SECTION A

ENGINE

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Section A.1

GENERAL DESCRIPTION

The overhead valve engine has its four cylinders vertically in line and cast integral with the crankcase. The detachable cylinder head is of cast iron and carries the push rod operated valve gear.

Large area water circulating passages and full length water jackets enable the engine to be adequately cooled even under the most arduous operation conditions.

Copper-lead plated bearings are utilised in the connecting-rod big end assemblies, thus necessitating complete and clean lubrication at all times. This is ensured by a rotor type oil pump and the provision of a full flow filter.

The choice of oils is of great importance and those recommended at the end of this manual have been tested under various running conditions and should be used in accordance with the schedule of regular attentions.

Section A.2

VISUAL INSPECTION

Examine the engine for any signs of oil leakage, with particular attention to the sump drain plug, the joint between the oil filter and crankcase, and the rocker cover to cylinder head joint.

The connections to the distributor should be checked occasionally for tightness, and any perished or cracked high tension cables renewed.

Section A.3

ADJUSTMENTS IN THE VEHICLE

The purpose of the following adjustments is to maintain the performance of the engine at its maximum, and consists of a series of cleaning, inspecting and adjusting operations. A compression test of each cylinder should first be made to determine the general condition of the engine before proceeding with any adjustments. If a compression gauge is not available, a simple method to test the compression is to remove all the sparking plugs with the exception of the one in the cylinder being tested, and then rotate the engine with the starting handle through at least two complete revolutions. If the cylinder compression is satisfactory, proceed as detailed below, otherwise the specific fault should be diagnosed by referring to 'Fault Diagnosis', Section A.32.

(1) Clean the engine generally and lubricate as indicated on the lubrication chart.

(2) Adjust the fan belt tension in accordance with the instructions given in Section C.

(3) Remove the valve gear cover and test the cylinder head studs for tightness, using a torque spanner set to the figures quoted under 'General Data'.

(4) Check and adjust the valve and rocker clearances as outlined in Section A.10.

(5) Check for evidence of cracked valve springs or scored or worn stems.

(6) Replace the valve gear cover, using a new gasket if necessary.

(7) Disconnect the high-tension cables and remove the sparking plugs.

(8) Check to make sure that the correct type of sparking plug is being used.

(9) Clean the sparking plugs and examine the insulation for breaks or cracks.

(10) Adjust the sparking plug gaps as specified in Section B.

(11) Test the sparking plugs and renew any found to be unfit for further service.

(12) Refit the sparking plugs, using new copper washers.

(13) Check the high tension cables for wear and deterioration before refitting.

(14) Remove the distributor head cover and clean it inside and out. Examine it for cracks and burned contacts and renew it if necessary.

(15) Inspect the contact breaker points to determine whether new points are needed. Follow the procedure given in Section B to clean and adjust the points.

(16) Check the distributor rotor arm, making sure the carbon brush makes contact. Check the capacitor terminal to make sure it is clean and tight.

(17) Check the ignition timing as outlined in Section B.

(18) Clean the air cleaners in accordance with the instructions in Section D.

(19) Make sure the fuel system is operating properly and clean all filters in the system as detailed in Section D.

(20) Check the carburetter manifold flange gaskets for evidence of leakage.

(21) Adjust the carburetters if necessary, in accordance with the procedure given in Section D.

Section A.4

ENGINE ASSEMBLY

To Remove (without gearbox)

(1) Detach the earth lead from the battery.

(2) Detach the bonnet from the bonnet hinges as described in Section O.2.

(3) Remove the radiator as described in Section C.
(4) Disconnect the heater inlet and outlet hoses at the heater unit (if applicable).
(5) Detach the choke cable and its outer casing at the carburetters.
(6) Detach the throttle cable at the carburetter throttle lever.
(7) Unscrew the oil pressure gauge pipe at its terminal in the cylinder block.
(8) Unscrew the reduction drive (if fitted) complete with tachometer cable from the rear end of the generator.
(9) Release the generator, coil and distributor low tension cables.
(10) Release the high tension cables from their connections at the coil and sparking plugs.
(11) Remove the distributor as detailed in the Ignition Section.

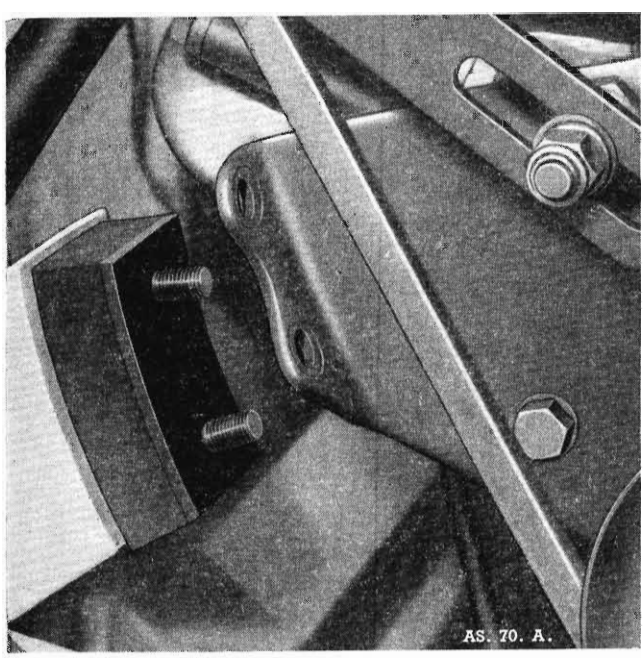


Fig. A.1. Illustrating the position of the rubber mounting and mounting bracket.

(12) Remove the starter as described in the Electrical System.
(13) Disconnect the petrol (gasoline) inlet pipe at the fuel pump union.
(14) Release the clamp attaching the exhaust manifold to the down pipe.
(15) Attach lifting tackle as illustrated in Fig. A.2.
(16) Place a suitable jack beneath the vehicle to support the gearbox and unscrew the nuts, bolts and setpins securing the gearbox bell housing to the engine backplate.

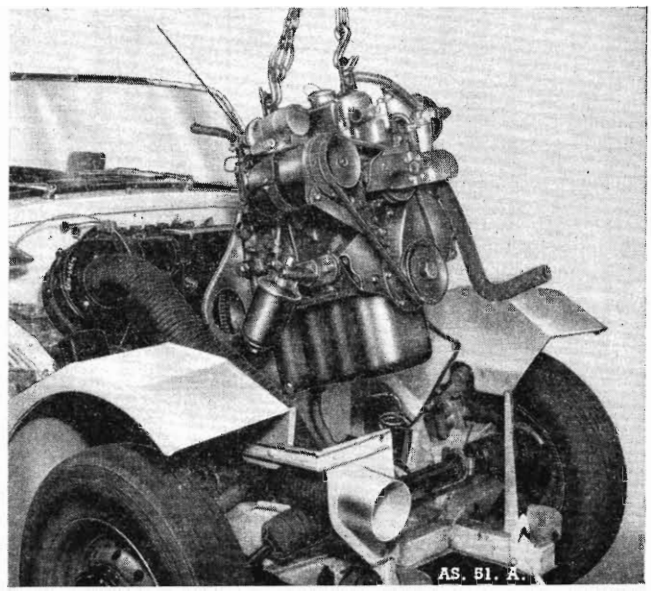


Fig. A.2. Showing the engine being removed at the correct lifting angle.

