrust muff and gear |
| 7 Bolt | 17 Thrust muff |
| 8 Lockwasher | 18 Bush |
| 9 Gasket | 19 Shim |
| 10 Stud | |

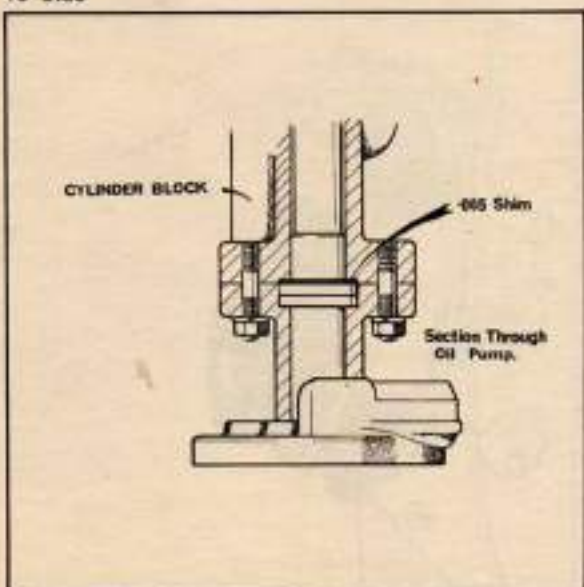


Figure 5 Oil pump driveshaft shims

Operation 5 – Crankshaft rear cover and oil seal replacement (with flywheel removed)

1 Unscrew six set screws and remove oil seal cover, complete with oil seal and gasket from the cylinder block.

2 Using a suitable tool, press the oil seal from the rear cover.

Note: Do not use a screwdriver as this will damage the oil seal seating.

3 Carefully press a new oil seal into the rear cover. To ensure the seal is seated firmly and squarely use a press tool, similar to that shown in **Figure 6**.

4 Locate the two dowels of the rear cover in the cylinder block and then secure the cover with six set screws and lockwashers (see **Figure 7**).

Operation 6 – Timing chain cover, oil seal and gasket replacement (without engine removal)

1 Drain the cooling system.

2 Remove the radiator, complete with hoses, from the vehicle.

3 Slacken alternator mountings and remove the fan belt.

4 Unscrew four nuts and lockwashers and remove the water pump from cylinder block.

5 Unscrew the retaining bolt and withdraw the crankshaft pulley.

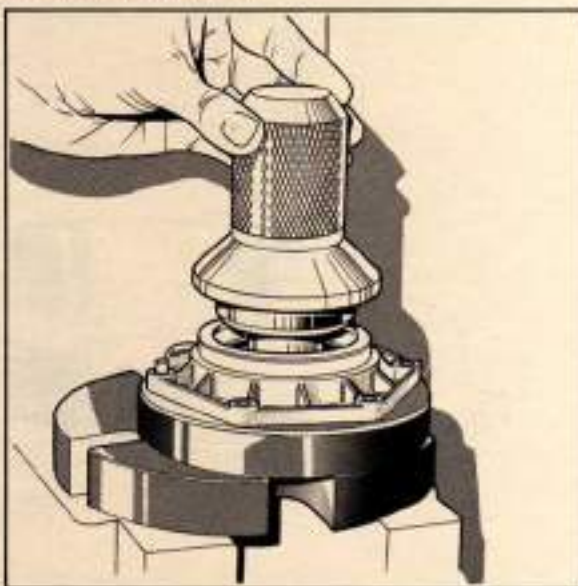


Figure 6 Replacing rear cover oil seal

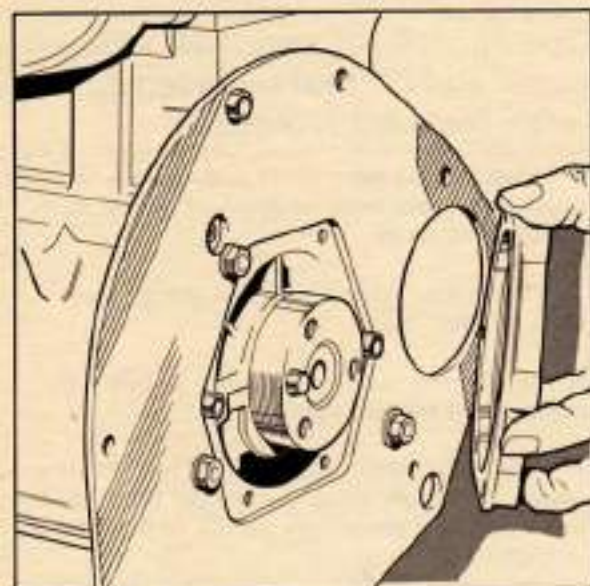


Figure 7 Fitting rear cover

6 Remove seven bolts and two nuts, complete with lockwashers, and detach the timing chain cover from the cylinder block.

7 Extract oil seal from cover using tool No. RT 7480 and drive handle part No. 550 (see **Figure 8**).

8 Fit new oil seal, using tool No. RT 7480 and drive handle, locating as shown in **Figure 9**.

9 With the aid of centralising tool part No. RT 7481 fit the timing chain cover complete with gasket, to cylinder block, securing with seven bolts, two nuts and lockwashers (see **Figure 10**).

10 Replace crankshaft pulley, water pump, refit fan belt, and secure alternator.

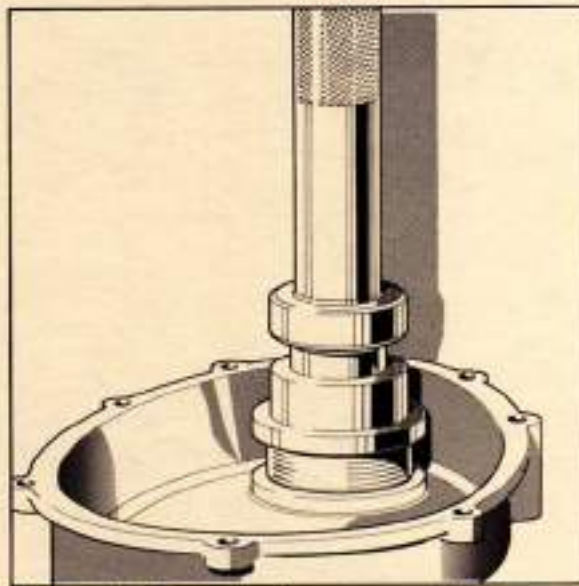


Figure 9 Replacing front cover oil seal

11 Replace radiator, reconnect hoses and refill the cooling system.

Operation 7 – Timing chain replacement (with front cover removed)

1 Release locking plate, unscrew two bolts, remove camshaft sprocket and lift off timing chain. Retain camshaft sprocket locking plate.

2 Fit new timing chain to crankshaft and camshaft sprocket which can be secured to the camshaft, using the locking plate and two bolts.

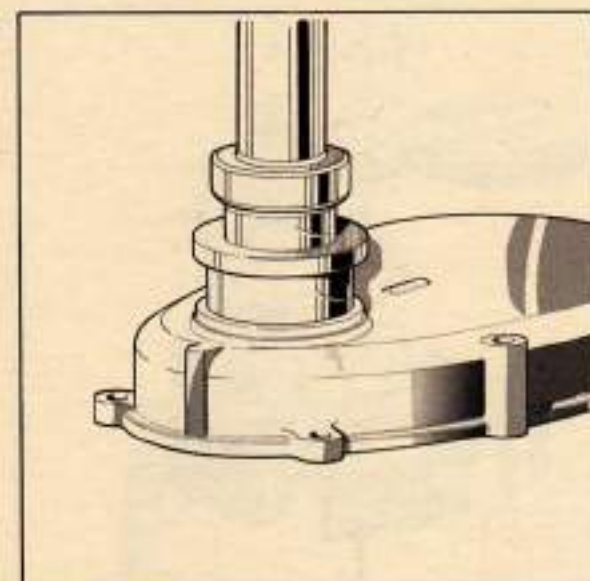


Figure 8 Extracting front cover oil seal

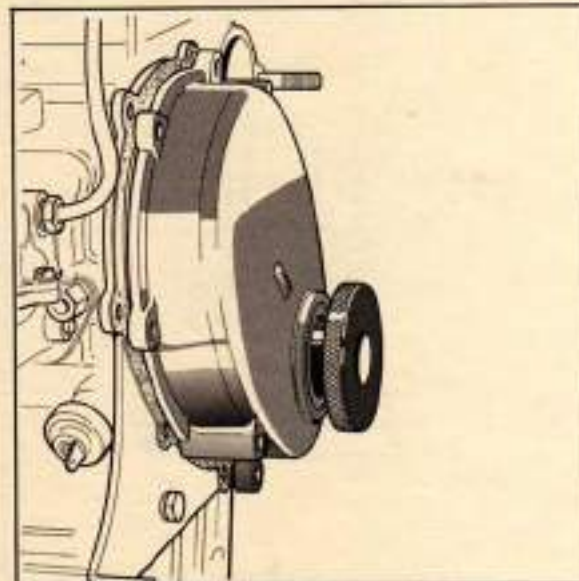


Figure 10 Centralising front cover

3 Check valve timing, ensuring that the timing mark of the camshaft sprocket aligns with the Woodruff key on the crankshaft (see **Figure 11**).

