

## CYLINDER HEAD

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#### To Remove the Cylinder Head

1. Drain the cooling system.
2. Disconnect battery terminals.
3. Detach the exhaust pipe.
4. Remove the atomiser leak-off pipe assembly.
5. Remove the fuel pipes from the fuel injection pump outlet and inlet to filter.
6. Disconnect fuel pipe from fuel lift pump outlet to fuel filter. Remove fuel filter.
7. Remove breather assembly.
8. Remove high pressure fuel pipes and atomisers (Fig. 2).
9. Disconnect fuel pipe and electrical lead at the thermostart.

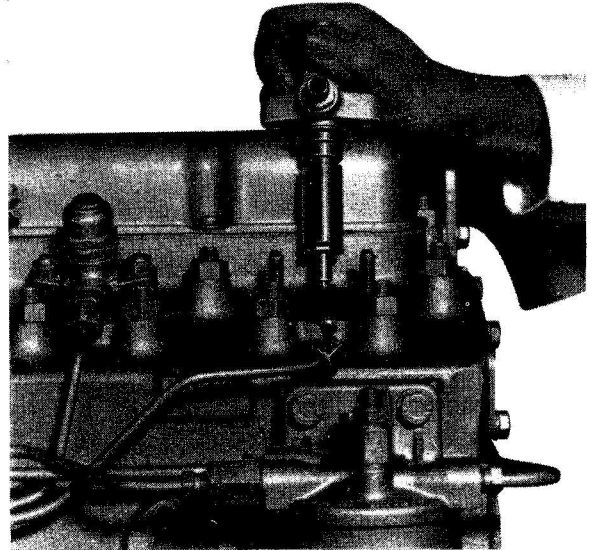


Fig. 2

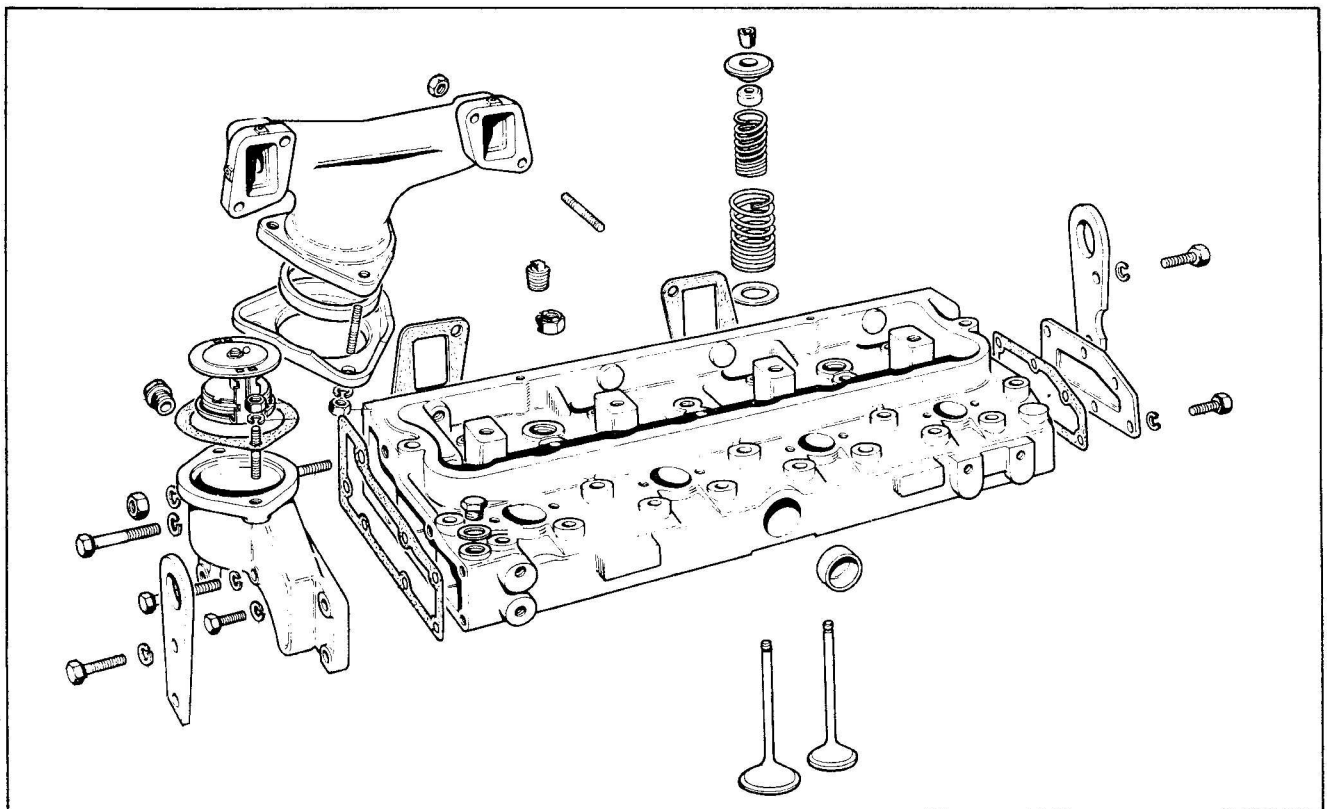


Fig. 1

10. Remove air filter and/or connecting hose. Remove induction and exhaust manifolds.
11. Detach cylinder head cover.
12. Remove rocker assembly from cylinder head (Fig. 4). Remove push rods.
13. Remove cylinder head nuts/setscrews in reverse order of tightening sequence shown in Fig. 11.