Note: The bottom right-hand nut and bolt also secures the engine earthing wire.
(17) Remove the four nuts and spring washers securing the engine front mounting bracket to the chassis frame.
(18) Ascertain that the engine mounting bracket is clear of its mounting studs by jacking the gearbox and at the same time lifting the engine.
(19) Hoist and pull the engine forward to disengage the gearbox first motion shaft splines and lift clear of the vehicle (Fig. A.2).

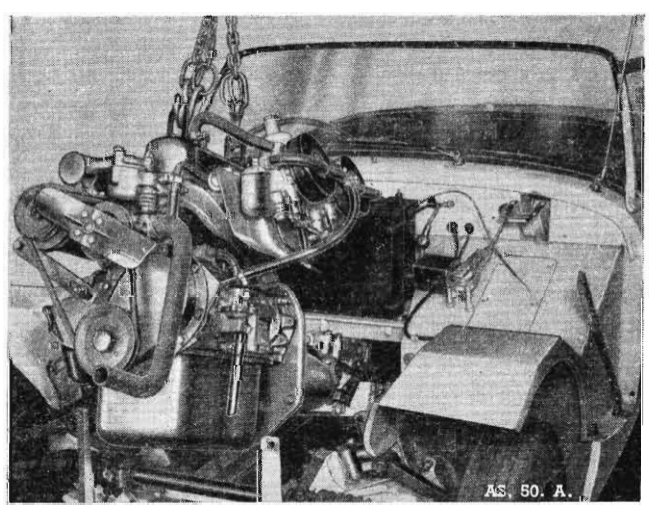


Fig. A.3. Showing the removal of the engine, gearbox and propeller shaft.

To Replace

Replacing the engine is the reverse of the procedure 'To Remove'.

To Remove (with gearbox)

(1) Perform the operations (1) to (14) as detailed previously and then proceed as follows:

(2) Within the car remove the four self tapping screws securing the gear lever aperture cover to the gearbox surround and withdraw the cover.

(3) Unscrew and remove the anti-rattle plunger, spring and cap (accessible within the car) (7, Fig. F.6).

(4) Unscrew the three setscrews attaching the change speed lever retaining plate and remove the change speed lever.

(5) Peel back the carpet surrounding the gearbox cover to expose the two $\frac{5}{16}$ in. gearbox rear mounting setpins, the location of one of the setpins is shown (1) Fig. F. 3, and unscrew the setpins.

(6) Working beneath the vehicle unscrew the speedometer drive cable at its union with the gearbox rear extension.

(7) Detach the slave cylinder from the gearbox bell housing by unscrewing its two mounting setpins and withdrawing the push rod from the rear of the cylinder.

(8) Disconnect the propeller shaft from the rear axle. This operation is performed by removal of the four self-locking nuts.

(9) Unscrew the remaining two gearbox rear mounting setpins. The location of one of the setpins is shown in Fig. F.3 (2).

(10) By means of lifting tackle, similar to that illustrated in Fig. A.2, support the engine.

(11) Remove the four nuts and spring washers securing the engine front mounting bracket to the chassis frame.

(12) Hoist the engine, gearbox and propeller shaft, and at the same time pull the whole assembly forward clear of the vehicle.

Section A.5

LUBRICATION

Description

The oil supply is carried in the sump below the cylinder block, and the filler cap is fitted to the valve rocker cover. The dipstick is on the right-hand side of the engine and is marked to indicate the 'FULL' level.

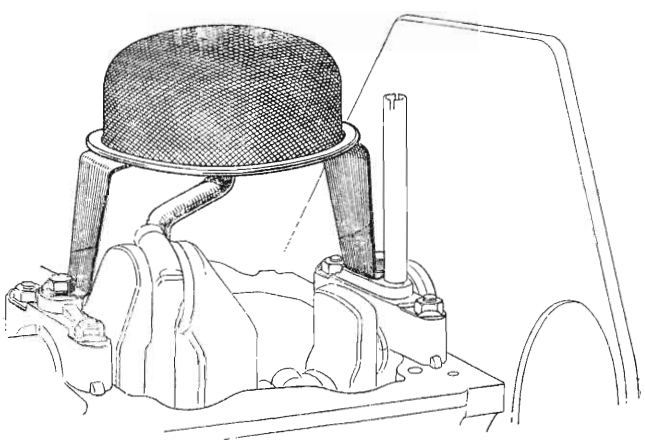
The eccentric vane non-draining-type oil pump is mounted on the rear end of the crankcase and is driven by the camshaft.

Draining the Sump

The sump on new and reconditioned engines must be drained and filled with new oil after the first 500 miles (800 km.). The hexagon-headed sump drain plug is at the rear on the right-hand side.

The sump should be allowed to drain for at least ten minutes before the drain plug is replaced. The oil will flow more readily if it is drained while the engine is hot. When the sump has been drained, approximately 6 pints (7·2 U.S. pints, 3·41 litres) of oil are required to fill it. The capacity of the filter is approximately 1 pint (1·2 U.S. pints, 0·57 litres), giving a total of 7 pints (8·4 U.S. pints, 3·98 litres). Do not forget to replace the sump drain plug.

Never use petrol or paraffin for flushing purposes. Such cleaning mediums are never completely dispersed from the engine lubricating system, and will remain to contaminate any fresh oil. This may cause premature bearing failure.



H30. 129. B.

Fig. A.4. Oil Strainer

Every 6,000 miles (9600 km.), a new oil filter element must be fitted after the filter bowl has been carefully cleaned in petrol.