4 Check the timing chain tensioner for wear and replace if necessary.

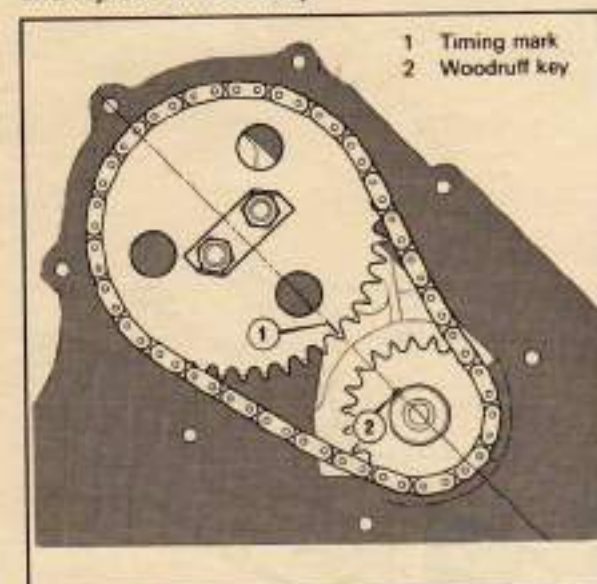


Figure 11 Alignment of camshaft sprocket and Woodruff key

Operation 8 – Camshaft sprocket alignment (timing chain cover and timing chain removed)

- 1** First ensure that the timing mark on the camshaft sprocket aligns with the Woodruff key on the crankshaft to align No. 1 or No. 4 piston on TDC.
- 2** Release locking plate, unscrew two bolts and remove the locking plate and sprocket.
- 3** Ensure that the timing mark, a notch, on the camshaft end aligns with the Woodruff key on the crankshaft.
- 4** Remove the crankshaft Woodruff key.
- 5** Temporarily refit both sprockets.
- 6** Check the alignment of the sprockets by placing a straight edge across the teeth of both sprockets.
- 7** Correct any misalignment by fitting an alternative spacer behind the crankshaft sprocket. Alternative crankshaft sprocket spacers, increasing in thickness by 0.005 in, are available.
- 8** Remove the sprockets.
- 9** Refit the drive key.

10 Fit a new camshaft sprocket lock plate, refit the bolts and bend the tabs.

Operation 9 – Cylinder head removal (without engine removed)

- 1** Disconnect battery.
- 2** Remove blower motor air hose.
- 3** Drain cooling system.
- 4** Release the two retaining clips and remove the air cleaner body from its base plate.
- 5** Remove two bolts securing the air cleaner base plate to the carburettor.
- 6** Remove the oil filler cap, disconnecting the engine ventilation pipe from the carburettor.
- 7** Disconnect the heater hoses from the inlet manifold adaptor and the water pump.
- 8** Remove the radiator top hose.
- 9** Remove the distributor cap and leads.
- 10** To allow easier access remove the single fixing bolt securing the distributor to the cylinder block and remove the distributor.
- 11** Remove the two rocker cover nuts and remove cover complete with the heater hose and fuel pipe clips.
- 12** Remove the petrol pipe from the carburettor, plug to prevent ingress of dirt. Remove the pipe from the clip on the side of the cylinder head and hold the pipe back to the side of the engine compartment with adhesive tape to facilitate access to the cylinder head.
- 13** Disconnect the lead from the temperature sender in the thermostat housing.
- 14** Disconnect the accelerator cable from the carburettor bracket.
- 15** Disconnect the choke cable from the carburettor.
- 16** Disconnect the inlet manifold hoses at the manifold adaptor.
- 17** Disconnect the advance and retard/fuel trap pipe from the carburettor.
- 18** Disconnect the accelerator return spring from the throttle linkage.

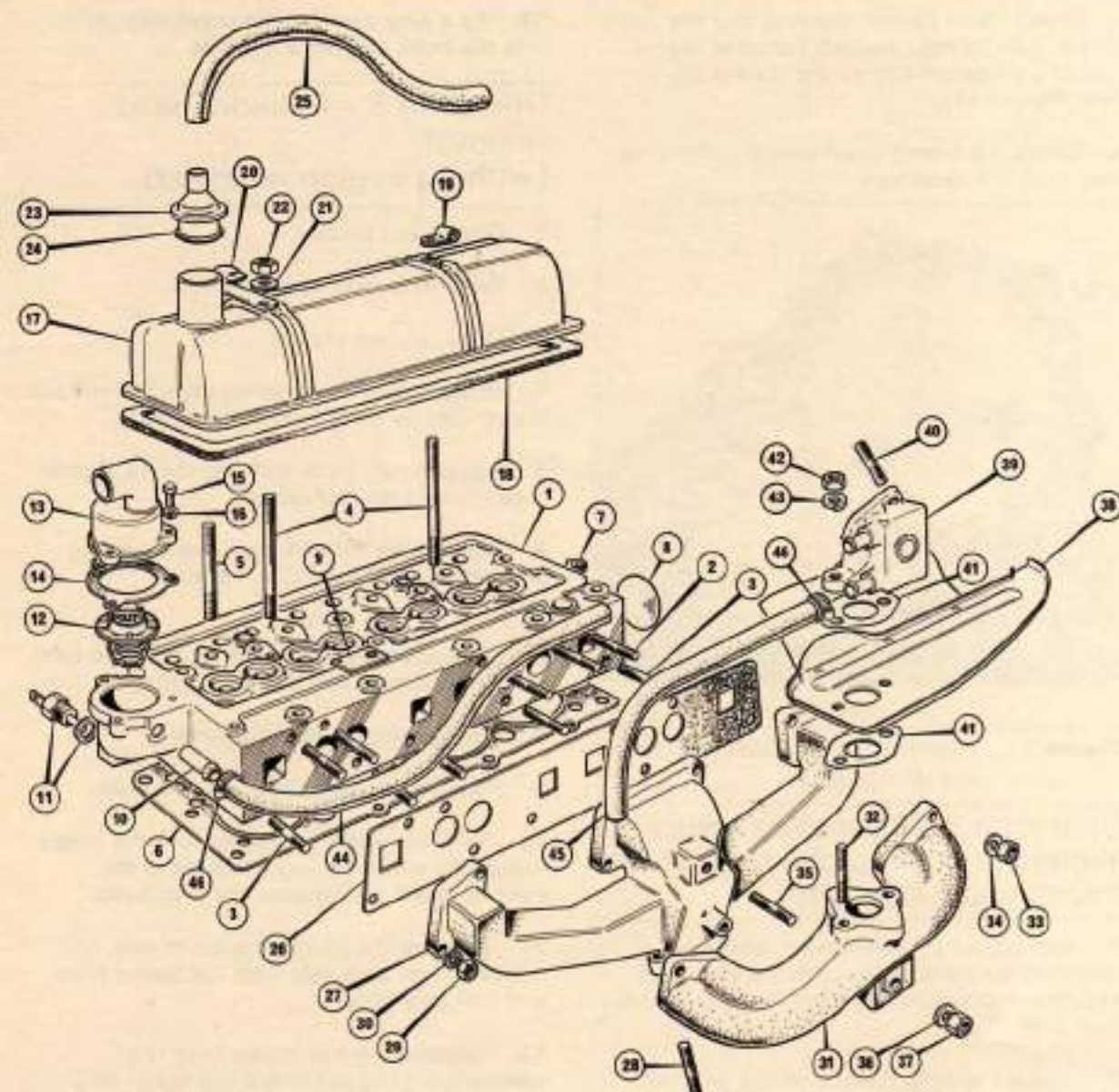


Figure 12 Cylinder head and manifolds – exploded

1 Cylinder head	16 Washer	31 Manifold, inlet
2 Stud	17 Rocker cover	32 Stud, manifold
3 Stud	18 Gasket, cover	33 Nut, manifold
4 Stud	19 'P' clip	34 Lockwasher, manifold
5 Stud	20 Support bracket	35 Stud
6 Gasket	21 Washer	36 Washer
7 Plug, oilway	22 Nut	37 Nut
8 Core plug	23 Oil filler cap	38 Drip tray
9 Plate, return spring	24 'O' ring, cap	39 Manifold adaptor
10 Connection, hose	25 Breather pipe	40 Stud
11 Temperature transmitter	26 Gasket, exhaust manifold	41 Gasket
12 Thermostat	27 Manifold, exhaust	42 Nut
13 Water outlet branch	28 Stud, downpipe	43 Lockwasher
14 Gasket	29 Nut, manifold	44 Hose
15 Set screw	30 Washer, manifold	45 Hose
		46 Clip