14. Remove cylinder head.

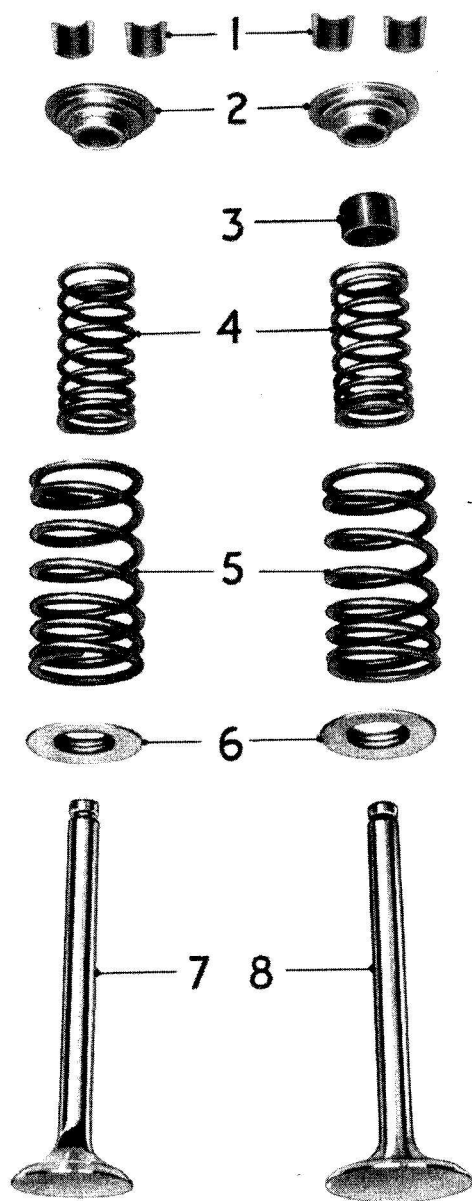


Fig. 3

- |                       |                       |
|-----------------------|-----------------------|
| 1. COLLETS            | 5. OUTER VALVE SPRING |
| 2. VALVE SPRING CAP   | 6. VALVE SPRING SEAT  |
| 3. OIL DEFLECTOR      | 7. EXHAUST VALVE      |
| 4. INNER VALVE SPRING | 8. INLET VALVE        |

#### To Remove the Valves

Mark all valves with a corresponding mark on the cylinder head to ensure that valves are refitted to their original positions unless replaced with new ones. Earlier engines had their valves and heads numbered during assembly as illustrated in Fig. 6.

1. Compress spring caps and springs with a suitable valve spring compressor (Fig. 5) and remove the two half conical collets from each valve.
2. Remove spring caps, springs and valve stem oil seals. Remove valves.