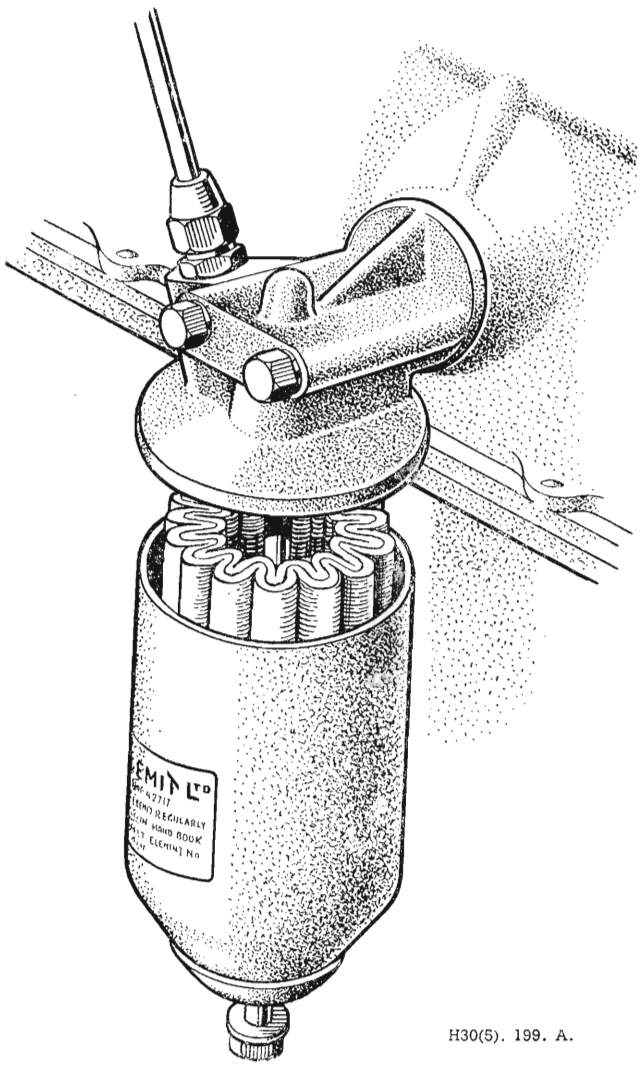


Fig. A.5. Showing the container detached and exposing the filter element.

Refilling

When refilling the sump do not pour the oil in too quickly, as it may overflow from the filler orifice and mislead the operator as to the quantity of lubricant in the engine.

Before testing the level of the oil, ensure that the vehicle is as near level as possible. Always wipe the dipstick clean with a non-fluffy cloth before taking the reading. It must be remembered that time must be allowed for new oil to reach the sump before reading the dipstick. The dipstick location is shown in Fig. A.6.

Oil Pressure

The normal operating pressure is 60 lb./sq. in. (4·2 kg/cm^2).

The oil gauge is combined with the thermometer on the instrument panel.

A minimum pressure of 15 lb./sq. in. (1·05 kg/cm^2) should be registered when the engine is idling. **If no pressure is registered by the gauge stop the engine at once and investigate the cause.**

Note: The automatic release valve in the lubrication system deals with any excessive oil pressure when starting from cold.

Check for Low Oil Pressure

Check the level of the oil in the sump by means of the dipstick and top up if necessary. Ascertain that the gauze strainer in the sump is clean and not choked with sludge, also that there is no leakage at the strainer union on the suction side of the sump.

In the unlikely event of the oil pump being defective, remove the unit and rectify the fault, see Section A.8. The oil release valve should be examined, see Section A.9.

If the engine bearings are worn the oil pressure will be reduced. A complete bearing overhaul and the fitting of replacement parts is the only remedy, necessitating the removal of the engine from the vehicle.

Section A.6

OIL FILTER

The external oil filter is of the full flow type, thus ensuring that all oil in the lubrication system passes through the filter before reaching the bearings.

The element of the filter is of star formation in which a special quality felt, selected for its filtering properties, is used.

Oil is passed to the filter from the pump at a pressure controlled at 60 lb./sq. in. by the engine oil release valve. This pressure will, of course, be somewhat higher until the oil reaches a working temperature. Some pressure is lost in passing the oil through the filter element, this will only be a pound or two per square inch with a new element, but will increase as the element becomes progressively contaminated by foreign matter removed from the oil.

Should the filter become completely choked due to neglect, a balance valve is provided to ensure that oil will still reach the bearings. This valve, set to open at pressure difference of 15–20 lb./sq. in., is non-adjustable and is located in the filter head casting. When the valve is opened, unfiltered oil can by-pass the filter element and reach the bearings.

To renew the filter element proceed as follows:

(1) Stop the engine, extract the centre fixing bolt, remove the container and drain.