19 Remove the nut securing the carburettor abutment bracket to the carburettor.

20 Remove the remaining nut securing the carburettor to the manifold. Remove carburettor complete with gasket.

21 Remove two nuts and washers and remove the adaptor from the manifold studs, complete with gasket.

22 Remove the drip tray complete with gasket.

The engine

23 Remove the four nuts securing the rocker shaft. Remove the rocker shaft assembly.

24 Remove the eight push rods, carefully noting their correct order for subsequent replacement.

25 Disconnect the downpipe from the exhaust manifold, secured by two nuts.

26 Remove the three nuts and lockwashers securing the cylinder head to the cylinder block on the spark plug side.

27 Remove the three bolts securing the thermostat housing to the cylinder head.

28 Remove the nut securing the dipstick support bracket and earth lead to the cylinder head.

29 Remove the 12 nuts and washers securing the cylinder head to the cylinder block studs.

30 Remove by-pass hose from thermostat housing, fitted on early vehicles only.

31 Carefully lift the cylinder head complete with inlet and exhaust manifolds from the cylinder block. Replace in reverse order, after cleaning the cylinder head and block faces and fitting a new gasket.

To ensure a good seal when replacing the cylinder head, smear grease around the metal edges of the gasket bore eyelets.

Tighten the cylinder head nuts to a torque of 3.46 kg m (25.0 lb ft) in the sequence shown in

Figure 13. The three nuts fitted to the spark plug side of the cylinder head should be tightened to a torque of 2.07 kg m (15 lb ft).

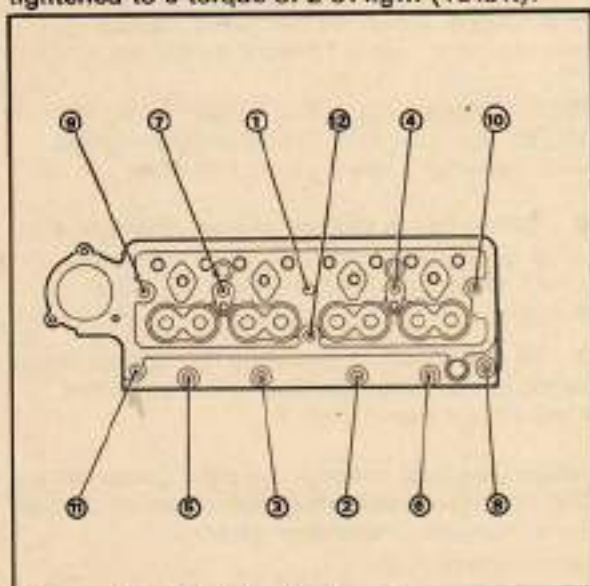


Figure 13 Cylinder head nut tightening sequence

Operation 10 – Cylinder head decarbonise (with cylinder head removed)

1 Remove the spark plugs.

2 Remove the nuts and lockwashers securing the inlet and exhaust manifolds to the cylinder head. Remove the manifolds and carefully remove the manifold gasket.

3 Using a suitable valve spring compression tool, remove the valves from the cylinder head, keeping in correct order. Retain the valve springs, cups and cotters for inspection.

4 Check the inlet and exhaust valve guides for wear and renew if necessary.

5 If valve guides are worn remove them using tool No. RT 7478 (see **Figure 14**).

6 Examine the valve seats for pitting and wear. Reface where necessary, removing the minimum of material.

7 Examine the valves for burning and reface if necessary. Replace any valves having bent or worn stems.

8 Test the valve springs for fatigue to the dimensions given in the data at the end of this section.

9 Remove carbon deposits from the combustion chambers and ports. Use a piece of sharpened wood to break up the carbon, and then polish with wire wool.

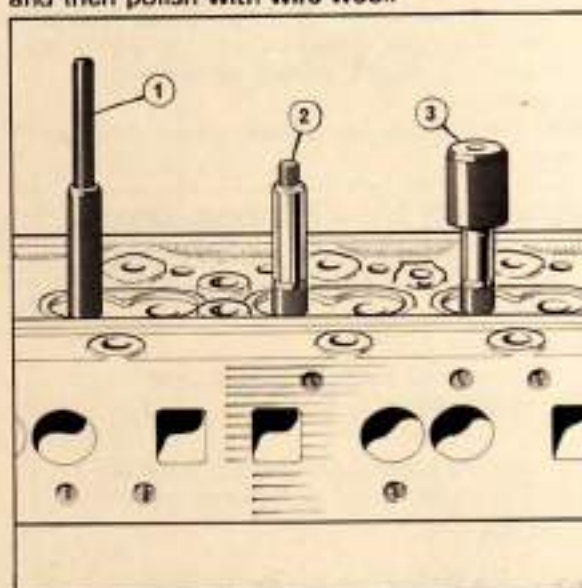


Figure 14 Valve guide removal and replacement

- 1 Valve guide removal
- 2 Valve guide replacement
- 3 Valve guide protection sleeve

10 Clean the face of the cylinder head and remove all traces of carbon and any high spots.

11 Clean out the water ways.

If deposits exist on the piston crowns proceed as follows:

(a) Turn the crankshaft until the Nos. 1 and 4 pistons are at TDC.

(b) Fill the Nos. 2 and 3 cylinder liner bores with clean non-fluffy rag to prevent carbon falling into the bores, and cover the cam follower apertures.

(c) Carefully, without scoring the piston crown, remove the carbon deposits leaving a band of carbon approximately 3.1 mm ($\frac{1}{8}$ in) wide around the periphery of the piston crown, on No. 1 piston. Avoid carbon particles falling into the cylinder block water ways. Repeat for No. 4 piston.

(d) Turn the crankshaft to enable pistons 2 and 3 to be cleaned.

To replace

1 Clean the cylinder block face, removing all traces of carbon and any high spots.

2 Replace valve guides in cylinder head using tool No. RT 7478 (see **Figure 14**).

3 Lap-in the valves using fine grinding paste until a gas-tight joint is obtained. Ensure valves are replaced in original positions and that no grinding paste particles remain.

4 Lubricate the valve stems with clean engine oil and assemble to the cylinder head. Ensure that valve spring collars and split cotters are correctly seated. Renew valve stem oil seals.

Refit the cylinder head, using a new cylinder head gasket.

Operation 11 – Pistons, connecting rods and bearing replacement (with cylinder head and sump removed)

To remove

1 Remove oil pump assembly (see **Operation 4**).

2 Turn the crankshaft to bring numbers 1 and 4 connecting rod bolts to an accessible position.

3 Check the identifying marks on the connecting rods and bearing caps. Mark if necessary.

4 Release the locking plates, unscrew the bolts and remove the big end bearing caps, complete with the lower half bearing shells.

5 Push the connecting rods and pistons upwards and carefully withdraw, identifying for reassembly.

6 Match up the top and bottom bearing shells and caps with their respective connecting rods and piston assemblies.

Overhaul

1 Immerse piston and con rod assemblies in hot water for a few minutes, then release the gudgeon pin retaining circlips.

2 Using a suitable drift remove the gudgeon pins and disconnect the con rods from the pistons.

3 Check the small end bushes for wear and, if necessary, renew using a suitable hand press to remove the old bushes and fit new. Ensure that the oil hole in the bush corresponds with the hole in the connecting rod.

4 Having pressed in new small end bushes, check that they will accept new gudgeon pins, for it may be necessary to ream out the bushes with an expanding reamer until a tight push fit is obtained.

Note: It is important during this operation that the bush is reamed squarely to the con rod to ensure correct alignment.

5 Remove the piston rings with an expander tool and clean.

6 Clean the pistons, removing all carbon deposits, particularly from the piston ring grooves.

7 Assemble pistons to the connecting rods, securing in position with the gudgeon pins and circlips. It may be necessary to heat the pistons in hot water to facilitate the operation.