#### Cleaning

1. Remove all traces of carbon from cylinder head
2. If the water jacket of the cylinder head shows signs of excessive scale, a proprietary brand of descaling solution should be used.
3. Blank off rocker oil feed oil-way between numbers 2 and 3 cylinders and remove carbon from pistons and cylinder block face.
4. After valve seat machining and valve grinding operations have been carried out, all parts should be thoroughly washed.

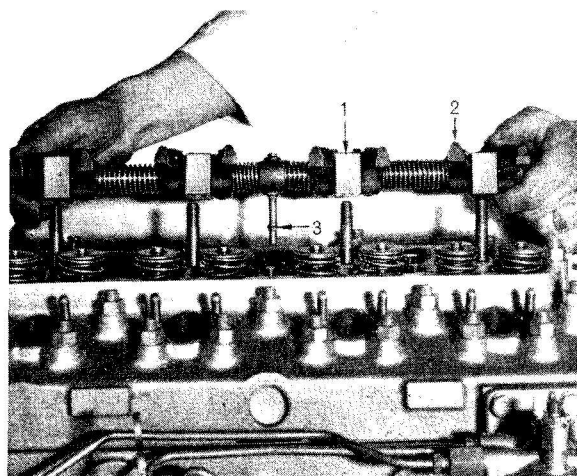


Fig. 4.

- |                         |
|-------------------------|
| 1. ROCKER SHAFT BRACKET |
| 2. ROCKER LEVER         |
| 3. OIL FEED CONNECTION  |

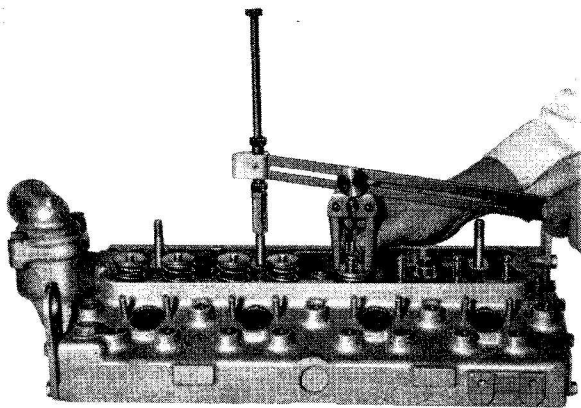


Fig. 5

### Valve Guides

Engines are fitted with either detachable valve guides or the valve bores are machined direct into the cylinder head.

When wear takes place in the valve bores of cylinder heads without detachable valve guides, valves with oversize stems should be fitted.

Three service valves are available for both inlet and exhaust with oversize stems of 0,08, 0,38 and 0,76 mm (0.003, 0.015 and 0.030 in) respectively.

To fit 0.015 and 0.030 in oversize valves, the bores in the cylinder head must be reamed with a piloted reamer.

Where detachable valve guides are fitted, these can be replaced.

To fit new guides: clean the parent bore, smear the outer surface of the guide with clean oil and press home the guide until 15,87 mm (0.625 in) is protruding above the cylinder head. The guides are manufactured from cast iron and are brittle.

### Valves and Valve Seats

Check the valve stems for wear and their fit in the guides.

Examine the valve faces for pitting or distortion. Valve refacing should be at an angle of 45°.

Valves should always be refitted to their original seats and any new valve fitted should be suitably marked to identify its position if removed at a later date. Refer to Fig. 6 for illustration of valve numbering.

**Note:** Special exhaust valve depths are shown in 'Data' for engines which have to comply with BSAU171a:1971.

Where it is necessary to conform with the smoke density regulation B.S.AU 141a:1971, then valve depths must not exceed production limits.