(2) Withdraw the contaminated element and carefully

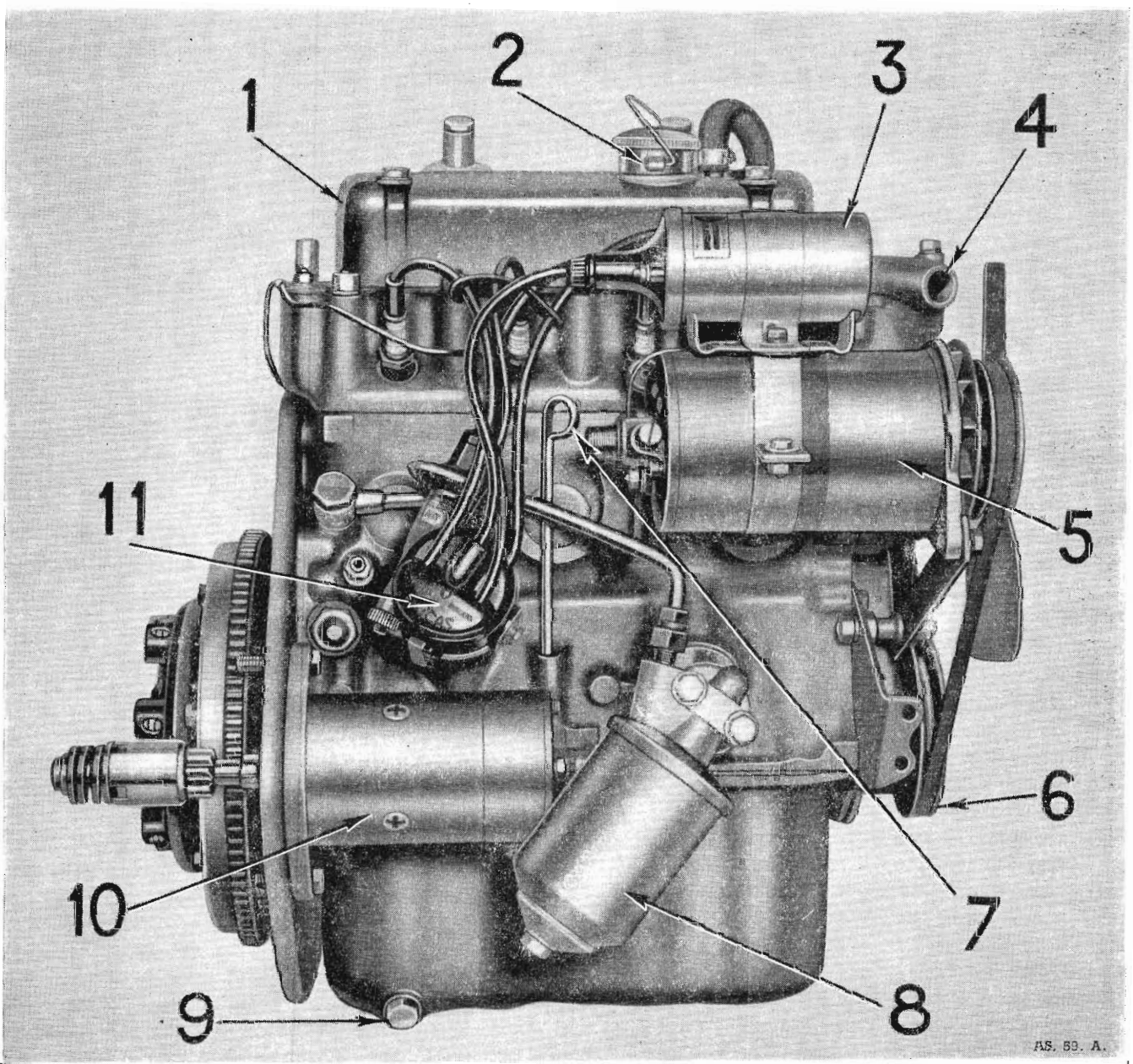


Fig. A.6. Right-hand view of engine.

1. *Valve rocker cover.*
2. *Oil filler cap.*
3. *Ignition coil.*
4. *Thermostat cover and coolant outlet.*
5. *Generator.*
6. *Crankshaft pulley.*
7. *Oil level dipstick.*
8. *Full flow oil filter.*
9. *Oil sump drain plug.*
10. *Starter motor.*
11. *Distributor cap.*

cleanse the container of all foreign matter that has been trapped.

(3) After ensuring that no fibres from the cleansing operation **have been left in the container,** put in a new element. Care must be taken to ensure that the washers below the element inside the bowl are fitted correctly. The small felt washer must must be positioned between the element pressure plate and the metal washer above the pressure spring. It is essential for correct oil filtration that the felt washer should be in good condition and be a snug fit on the centre-securing bolt. Hold centre bolt firm, prime the filter, and refit to head casting, tightening the centre fixing bolt sufficiently to make an oil-tight joint and then top up the engine with oil.

It is highly recommended that the filter container should not be disturbed other than for cleaning or fitting a new element; to do so invites the hazard of added contamination from accumulated dirt on the outside of the filter entering the container and thus being carried into the bearings on restarting the engine.

Section A.7

SUMP AND GAUZE STRAINER

Removing

(1) Drain off the oil into a suitable container and then extract the setscrews and washers, thus enabling the sump to be removed.

(2) Detach the oil suction pipe at its connection with the crankcase.

(3) Unscrew the two setpins securing the strainer support bracket to the main bearing caps.

(4) The strainer and support bracket may now be removed from the engine.

(5) Swill the strainer in petrol or paraffin and thoroughly dry with a non-fluffy rag.

(6) Inspect the sump joint washers and renew if necessary.

Refitting

(1) Install the strainer and its securing bracket into position, ascertaining that the oil suction pipe is located in its connection to the crankcase.

(2) Tighten the suction pipe connection.

(3) Clean out the sump by washing it in paraffin. Take care to remove any traces of the paraffin before refitting the sump to the engine.

Pay particular attention to the sump and crankcase joint faces, and remove any remainder of old jointing material. Examine the joint washers and renew if necessary. The old joint washers may be used again if they are sound, but it is advisable to fit new ones.

(4) Smear the faces of the joints with grease and fit the joint washers. Lift the sump into position and insert the setscrews into the flange tightening them up evenly.

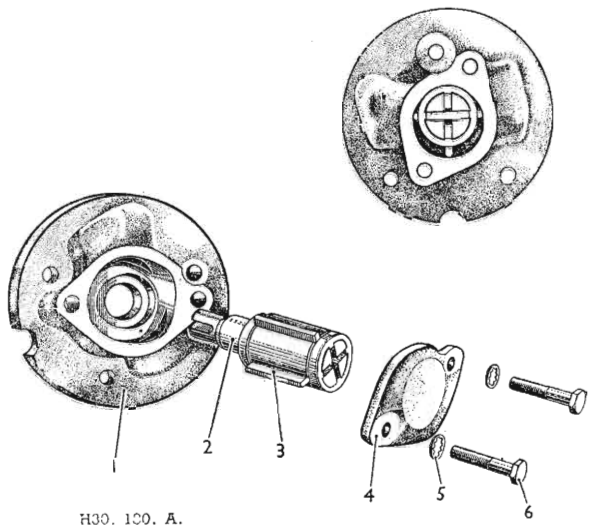


Fig. A.7. Exploded view and plan view of the 'Burman' oil pump.
1. *Oil pump flange.*
2. *Rotor.*
3. *Vane.*
4. *Pump cover.*
5. *Cover bolt washer.*
6. *Cover bolt.*

Section A.8

OIL PUMP

To Remove

(1) The detachment of the oil pump first entails the removal of the engine from the car. Details of this procedure are described in Section A.4.

(2) Remove both flywheel and engine backplate as described in Section A.29 when access is gained to the oil pump.

(3) Tap back the locking washers and remove the three $\frac{1}{4}$ in. U.N.F. securing setscrews.

(4) Withdraw the pump noting the position of the slot in the driving shaft in order to assist replacement. If the paper joint washer is damaged in any way it must be renewed.

Dismantling

(1) Remove the oil pump cover after unscrewing its two securing setpins.

(2) The oil pump cover, the outer rotor and the combined oil pump shaft and inner rotor are all now removable.

The component parts of the oil pump are shown in Figs. A.7 and A.8. Hobourn Eaton or Burman types are fitted.

Replacing

The replacement of the oil pump is a reversal of the removal procedure; however, the operator must pay

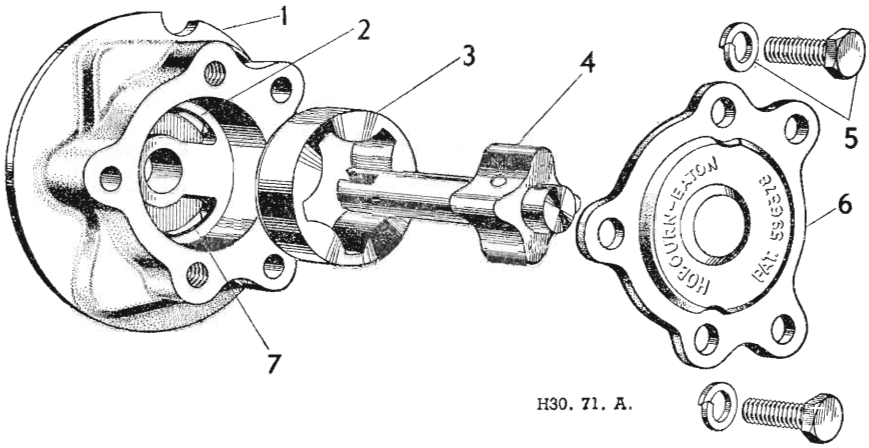


Fig. A.8. Oil pump exploded.