Note: Engines up to No. 5J/85/25866 have angled con rods which must be assembled with cutaway angle on camshaft side.

8 Before fitting the piston rings, position the rings in their appropriate liners for gapping, which should be 0.17-0.30 mm (0.007-0.012 in).

9 Fit the piston rings, fitting the scraper ring in the lower piston groove, followed by the taper compression ring.

Note: The 'top' mark on the taper compression ring must face uppermost. The upper groove in the piston accommodates the plain compression ring.

10 Insert the piston and connecting rod assemblies into the appropriate bores.

ensuring that the 'front' mark on the piston crowns are facing forward. The piston rings should be arranged so that the gaps are equi-spaced around the piston circumference, i.e. 120° apart, ensuring that no gap is in line with the gudgeon pin. Compress the rings using a tool similar to that shown in **Figure 15**.

11 Fit new big end bearings into the connecting rod end caps.

12 Pull down the connecting rod and locate onto the crankshaft, position the caps and secure in position with bolts and locking plates, tightening to a torque of 2.90 kg m (21 lb ft). Ensure that the correct con rod caps are fitted to the corresponding con rods.

13 Replace oil pump assembly, sump and cylinder head.

Operation 12—Crankshaft removal and installation (with sump, front cover, flywheel, rear oil seal cover, connecting rods and camshaft sprocket removed)

- 1** Remove two bolts and lockwashers and detach the camshaft retaining plate.
- 2** Unscrew two nuts, complete with lockwashers and remove front engine plate and gaskets from cylinder block.
- 3** Unscrew four set screws and remove the rear engine plate from the cylinder block.
- 4** Remove four screws and detach the front and rear bridge pieces from the cylinder block.
- 5** Disconnect all three main bearing caps, each secured by two nuts and washers.
- 6** The crankshaft can now be withdrawn from the cylinder block.

Overhaul

- 1** Inspect and check crankshaft main bearing journals.
- 2** Fit new bearing shells to crankshaft and bearing caps (see data for reground journal and oversize bearings available).
- 3** Position the crankshaft complete with bearing shells and refit 'rear' and 'centre' bearing caps.
- 4** Locate the upper half of the thrust washer in the register on the inside face of the crankshaft bearing bore in the crank case,

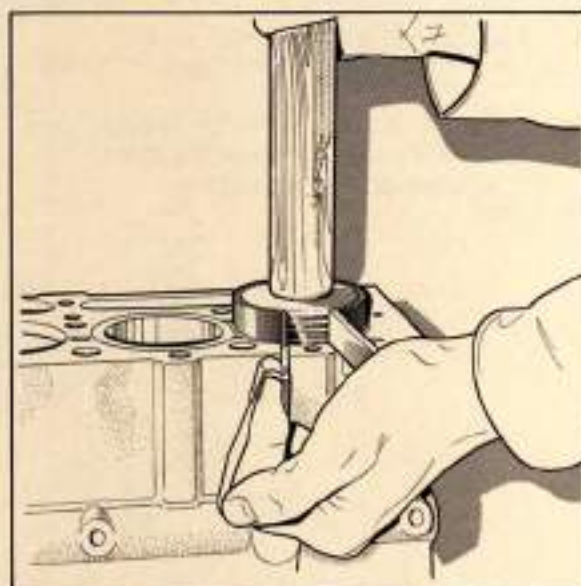


Figure 15 Compressing rings for refitting pistons

5 Position the 'front' bearing cap and locate the lower half of the thrust washer in the register in the cap inside face.

Note: The thrust washer is fitted so that the 'thrust face', identified by oil grooves, bears against the crankshaft ground face.

- 6** Fit new bearing cap nuts and washers and tighten to a torque of 3.31 kg m (24 lb ft). Check the crankshaft end float as follows:
 - (a) Assemble the two halves of the outer thrust washer in the register on the outside face of the 'front' bearing cap and block. Ensure that the oil grooves are facing forwards.
 - (b) Position the steel countersunk thrust washer, against the by-metal thru it washer halves, with its countersunk aperture facing rearwards.
 - (c) Replace crankshaft sprocket spacer and sprocket.
 - (d) Position crankshaft pulley and secure with bolt, plain washer and lockwasher.
 - (e) Turn crankshaft assembly to ensure freedom of movement and secure a dial gauge to the crank case so that the indicator plunger rests, in a loaded condition, against a machined surface on a crankshaft balance weight.
 - (f) Carefully strike the rear end of the crankshaft with a hide mallet to force the shaft against the dial indicator plunger. Zero the dial.
 - (g) Carefully strike the pulley end of the crankshaft to force it in the opposite direction and note the gauge reading, which should indicate 0.0764-0.279 mm (0.003-0.011 in).
 - (h) If necessary, adjust end float by removing the front main bearing cap and existing thrust washers and renewing with thrust washers of a suitable thickness (see data at end of this section, page 21).

Refit bearing cap complete with shell bearings and recheck the end float.

Note: The end float may also be checked with feeler gauges inserted between the thrust washer and the ground face of the crankshaft.

To replace

Replace components in reverse order.

Note: When refitting front and rear bridge pieces care should be taken to ensure that their faces mate flush with the cylinder block face. New cork inserts should be fitted when replacing bridge pieces.