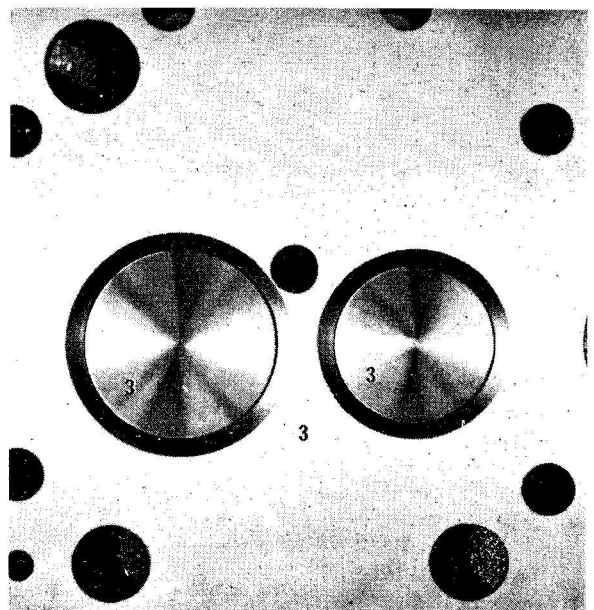


Fig. 6

The maximum wear limits quoted are for areas in which the smoke density regulation do not apply.

The valve seats in the cylinder head should be reconditioned by means of cutters or specialised grinding equipment, at an angle of  $45^{\circ}$ . Suitable valve seat cutters are included in kit MS 73 (see Appendix) and these cutters give a differential valve seat to reduce the width of the valve seat.

As narrow a seat as possible should always be maintained.

#### Hand Grinding

When grinding in valves it is essential that no signs of pitting are left on the seatings. At the same time care should be taken to avoid unnecessary grinding away of the seat.

After grinding operations have been completed, check the valve head depths relative to the cylinder head face (Fig. 7) and wash the cylinder head.

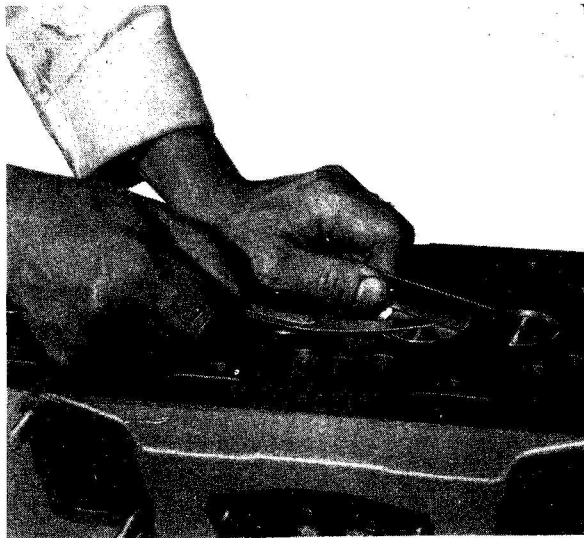


Fig. 7

#### Valve Seat Inserts

In the majority of applications, valve seat inserts are not fitted to production engines, but may be fitted in service.

When fitting inserts to the valve seat, ensure that genuine Perkins Parts are used and proceed as follows:

a) For cylinder heads having removable valve guides, press out existing guide and clean the parent bore. Press in new guide.

b) For guidless cylinder heads.

Using the appropriate oversize piloted reamer — 0,38 mm (0.015 in) or 0,76 mm (0.030 in) according to the condition of the valve bores in the cylinder head — ream out the valve stem bores.

**NOTE:** Appropriate oversize stem replacement valves will be needed when this operation has been carried out on guideless cylinder heads.