1. *Pump body.*
2. *Delivery port.*
3. *Outer rotor.*
4. *Inner rotor and driving shaft.*
5. *Setscrew and washer.*
6. *Cover.*
7. *Suction port.*

particular attention when positioning the paper joint washer to ensure that the intake and delivery ports are not obstructed.

Section A.9

RELIEF VALVE

The oil relief valve (Fig. A.9) is situated at the rear right-hand side of the cylinder block, alongside the distributor. It is non-adjustable and is held in position by a compressed coil spring. This compression is maintained by two fibre washers and a domed screw plug.

The function of the valve is to provide an extra return passage for the oil should the pressure become excessive.

A pre-determined spring rating allows a release pressure of 60 lb./sq. in., and this can be checked by measuring the length of the spring, the correct figure being $2\frac{7}{8}$ in. Fit a new spring if the tension has been lost. Service Tool 18G 69 should be used to grind the valve cup into its seating.

Section A.10

ADJUSTING VALVE CLEARANCE

Lift off the valve cover after removing the two cap nuts

Between the rocker arm and the valve stem there must be a clearance of ·012 in. (·305 mm.) for both inlet and exhaust, clearance being set with the engine hot.

(1) If adjustment is necessary slacken off the locknut (3 Fig. A.13) whilst pressure is applied, with a screwdriver, to the adjusting screw.

(2) Insert a ·012 in. feeler gauge between the valve stem and rocker arm and raise or lower the adjusting screw until the correct clearance is achieved.

(3) Tighten the locknut but re-check the clearance in case the adjustment has been disturbed during the locking process.

(4) When replacing the valve cover, take care that the joint washer (using a new one if necessary) is properly seated to ensure an oil tight joint.

Section A.11

VALVE ROCKER SHAFT

Of hollow construction, the valve rocker shaft is mounted on the cylinder head and secured by means of four pedestal brackets.

It is supplied with oil through a drilling in the foremost pedestal bracket for lubrication to each rocker bearing.

The shaft is plugged at each end, one of the plugs being screwed in order that the shaft may be cleaned internally.

Section A.12

ROCKER SHAFT ASSEMBLY

Removal

(1) Drain the cooling system.

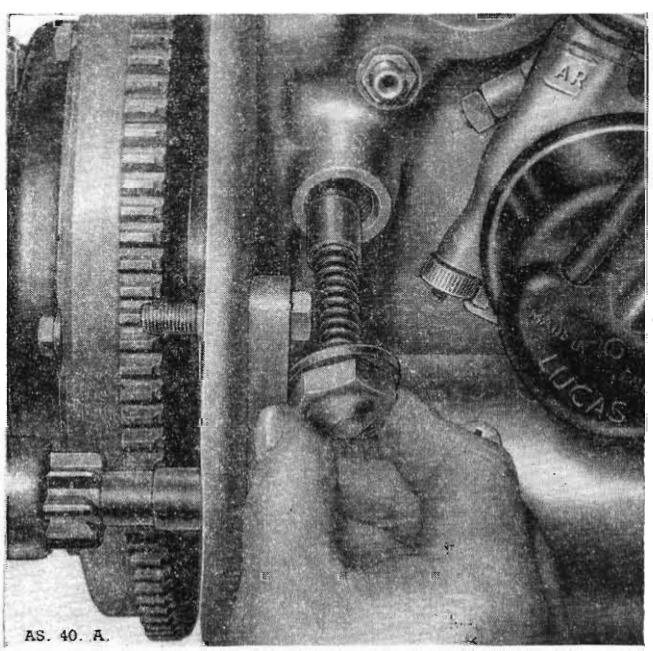


Fig. A.9. Showing the location of the oil relief valve assembly on the right side of the engine.

(2) Unscrew the two nuts securing the rocker cover to the cylinder head, taking care not to damage the cork gasket, and remove the rocker cover.

(3) Unscrew the eight rocker shaft bracket fixing nuts and the five external cylinder head securing nuts gradually, a turn at a time, in the order shown in Fig. A.15, until all load had been released.

Note the special locking plate mounted on each rocker bracket.

(4) Completely unscrew the eight rocker shaft bracket nuts and remove the rocker assembly, complete with brackets and rockers.

Dismantling

(1) Remove the grub screw which locates the rocker shaft to the front rocker mounting bracket.

(2) Remove the split pins from each end of the rocker shaft to release thrust washers and double coil springs.

(3) Withdraw rocker, rocker shaft brackets, thrust washers and springs, retaining them in their original order for reassembly.

Reassembly

When reassembling the rocker gear, commence with the front mounting bracket, securing it with the grub screw. Follow up with the remaining brackets and springs. The screwed in end plug of the rocker shaft should be positioned towards the front of the engine.

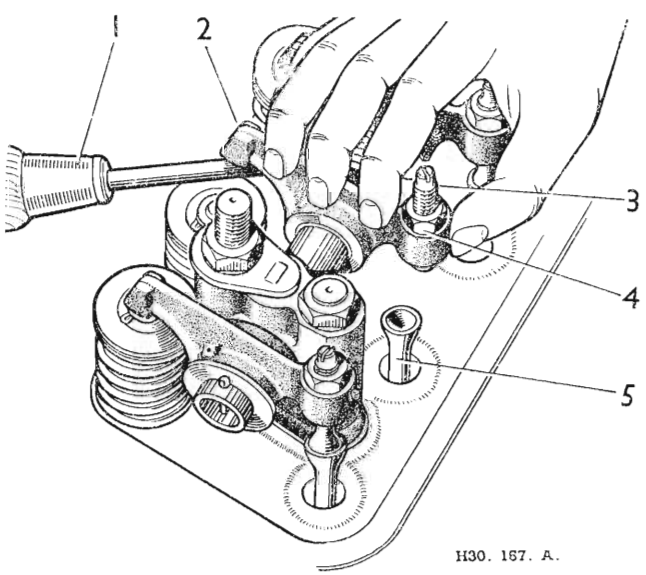


Fig. A.10. Push rod removal.

1. *Screwdriver.*
2. *Valve rocker.*
3. *Adjusting screw.*
4. *Locknut*
5. *Push rod.*

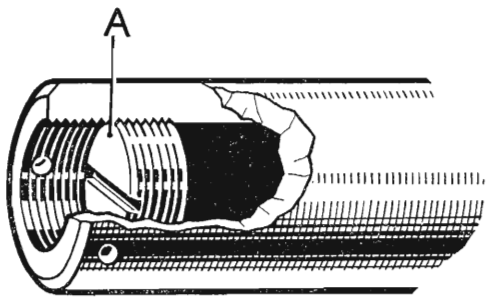


Fig. A.11. Showing a screwed plug 'A' to facilitate internal cleaning of the shaft.