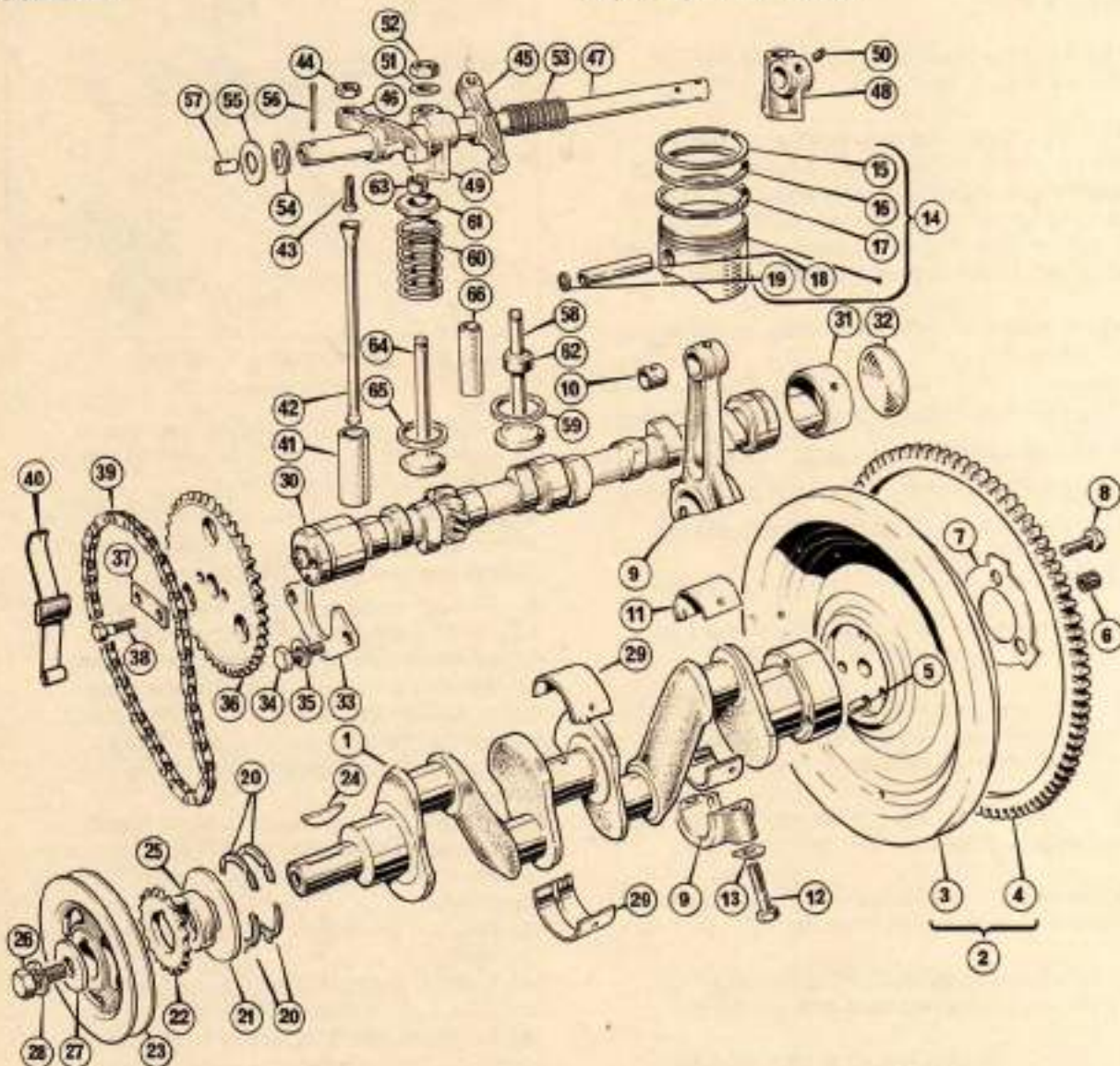


Figure 16 Engine, crankshaft and camshaft – exploded

1 Crankshaft	18 Gudgeon pin	35 Lockwasher	52 Nut
2 Flywheel assembly	19 Circlip	36 Sprocket	53 Spring, rocker shaft
3 Flywheel	20 Thrust washer, crankshaft	37 Plate	54 Spring, rocker shaft end
4 Gear, flywheel	21 Thrust washer, crankshaft	38 Screw	55 Washer
5 Dowel	22 Sprocket	39 Timing chain	56 Split pin
6 Bearing, crankshaft	23 Pulley	40 Tensioner, timing chain	57 Plug
7 Tabwasher, flywheel	24 Key	41 Tappet	58 Valve, inlet
8 Set screw	25 Spacer	42 Push rod	59 Insert, inlet valve
9 Connecting rod	26 Bolt	43 Screw	60 Spring valve
10 Small end bearing	27 Washer	44 Locknut	61 Cup, valve spring
11 Big end bearing	28 Lockwasher	45 Rocker, LH	62 Seal, valve stem
12 Bolt	29 Main bearing crankshaft	46 Rocker, RH	63 Cotter, valve
13 Plate	30 Camshaft	47 Rocker shaft	64 Valve, exhaust
14 Piston assembly	31 Bearing, camshaft	48 Bracket	65 Insert, valve outlet
15 Compression ring	32 Core plug	49 Bracket	66 Guide, valves
16 Taper ring	33 Plate	50 Screw	
17 Scraper ring	34 Bolt	51 Washer	

Operation 13 – Camshaft removal and installation (with timing chain and sprocket removed)

Removal

- 1 Remove engine assembly (see **Operation 1**).
- 2 Unscrew two nuts and lift off the rocker cover and sealing gasket.
- 3 Remove four nuts and washers from the rocker shaft support bracket and remove the complete rocker assembly.
- 4 Withdraw the eight push rods keeping them in their correct order.
- 5 Remove cylinder head and distributor.
- 6 Remove sump (see **Operation 3**).
- 7 Remove two nuts, complete with lockwashers, and remove the oil pump assembly, complete with filter, from the cylinder block.
- 8 Knock out the pin securing the thrust muff to the distributor and oil pump driveshaft which can then be removed upwards through the distributor aperture.
- 9 Remove the two bolts, and lockwashers, securing the camshaft retaining plate.
- 10 Unscrew three nuts and washers and remove the front engine mounting plate from the cylinder block, including the gasket.

- 11 Lift the tappets up through the cylinder block and carefully withdraw the camshaft.

To replace

Replace in reverse order, fitting new gaskets where applicable.

Note: When refitting the distributor driveshaft ensure the large 'D' of the driving gear offset dog is facing towards the block at No. 1 piston, i.e. slot in a '5 minutes past 7 o'clock' position.

Take the opportunity of checking the camshaft end-float, which should be within 0.064-0.16 mm (0.0025-0.0065 in). Pull the camshaft out against the retaining plate, and insert a feeler gauge between the groove and the retaining plate. Reduce the end-float by fitting a new retaining plate. The camshaft retaining plate, fitted as original equipment, is 4.621 mm (0.182 in) thick. A service plate 5.258 mm (0.207 in) thick is available to counteract any end-float, but it may, of course, be necessary to reduce this thickness to give correct end-float, dependent on amount of wear.

Operation 14 – Camshaft bearing removal and replacement (with camshaft removed)

Removal

- 1 Remove flywheel (see **Operation 2**).
- 2 Unscrew four set screws and remove the rear engine plate from the cylinder block.
- 3 Drill a hole in the camshaft core plug and prise from the cylinder block.

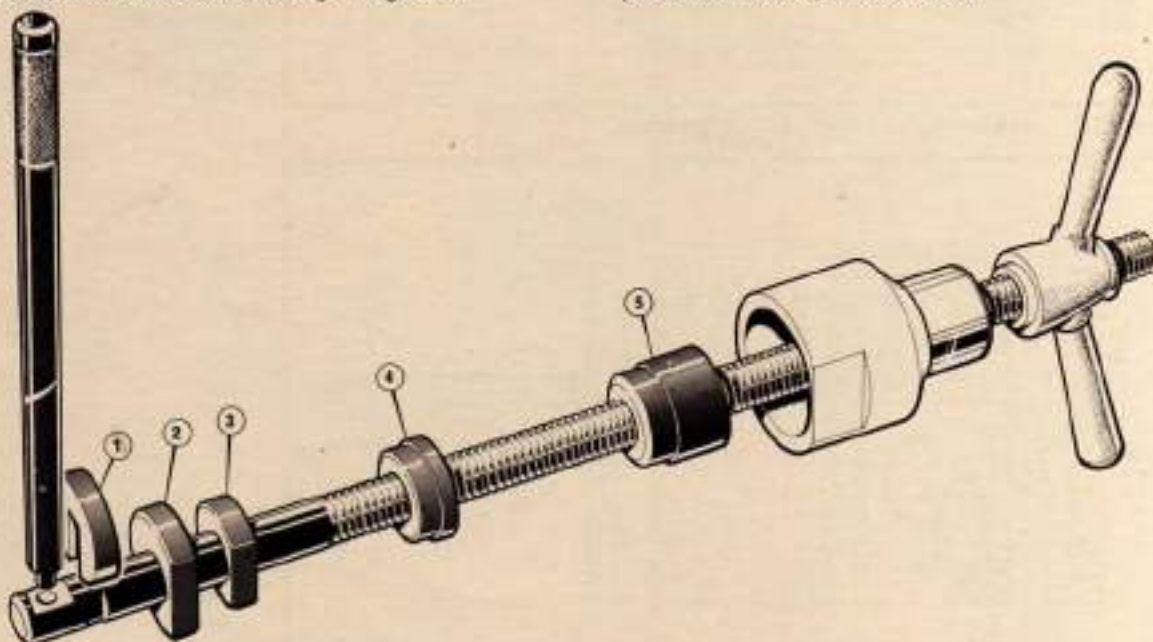


Figure 17 Camshaft bearing removal and replacement tool

1 Horseshoe
2 Large 'D' washer

3 Small 'D' washer
4 Mandrel

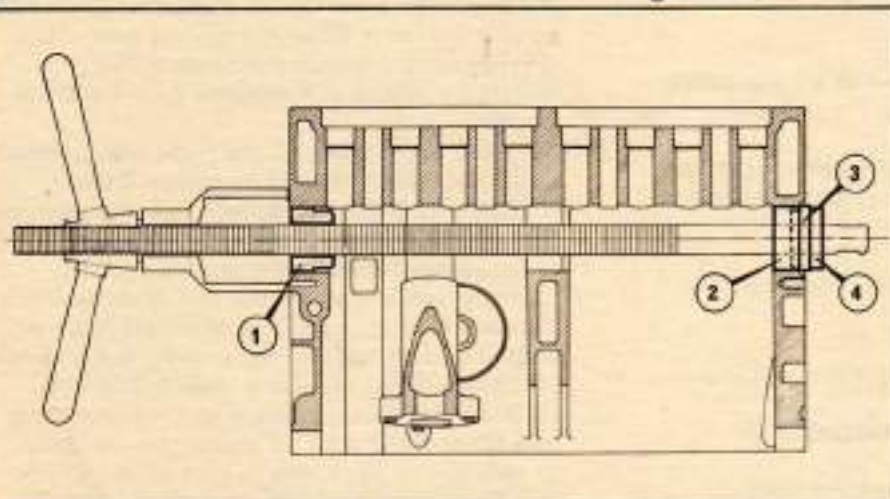
5 Pilot

4 Press out the rear, centre and front camshaft bearings using general tool No. 18G 124A and tool No. 7482 (see **Figure 17**) as follows:

(a) Insert general tool and position pilot, mandrel and horseshoe as shown in **Figure 18**.