Proceed as follows for either type cylinder head, with or without valve guides:—

1. Using the new valve bore as a pilot, machine the recess in the cylinder head face to the dimensions in Fig. 8.

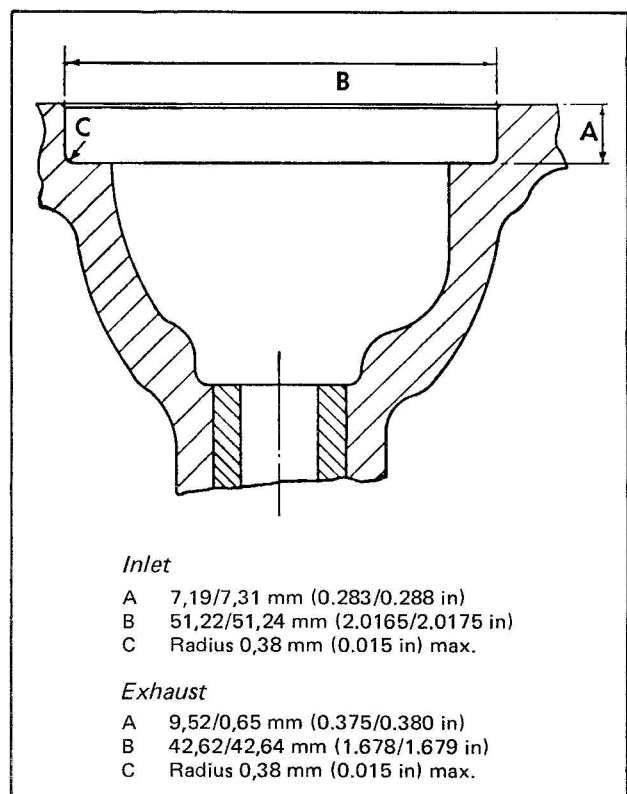


Fig. 8

## Cylinder Head

2. Remove all machining swarf and clean the insert recess. Using the valve bore as a pilot, press the insert home using the inserting tool (Fig. 9).
3. Inspect to ensure that the insert has been pressed fully home and is flush with the bottom of the recess.
4. Using the valve bore as a pilot, machine the "flare" to the dimensions in Fig. 10.

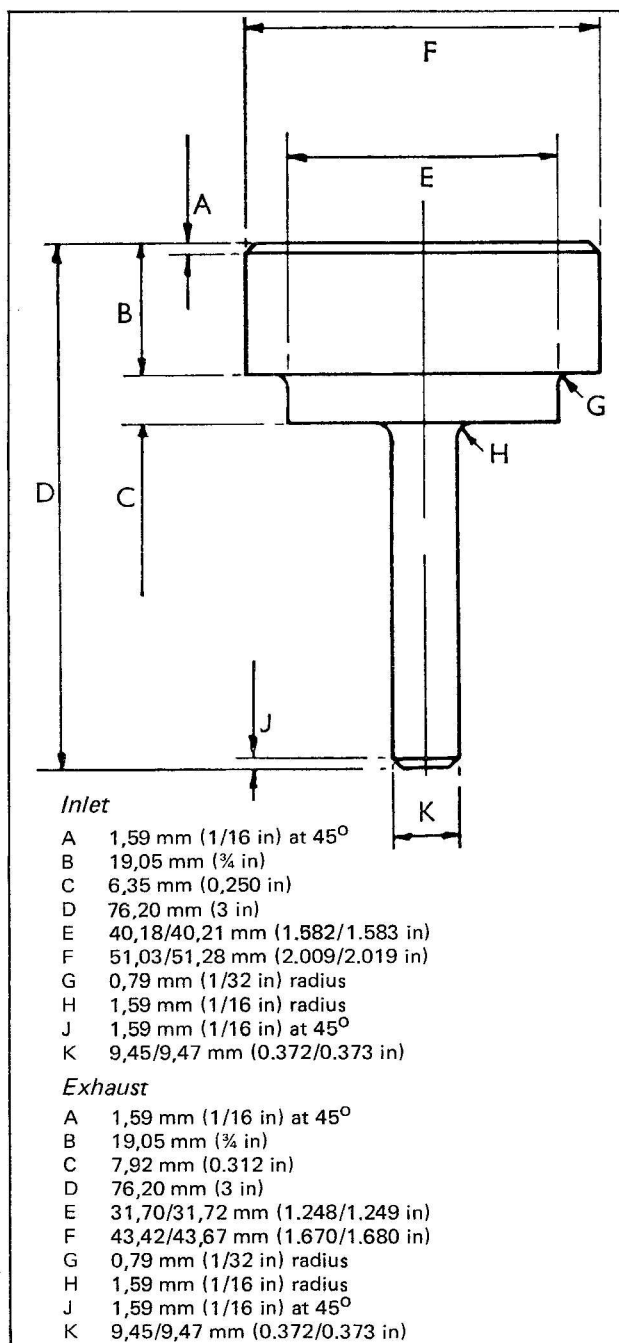


Fig. 9

5. Remove all machining swarf and burrs.
6. Re-cut the valve seat at an included angle of 90°, so that the valve head depth below the cylinder head face is within the production limits of 1,07/1,32 mm (0.042/0.052 in) for exhaust valves and 0,89/1,14 mm (0.035/0.045 in) for inlet valves.