All springs, remaining brackets, rockers and locking plates are interchangeable.

Section A.13

PUSH ROD REMOVAL

If the valve rocker assembly has already been removed all that remains is for the push rods to be lifted out. They may on the other hand be taken out without detaching the rocker assembly as described below:

(1) Remove the valve rocker cover as described in Section A.12 and slacken the valve adjustment screw to its full extent.

(2) With the aid of a screwdriver supported under the rocker shaft, depress the valve and slide the rocker sideways free of the push rod.

(3) Withdraw the push rod.

(4) In the case of the rocker at each end, it is necessary to take out the split pins at the end of the shaft.

(5) The above sequence should be reversed when replacing push rods and rockers.

Section A.14

ROCKER ARM BUSHES

(1) While the rocker gear is detached from the head, check for play between the rocker shaft and the rocker arm bushes. If this is excessive new bushes should be fitted. To do this dismantle the rocker assembly as described in Section A.12.

(2) The bush is best removed by using a drift and anvil (Service Tool 18G 226 with 18G 226A). The anvil is recessed to retain the rocker in position while the bush is gently knocked out by the drift. File and drill out the rivet in the rocker arm oilway.

(3) The flange of the drift is also recessed to prevent the new split bush from opening when being driven into position with the joint immediately above the rocker arm oilway.

(4) Drill an oilway through the bush from the top of the rocker using a No. H.7 ·0785 in. diameter

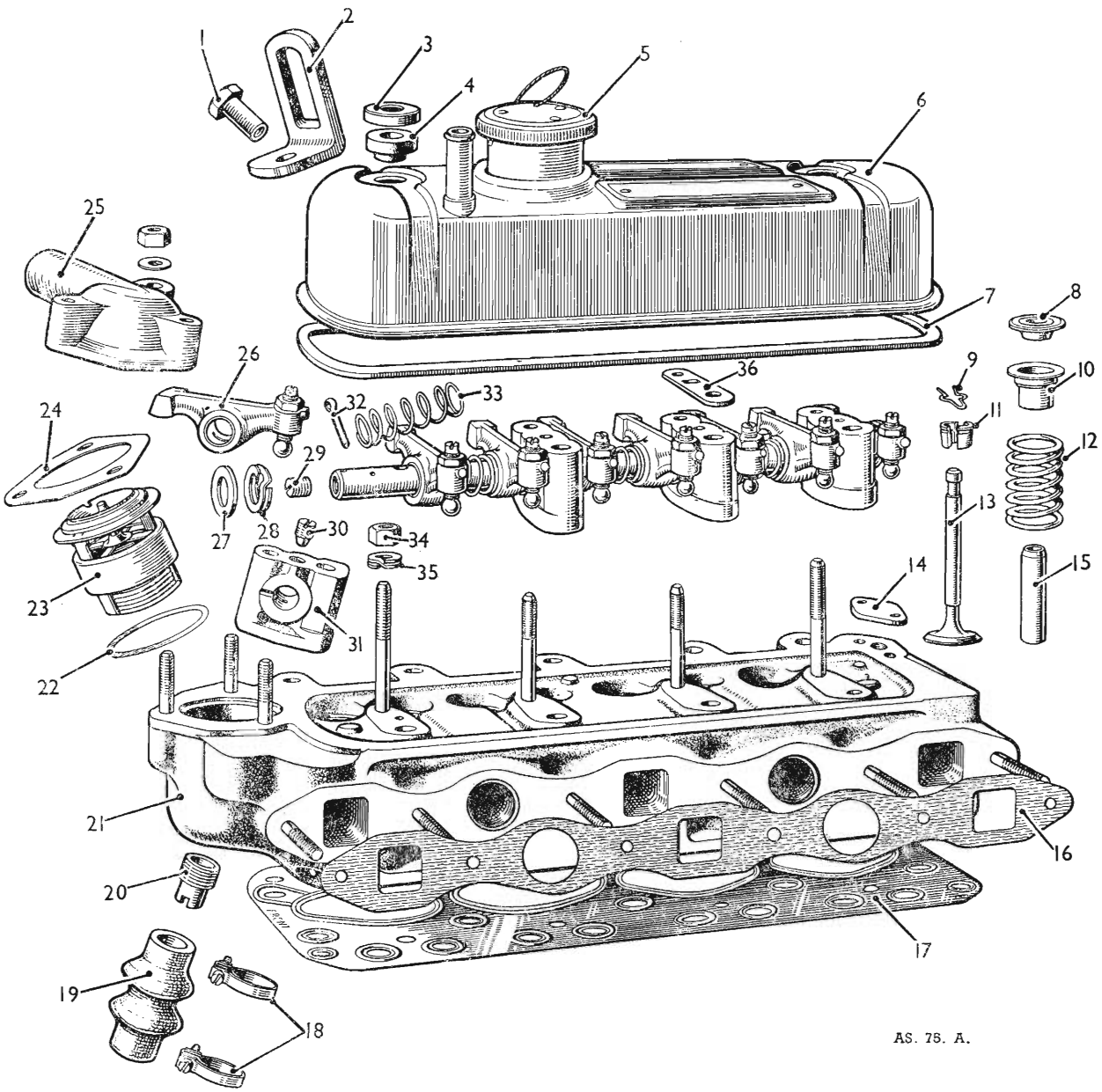


Fig. A.12. Cylinder head assembly.

1. *Valve rocker cover cap nut.*
2. *Engine sling bracket.*
3. *Cup washer.*
4. *Rubber bush.*
5. *Oil filler cap.*
6. *Valve rocker cover.*
7. *Rocker cover joint washer.*
8. *Valve spring cup.*
9. *Valve cotter circlip.*
10. *Valve oil seal retainer.*
11. *Valve cotters.*
12. *Valve spring.*
13. *Valve.*
14. *Cover plate.*
15. *Valve guide.*
16. *Joint washer.*
17. *Gasket.*
18. *Hose clips.*
19. *By-pass hose.*
20. *By-pass tube.*
21. *Cylinder head.*
22. *Thermostat joint washer.*
23. *Thermostat.*
24. *Water outlet elbow joint washer.*
25. *Water outlet elbow.*
26. *Rocker.*
27. *Plain washer.*
28. *Spring washer.*
29. *Rocker shaft plug.*
30. *Locating grub screw.*
31. *Rocker shaft pedestal.*
32. *Split pin.*
33. *Rocker spacing spring.*
34. *Rocker bracket nut.*
35. *Rocker bracket washer.*
36. *Rocker bracket plate.*

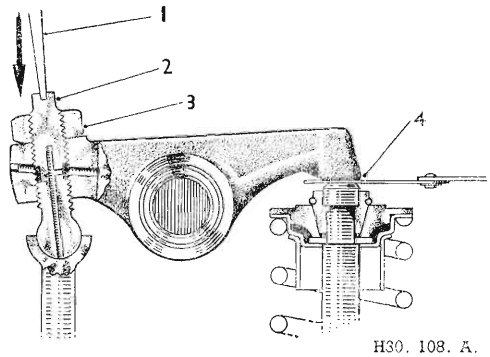


Fig. A.13. Adjusting valve clearance.
1. *Screwdriver.* 2. *Feeler gauge.*

drill. A second oilway must be drilled through the bush via the rocker arm using a No. 43 drill ·089 in. diameter.