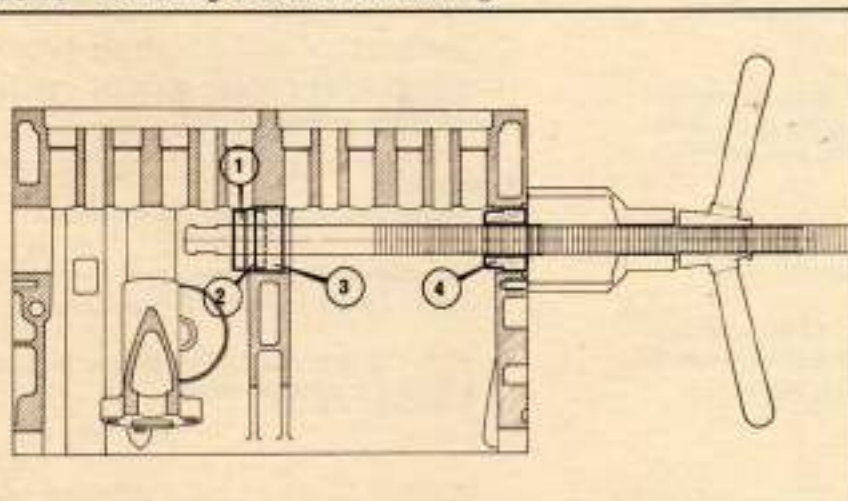
(b) Applying firm pressure rotate the general tool handle until the camshaft rear bearing is removed completely from its location.

(c) To remove centre and front camshaft bearings position the general tool and components as shown in **Figure 19** and **Figure 20**.



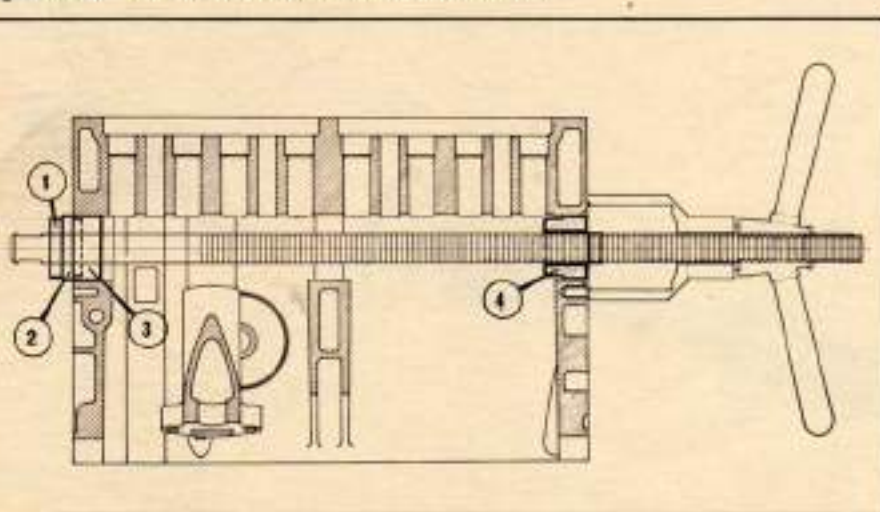
- 1 Pilot
- 2 Bearing
- 3 Mandrel
- 4 Horseshoe

Figure 18 Removing camshaft rear bearing



- 1 Horseshoe
- 2 Mandrel
- 3 Bearing
- 4 Pilot

Figure 19 Removing camshaft centre bearing



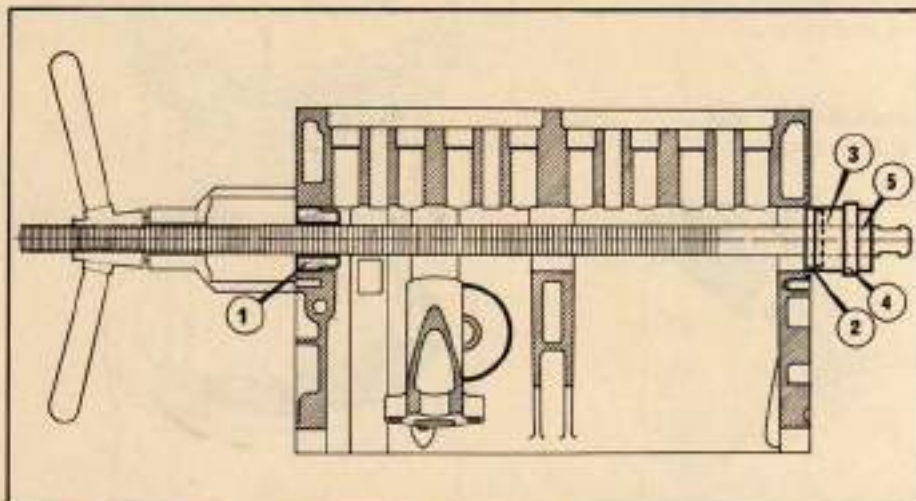
- 1 Horseshoe
- 2 Mandrel
- 3 Bearing
- 4 Pilot

Figure 20 Removing camshaft front bearing

To replace

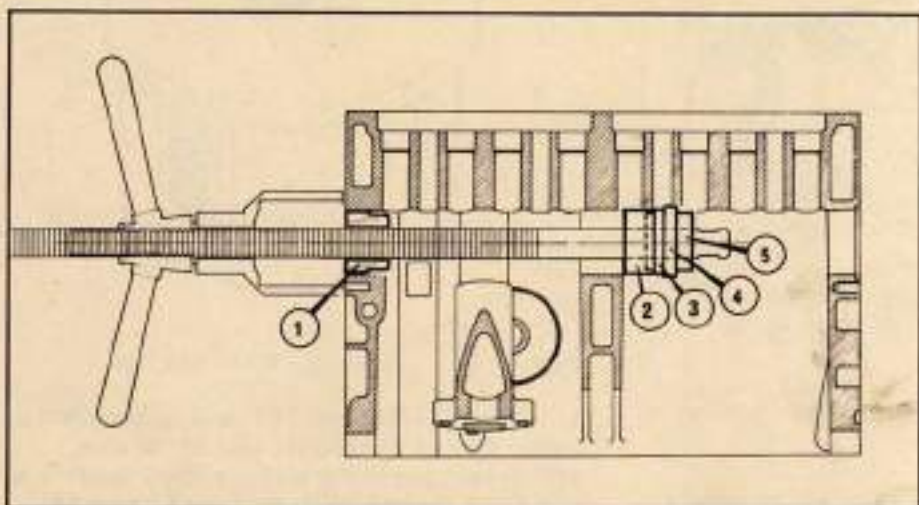
1 To replace camshaft bearings position the general tool and components as shown in **Figures 21, 22 and 23.**

Note: Ensure that the oil holes in the bearing shells correspond to those in the cylinder block.



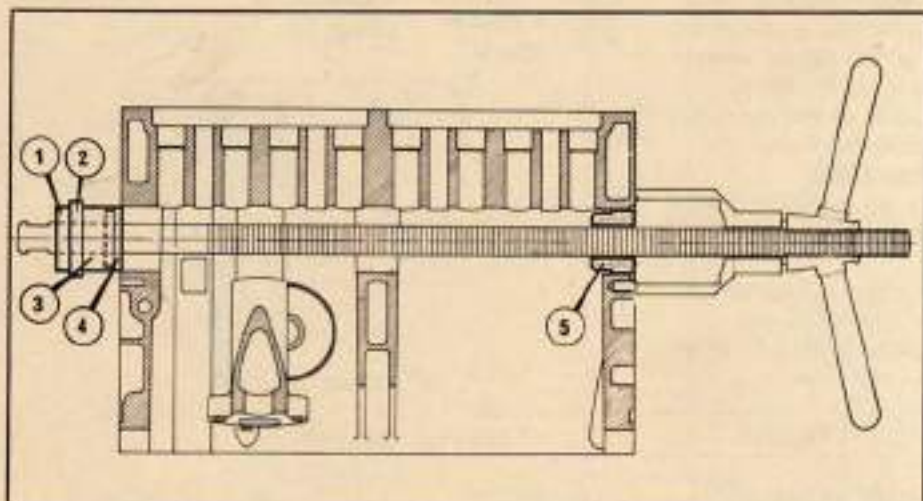
- 1 Pilot
- 2 Mandrel
- 3 Bearing
- 4 Small 'D' washer
- 5 Horseshoe

Figure 21 Replacing camshaft rear bearing



- 1 Pilot
- 2 Bearing
- 3 Mandrel
- 4 Small 'D' washer
- 5 Horseshoe

Figure 22 Replacing camshaft centre bearing



- 1 Horseshoe
- 2 Large 'D' washer
- 3 Bearing
- 4 Mandrel
- 5 Pilot

Figure 23 Replacing camshaft front bearing

Operation 15 – Cylinder liner replacement

Follow the dismantling procedure outlined in operations 1 to 14 and then continue as follows:

- 1 Extract the four liners from the cylinder block using a tool similar to that shown in **Figure 24**.