**NOTE:** Work as closely as possible to the minimum figure to allow for re-seating at a later date. When refacing a valve the included angle of the contact face is 90°.

If the cylinder head face has been skimmed since the fitting of valve seat inserts, then the following is allowed:—

- a) Machine to the dimensions given in Fig. 10 and continue as in stages 5 and 6.
- b) If the insert is damaged or unserviceable through wear, it must be removed and replaced with a new one. Before fitting, however, the back of the insert should be surface ground, removing sufficient material to give a flush fitting. Do not forget to re-chamfer the insert as it was prior to grinding, (i.e. 0,508/0,762 mm (0.020/0.030 in) at 45°. Then proceed as in stages 2 - 6.

## Skimming of Cylinder Head

A maximum of 0,30 mm (0.012 in) may be removed providing the nozzle protrusion is not greater than 4,44 mm (0.175 in). This figure must not be obtained by the use of additional washers to the atomisers.

Ensure that the valve depths are within the limits quoted in 'Data'.

## Valve Springs

A new set of valve springs should always be fitted at every major overhaul.

For engines rated at high speeds, two springs per valve are provided. Engines rated at lower speeds only have the outer spring fitted.

Examine the valve springs with regard to squareness of ends and pressures developed at specified lengths, details of which can be found in 'Data'.

Each spring incorporates damper coils at one end and these must be fitted towards the cylinder head.

### Rocker Shaft Assembly

To Dismantle:—

1. Remove circlips and washers from each end of the rocker shaft.
2. Withdraw the rocker levers, springs and support brackets.
3. Remove the locating screw from the rocker oil feed connection and withdraw the connection. Examine the rocker lever bores and shaft for wear. Rockers should be an easy fit on the shaft without excessive side play.

### To Reassemble

1. Fit oil feed connection to rocker shaft and secure with the locating screw, ensuring that the screw enters the locating hole in the shaft.
2. Refit the support brackets, springs, and rocker levers in the correct order (Fig. 4). The support brackets are interchangeable and when fitting them ensure that the securing stud holes are to the right viewing the shaft from the front end, with each pair of rockers inclined away from each other at the valve end.
3. Fit securing washer and circlip to each end of the shaft.

### Push Rods

Check the push rods for straightness. If any are bent, fit replacements.

### Valve Stem Oil Seals

Where oversize valves are fitted always ensure that correct size valve seals are used.

All hydraulically governed engines and certain mechanically governed engines have rubber oil deflectors fitted to inlet valve stems only (see Fig. 3). When fitting these oil deflectors, the open end should be towards the cylinder head,