(5) Plug the oilway in the rocker arm with a rivet and weld its head to the rocker boss. Reamer the internal diameter of the bush to suit the shaft.

Section A.15

TAPPETS

Removal

(1) Remove the pushrods after detaching the valve rocker assembly as described in Section A.12.
(2) Release the engine side covers by withdrawing their securing setscrews and fibre washers. The front cover is removed together with its vent pipe.
(3) Lift out the tappets, keeping them in their same respective locations. Inspect the tappet cam contacting surfaces for wear. New tappets should be fitted by selective assembly so that they just fall into their guides under their own weight when lubricated.

Replacement

Assembly is a reversal of the above procedure, but care should be taken to see that the tappet cover joints are oil-tight and that the rockers are adjusted to give the correct valve clearance.

Section A.16

RENEWING VALVE SPRING IN POSITION

(1) In an emergency a new valve spring can be fitted without lifting the cylinder head, but it is advisable first to bring the piston to top dead centre, to ensure that the valve cannot fall into the cylinder during the process.
(2) Remove the sparking plug, and by means of a length of copper tubing or similar tool inserted through the plug hole, the valve can be held on its seat whilst the spring is compressed. The valve rocker shaft can be used as a fulcrum point by an operator using two screwdrivers to bear on the valve spring cap each side of the valve stem, whilst the cotters are removed.

Section A.17

MANIFOLD

Removal and Replacement

(1) Detach the air cleaners from the carburetters by unscrewing the four setpins and releasing the breather pipe attached to the rear air cleaner.
(2) Disconnect the carburetters as described in Section D.
(3) Disconnect the exhaust down pipe by releasing its securing clip.
(4) Disconnect the throttle and choke linkages to the carburetters, together with the vacuum control pipe and petrol feed pipe.
(5) Unscrew and remove the six nuts and washers which secure the exhaust and inlet manifolds to the cylinder head. Four of these nuts bear on special clamping washers. The remaining two secure the end flanges of the exhaust manifold.
(6) The inlet and exhaust manifolds can now be drawn off their studs and lifted clear of the engine.
(7) The inlet and exhaust manifolds are separated by withdrawing the four connecting setscrews, noting the respective positions of the special hot spot and joint washer.
(8) Reassembly is the reverse of the above procedure; always use a new joint washer for the manifolds to ensure a gas-tight joint.

Section A.18

CYLINDER HEAD

Removing

(1) Drain all water from the cooling system, if the water contains anti-freeze mixture, it should be run into a clean container and used again.
(2) Detach the top water hose from the cylinder head.
(3) Disconnect the high tension wires from the sparking plugs.
(4) Detach the inlet and exhaust manifolds, complete with carburetters, as detailed in Section A.17.
(5) Remove rocker cover and breather pipe as described in Section A.12.
(6) Release the suction advance pipe clip from its securing point on the cylinder head. Also slacken the retaining clip and detach the heater inlet hose, if fitted.

(7) Remove the rocker assembly as described in Section A.12.

(8) Withdraw the push rods, keeping them in order of removal taking care not to pull the tappets out of their guides in the block.

(9) Remove the five external cylinder head nuts together with their flat washers and lift off the cylinder head.

(10) If removal of the cylinder head presents difficulty, rotate the engine by means of a spanner applied to the crankshaft pulley nut, when the head should lift off its seating.

Replacing

(1) Replace the cylinder head joint washer with the side marked 'Top' uppermost, it is not necessary to use jointing compound or grease for the gasket.

(2) Having slipped the gasket over the studs, next lower the cylinder head into position and position the cylinder head stud nut washers. Ensure that the suction advance pipe clip is replaced in its original position on the cylinder head.

(3) Insert the push rods, ensuring that the ball ends are correctly located in the tappets.

(4) Replace the rocker gear as described in Section A.12.

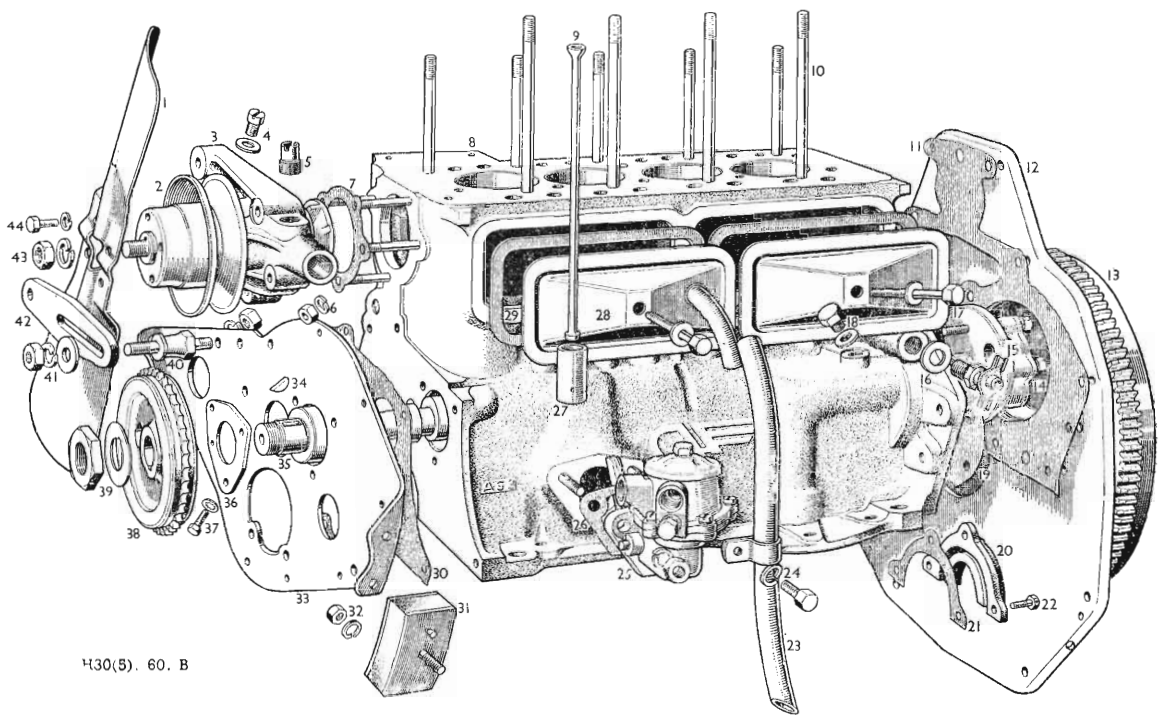


Fig. A.14. An exploded view of the crankcase assembly.