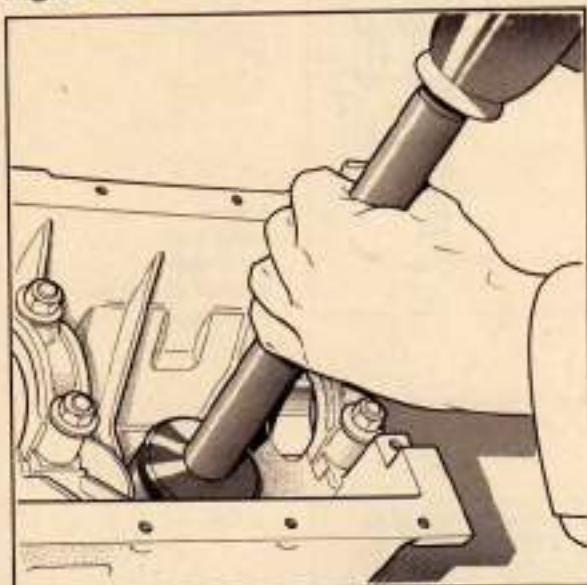


Figure 24 Removing cylinder liners

- 2 Remove all signs of sealing compound from both the liners and their seats in the cylinder block.

- 3 Measure the liner bores for taper, ovality and maximum wear.

Note: Cylinder liners are manufactured in different grade sizes and are graded as high, low or mean. Pistons are similarly graded and it is important that a piston and cylinder liner should be of the same grade. The grade of the piston is stamped on top of the piston with the appropriate grade letter, i.e. H–High, L–Low, M–Mean. The grade of the cylinder liner is marked on the outside wall with the appropriate letter (see **Figure 25**).

Pistons and cylinder liners are available from the Spares Department of your Dealer in matched pairs.

It should be noted that if pistons or cylinder liners, available separately, are fitted, the appropriate part number with a suffix H, L or M should be quoted when ordering.

Operation 16 – Engine rebuild

The following information covers the rebuilding of an engine that has been completely dismantled, e.g. to replace liners, etc.



Figure 25 Piston and liner markings

- 1 Smear ICI 'Silcoset 152' sealing compound, thinly, around the seating face of the liner and its location in the cylinder block, making a thin but complete 360° seal (see **Figure 26**).

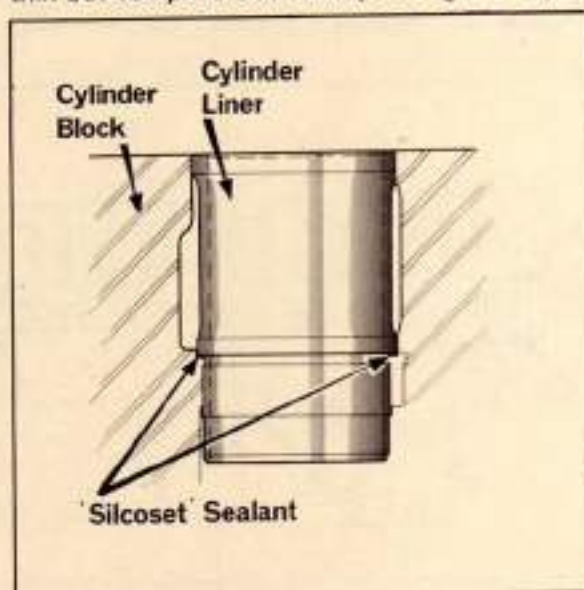


Figure 26 Sealing cylinder liners

2 Using a tool similar to that shown in **Figure 27**, insert the liners into the block and ensure that they stand proud 0.050-0.152 mm (0.002-0.006 in) from the cylinder block face. Check that there is 0.381 mm (0.015 in) clearance between liners.



Figure 27 Fitting cylinder liners

3 Assemble new pistons to the connecting rods, securing in position with the gudgeon pins and circlips. To facilitate this operation heat the pistons in hot water.

4 Before fitting the piston rings position in the appropriate liners for gapping, which should be 0.17-0.30 mm (0.007-0.012 in).

5 Insert the piston and connecting rod assemblies into the cylinder liners with the scraper and compression rings in their correct grooves and the ring gaps in their correct locations as described in **Operation 11**. Compress the rings for installation using a compression tool, similar to that shown in **Figure 15**.

6 Fit new big end bearings in the connecting rods and caps. Ensure the correct bearing sizes are used, see engine data.

7 Check crankshaft main bearing journals, see engine data.

8 Fit new main bearings to crankshaft and bearing caps.

9 Fit new thrust washers to the crankshaft ensuring the thrust face of the first washer makes good contact with the ground face of the crankshaft.

10 Replace crankshaft to cylinder block, fit main bearing caps in correct order, rear, centre and front, securing with six nuts and plain washers. Always fit new bearing cap nuts and tighten to a torque of 3.316 kg m (24 lb ft).

11 Fit a new oil seal into the rear cover, position a new gasket and secure the rear cover to the cylinder block ensuring the dowels are firmly seated in their locations.

12 Fit front and rear bridge pieces with cork packing, ensuring the end faces are flush with the cylinder block, and secure with the four screws.

13 Replace the rear engine plate, fixing with four set screws and lockwashers.

14 Fit flywheel assembly to crankshaft and secure with three bolts and tabwashers, tightening to a torque of 3.87-4.14 kg m (28-30 lb ft). Check flywheel run out (see **Operation 2**).

15 Replace front engine plate and new gasket to the cylinder block and secure with three nuts and lockwashers.

16 Fit the crankshaft outer thrust washers with the oil slots facing forward, followed by the steel thrust washer with its countersunk aperture facing rearwards.

17 Fit the Woodruff key sprocket spacer and crankshaft sprocket.

18 Using the crankshaft pulley or flywheel, turn the crankshaft until the Woodruff key is pointing to '11 o'clock'.

19 Turn the camshaft so that the groove in the end of the camshaft is in alignment with the Woodruff key on the crankshaft.

20 Replace the camshaft sprocket along with the timing chain and secure with two bolts and the locking plate.

21 Using a straight edge, check the camshaft sprocket is in alignment with the crankshaft sprocket. The valve timing mark on the camshaft sprocket should now be pointing to the Woodruff key on the crankshaft.

22 Check timing chain tensioner for wear, renew if necessary, and locate on the lug in the timing chain cover.

23 Fit the timing chain cover and new gasket to the front engine plate, using centralising tool No. RT 7481, and secure with seven bolts, two nuts and lockwashers (see **Figure 10**).

24 Replace crankshaft pulley and secure with bolt, plain washer and lockwasher.

25 Locate a new gasket and then fit the oil pump assembly, complete with filter, securing to the cylinder block with two nuts and lockwashers. Refit oil pump and distributor drive shaft.

26 Fit a new gasket and replace the sump, tightening the fifteen set screws, spacing washers and lockwashers evenly.

27 Clean the cylinder head and cylinder block faces and fit a new gasket. Smear grease around the metal edges of the gasket bore eyelets.

28 Carefully position the cylinder head squarely on the cylinder block and secure with the twelve nuts, plain washers and lockwashers. Replace the three nuts on the spark plug side of the cylinder head. Check that all cylinder head nuts indicated in **Figure 13** are tightened, in the order shown, to a torque of 3.46 kgm (25 lbft). The three remaining nuts, on the spark plug side, should be tightened to a torque of 2.07 kgm (15 lbft).

29 Replace the push rods ensuring they are replaced in their correct order.

30 Locate the rocker shaft assembly on the four studs and secure firmly with the four nuts and washers to a torque of 2.35-3.04 kgm (17-22 lbft). Check tappet clearance (see **Operation 17**).

31 Fit a new gasket and replace the rocker cover securing in position with the two nuts and washers.

32 Replace all ancillaries.

33 Install the engine and gearbox assembly (see **Operation 1**).

Operation 17 – Valve clearance – tappet adjustment

Tappet clearances are 0.152 mm (0.006 in) cold, 0.254 mm (0.010 in) hot.