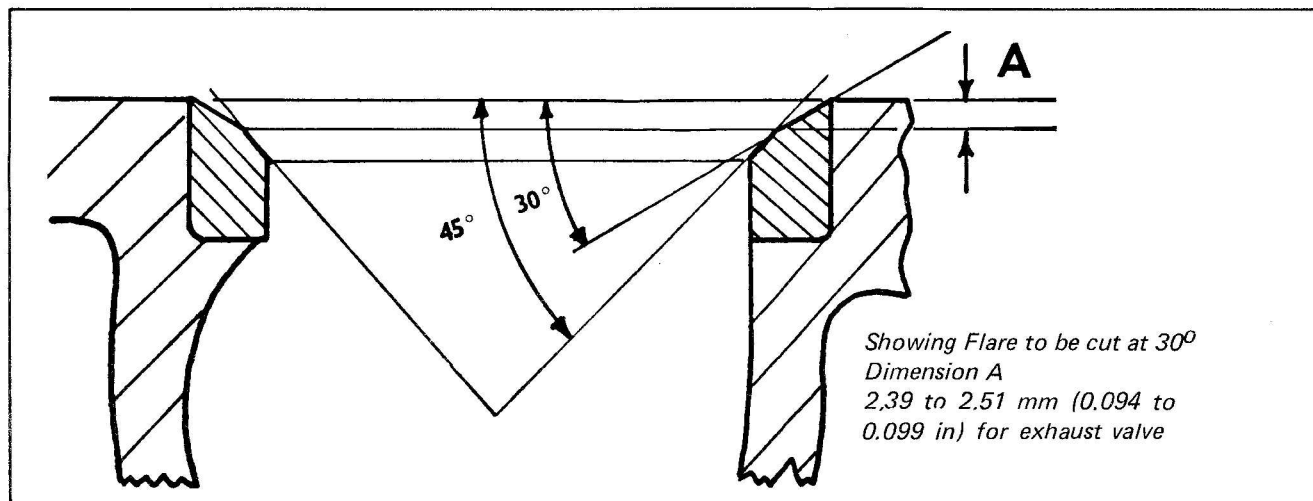


Fig. 10

**Cylinder Head**

With the majority of mechanically governed engines, oil seals are fitted to both inlet and exhaust valves. Earlier engines had a shallow rubber deflector fitted to the valve stems and positioned above the conical valve spring seating collar, the open end of the deflector being fitted towards the cylinder head. Later engines have a thin valve spring seating washer and a rubber oil seal which fits over the integral valve guide protrusion. In some cases, this latter seal has a nylon insert. The later sealing arrangement, due to a change in the diameter of the valve guide protrusion, is not interchangeable with the earlier sealing arrangement.

On some engines the seals are manufactured from Viton or silicon rubber material and they have a garter spring fitted around their outer circumference.

**To Re-Assemble the Cylinder Head****To Re-Assemble the Cylinder Head**

1. Lightly oil valve stems.
2. Fit valve to its correct guide or bore.
3. Fit valve stem oil seals.
4. Locate spring seat washers, valve springs and spring caps in position.
5. Compress each valve spring and fit the valve collars.

**Cylinder Head Gasket**

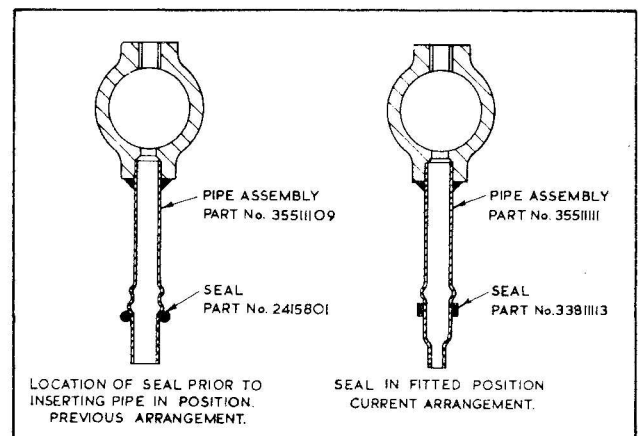
Always use a new cylinder head gasket.

**Note:** A special (thicker) Coopercor cylinder head gasket is used on engines which have to conform with the smoke density regulation B.S.AU 141a:1971 and if the correct gasket is not used, then piston/valve contact may result.

Cylinder liners are fitted to give a protrusion of 0,71/0,89 mm (0.028/0.035 in) above the cylinder block face. On early engines, cylinder liners were fitted as described in A412.

Where the cylinder head is mainly secured by set-screws, the two studs used for gasket location purposes should be fitted in the end position of the left hand row of tappets, positions 19 and 22 in Fig. 11.

Ensure that the correct replacement gasket is obtained and that it is fitted, either with jointing compound or dry, depending on the gasket type. Four gasket types will be found.

**Fig. 12**

Type	Identification	With or Without Jointing Compound
Klinger	Black coloured composition	Without
Copper/Asbestos	Copper	With. On both sides of gasket
Coopercor	Silver	Without
Coopercor with Dowty Sealant	Silver with strip of red or white sealant on push rod side, both sides	Without

The cylinder heads of all engines fitted with these four gasket types should all be re-torqued after initial warm-up and again when the machine or vehicle has completed 25/50 hours service or 500/1,000 miles.

See the following subsection for further cylinder head refitment details.



#### To Refit the Cylinder Head

Ensure that the rocker assembly oil feed passage in the cylinder head is free from obstruction. When refitting the cylinder head a new gasket should be used.

The rubber olive should be fitted in the recess in the cylinder head, before fitting the rocker shaft assembly.