To adjust

- 1 Remove rocker cover, secured by two nuts.
- 2 Remove spark plugs.
- 3 Turn engine in normal running direction in order to open and close the valves and check

in the following order:

- No. 1 valve with No. 8 valve fully open
- No. 2 valve with No. 7 valve fully open
- No. 3 valve with No. 6 valve fully open
- No. 4 valve with No. 5 valve fully open
- No. 5 valve with No. 4 valve fully open
- No. 6 valve with No. 3 valve fully open
- No. 7 valve with No. 2 valve fully open
- No. 8 valve with No. 1 valve fully open

If adjustment is required, insert a screwdriver blade in the slot in the adjustment screw and slacken the locknut. Turn the adjustment screw clockwise to decrease and anti-clockwise to increase the gap.

Check the gap and tighten the locknut. When adjustment is made the valve must be in the fully closed position (**Figure 28**).

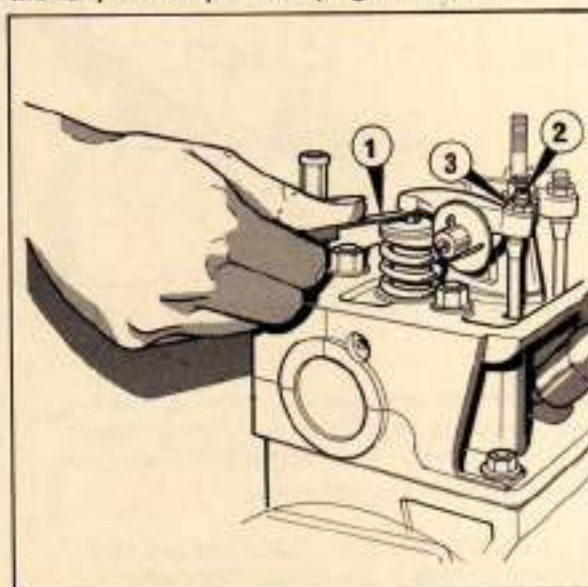


Figure 28 Valve clearance – tappet adjustment

- 1 Feeler gauge
- 2 Adjusting screw
- 3 Locknut

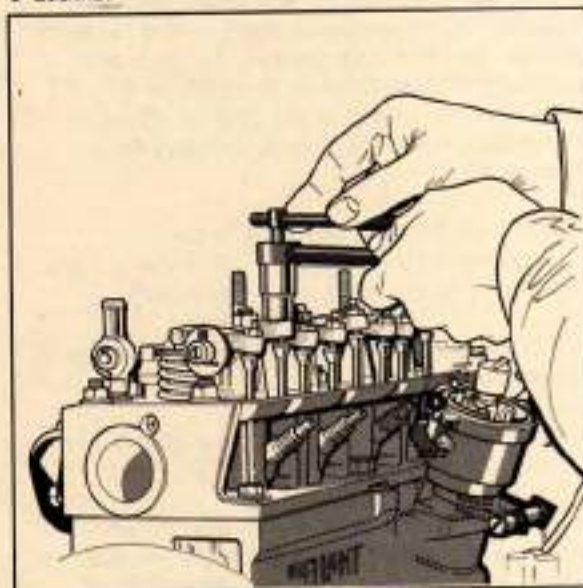


Figure 29 Tappet adjustment tool

4 Refit spark plugs, connecting HT leads in correct sequence.

5 Refit rocker cover, renewing gasket if necessary, and secure with nuts and washers; tighten to a torque of 0.14 to 0.3kgm (1 to 2lb ft).

Alternatively, the valve clearances and tappets can be adjusted, using general tool No. 6500A (see **Figure 29**).

Stud removal

Damaged studs can be removed using extractor tool, part number 450A, in conjunction with the tappet adjustment wrench, general tool part number 6500A, as shown in **Figure 30**.

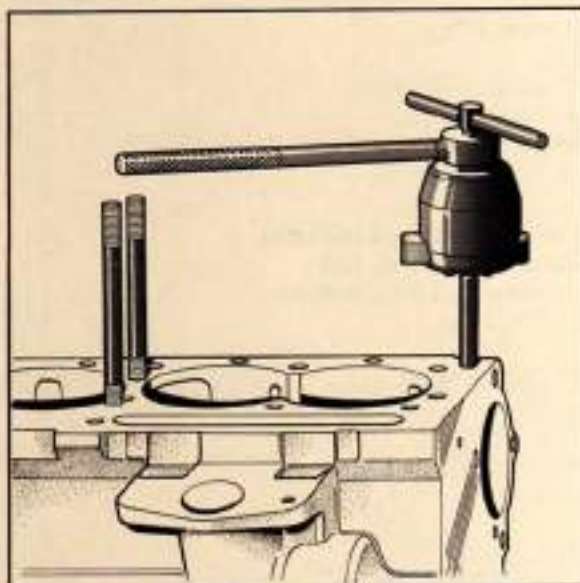


Figure 30 Stud removal tool

Engine specification

Cylinder head

Material
Joint washer thickness

Aluminium alloy
1.02 mm (0.040 in)

Cylinder block

Material

Aluminium alloy with cast iron liners

Crankshaft

Material
Main bearing journals
Crankpin journals
End-float

Forged high tensile steel
50.787-50.800 mm (1.995-2.00 in)
33.32-33.33 mm (1.3120-1.3125 in)
0.0764 mm (0.003 in) min.
0.279 mm (0.011 in) max.

Crankshaft regrinding size

1st undersize
Main bearing journals
Crankpin journals
2nd undersize
Main bearing journals
Crankpin journals
3rd undersize
Main bearing journals
Crankpin journals

0.254 mm (0.010 in)
50.533-50.546 mm (1.988-1.989 in)
33.07-33.08 mm (1.3020-1.3025 in)
0.508 mm (0.020 in)
50.279-50.292 mm (1.978-1.979 in)
32.81-32.82 mm (1.2920-1.2925 in)
1.016 mm (0.040 in)
49.771-49.784 mm (1.959-1.960 in)
32.31-32.32 mm (1.2720-1.2725 in)

Note: Connecting rod, big end bearing shells are available to suit crankshafts reground to the above sizes.

Crankshaft thrust washer sets

Oversize sets available

0.0635 mm (0.0025 in)
0.1270 mm (0.0050 in)
0.1905 mm (0.0075 in)
0.254 mm (0.010 in)

Pistons

Material
Size
All lands
At skirt

Low expansion aluminium alloy
62.53 mm (2.462 in)
62.17-62.26 mm (2.448-2.451 in)
62.47-62.50 mm (2.459-2.638 in)

Piston rings

Gap	0.17-0.30 mm (0.007-0.012 in)
Width (compression)	1.245-1.250 mm (0.049-0.050 in)
Groove clearance	0.038-0.089 mm (0.0015-0.0035 in)
Width (scraper)	3.150-3.175 mm (0.124-0.125 in)
Groove clearance	0.038-0.089 mm (0.0015-0.0035 in)

Overize rings available

Compression ring, top	0.254 mm (0.010 in)
Compression ring, bottom	0.254 mm (0.010 in)
Scraper ring	0.254 mm (0.010 in)

Gudgeon pin

Diameter	14.283-14.288 mm (0.5623-0.5625 in)
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Small end bush

Bore	14.292-14.298 mm (0.562-0.563 in)
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Camshaft

Bearing diameter	38.66-38.67 mm (1.521-1.522 in)
Bearing clearances	0.0254-0.0889 mm (0.0010-0.0035 in)
End-float	0.064-0.16 mm (0.0025-0.0065 in)
Chain pitch	9.525 mm (0.375 in)
Number of pitches	50

Valves

Seat angle	45°-45° 30'
Seat width	
Inlet	1.397-1.524 mm (0.055-0.060 in)
Exhaust	1.397-1.524 mm (0.055-0.060 in)
Valve lift	25.42 mm (1.00 in)
Valve guide lengths (inlet and exhaust)	41.40-41.86 mm (1.630-1.640 in)
Valve guide clearance	0.0381-0.0889 mm (0.0015-0.0035 in)

Valve springs

Free length	39.62 mm (1.56 in)
Fitted length and load	34.11 mm (1.343 in) at 17.01 kg (37.50 lb)
Length and load valve open	28.60 mm (1.125 in) at 39.60 kg (87.30 lb)

Flywheel

Material	Chromium cast iron
Diameter	246.126 mm (9.69 in)

Starter ring

Number of teeth	100
Diameter over teeth	257.81 mm (10.15 in)

Crankshaft identification

Colour code	-0.254 mm (-0.010 in) red
	-0.508 mm (-0.020 in) blue
	-1.016 mm (-0.040 in) green