1. Lightly oil threads and tighten the nuts/set-screws progressively (in 3 stages) in the order shown in Fig. 11, to a torque of 81 Nm (60 lbf ft) for 7/16 in studs or 136 Nm (100 lbf ft) for ½ in studs/set-screws. The final stages should be repeated.
2. Fit the push rods and refit the rocker shaft assembly. Fit a new rubber sealing ring to the rocker oil feed connection.
3. Adjust the valve clearances, as detailed later. Fit the rocker cover.
4. Refit atomisers with new copper sealing washers ensuring that they seat squarely. Refit the high pressure fuel pipes (see A450).
5. Fit the breather pipe assembly to the cylinder head cover.
6. Refit the fuel filter to the cylinder head and the fuel pipe between the lift pump outlet and the filter.
7. Fit the fuel pipes between the filter and the injection pump inlet and outlet.
8. Refit the atomiser leak-off pipe assembly.
9. Refit inlet and exhaust manifolds. Connect the electrical lead and fuel feed pipe to the thermostart unit.
10. Connect the exhaust pipe.
11. Refit the air filter and connections. Fit the water outlet hose. Re-connect the battery terminals.
12. Fill the cooling system and check for water leaks.
13. Bleed the air from the fuel system as detailed in A450.

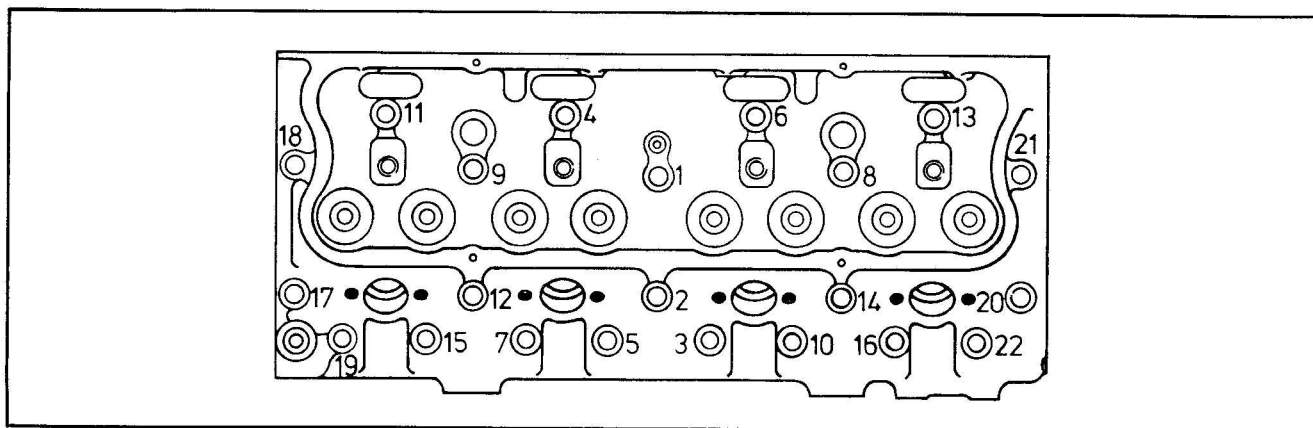


Fig. 11



**Cylinder Head**

14. Run the engine until normal operating temperature is attained and re-torque the cylinder head nuts/setscrews, in sequence, to the torque given in 'Data'.
15. Reset the valve clearances, as detailed below. Fit the rocker cover.

**Note:** It is most important that the cylinder head be tightened down to the correct torque in the correct sequence after the vehicle has completed 800/1600 km (500/1,000 miles) (25/50 hours) service.

**To Check or Adjust Valve Tip Clearances**

These are checked between the top of the valve stem and rocker arm (Fig. 13) and should be 0,3 mm (0.012 in) with the engine cold.

When adjusting valve clearances the following procedure should be adopted:—

1. With the valves rocking on No. 4 cylinder (i.e. the period between the opening of the inlet valve and the closing of the exhaust valve), set the valve clearances on No. 1 cylinder.

2. With the valves rocking on No. 2 cylinder, set the valve clearances on No. 3 cylinder.
3. With the valves rocking on No. 1 cylinder, set the valve clearances on No. 4 cylinder.
4. With the valves rocking on No. 3 cylinder, set the valve clearances on No. 2 cylinder.



**Fig. 13**