1. *Fan blade.*
2. *Water pump pulley.*
3. *Water pump.*
4. *Water pump screwed plug and washer.*
5. *Water pump by-pass tube.*
6. *Nut and washer for water pump stud.*
7. *Water pump joint washer.*
8. *Cylinder block.*
9. *Push rod.*
10. *Cylinder head studs in block.*
11. *Rear mounting plate joint washer*
12. *Rear mounting plate.*
13. *Flywheel and starter ring.*
14. *Oil pump.*
15. *Cylinder block drain tap.*
16. *Washer for drain tap.*
17. *Setscrew and washer for side cover.*
18. *Oil priming plug and joint washer.*
19. *Oil pump joint washer.*
20. *Crankcase rear cover.*
21. *Joint washer for rear cover.*
22. *Rear cover setscrew.*
23. *Crankcase vent pipe.*
24. *Setscrew and washer.*
25. *Petrol pump.*
26. *Petrol pump joint washer.*
27. *Tappet.*
28. *Cylinder side cover, front.*
29. *Joint washer for side cover.*
30. *Front mounting plate joint washer.*
31. *Rubber mounting.*
32. *Nut and washer for rubber mounting.*
33. *Engine front mounting plate.*
34. *Woodruff key.*
35. *Camshaft.*
36. *Camshaft locating plate.*
37. *Setscrew and shakeproof washer.*
38. *Camshaft gear and tensioner rings.*
39. *Nut and lockwasher.*
40. *Pillar for adjusting link.*
41. *Nut and washers for link.*
42. *Dynamo adjusting link.*
43. *Nut and washer for pulley.*
44. *Setscrew and washer for fan blade.*

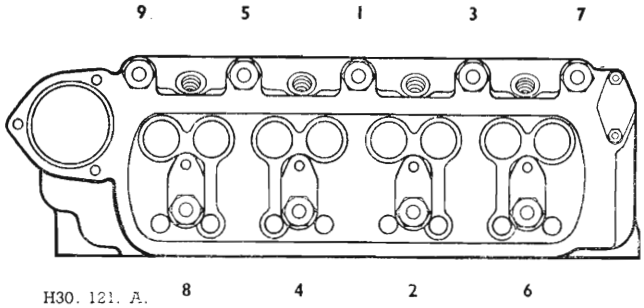


Fig. A.15. This figure illustrates the order of tightening cylinder head nuts.

(5) Fit the nuts finger tight and then tighten them a turn at a time, in the order given in Fig. A.15, to the recommended torque spanner readings (see 'General Data.')

(6) Reset the valve clearance, and replace the rocker cover using a new joint washer if the old one is damaged in any way.

(7) Replace the inlet and exhaust manifold and carburetters and connect up the petrol pipe, throttle and choke controls and heater outlet pipe, if fitted. Tighten the manifold nuts evenly ensuring that a good joint is made.

(8) Reconnect heater inlet pipe, water hose from the thermostat housing to the radiator, and breather pipe.

(9) Refill the cooling system, replace the sparking plugs and their washers, and the high tension wires to their respective plugs.

(10) Check the valve clearance again after the vehicle has run about 100 miles (160 km.) as the valves have a tendency to bed down. At the same time it is advisable to test the cylinder head nuts for tightness. Tightening the cylinder head nuts may affect valve clearances, although not usually enough to justify resetting.

Section A.19

REMOVING AND REFITTING VALVES

With the cylinder head removed, a valve lifting tool can be used to compress the springs (Service Tool 18G 45). Take away the circlip, split cotters, and valve stem cap, so releasing the spring and shroud and allowing the valve to be removed.

(1) When removing the valves, place them in a rack, thus enabling them to be paired up with their correct cylinders.

(2) Clean the carbon from the top and bottom of the valve heads, as well as any deposit that may have accumulated on the stems. The valve heads should, if necessary, be refaced at an angle of 45° for both exhaust and inlet valves. If the valve seats show signs of excessive pitting it is advisable to reface these also.

(3) The valves are made without any indentures or slots in the head, this necessitates the use of a rubber suction valve grinding tool.

(4) Reassembly is a reversal of the operations for removal.

Section A.20

VALVE GRINDING

(1) For valve grinding a little grinding paste should be smeared evenly on the valve face, and the valve rotated backwards and forwards against its seat (using Service Tool 18G 29 with suction pad 18G 29B), advancing it a step at short intervals until a clean and unpitted seating is obtained. The cutting action is facilitated by allowing a light spring situated under the valve head, to periodically lift the valve from its seat. This allows the grinding compound to re-penetrate between the two faces after being squeezed out.

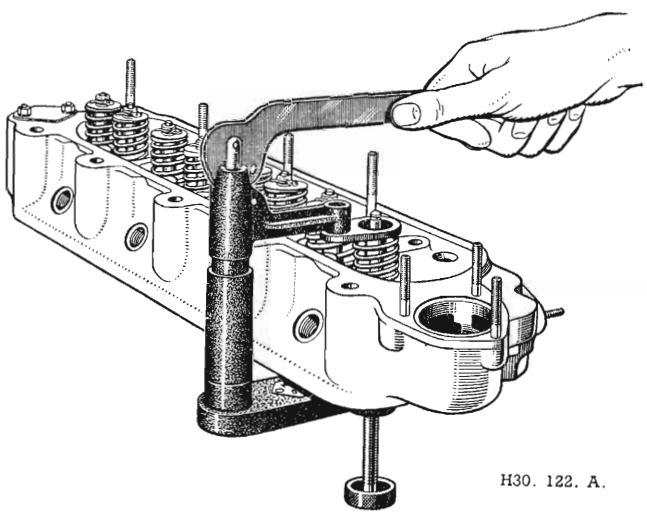


Fig. A.16. Using Service Tool 18G 45 to compress a valve spring.

(2) On completion, all traces of compound must be removed from the valve and seating. It is essential that each valve is ground-in and refitted to its own seating.

(3) It is also desirable to clean the valve guides; this can be done by dipping the valve stem in petrol or paraffin, and moving it up and down in the guide until it is free.

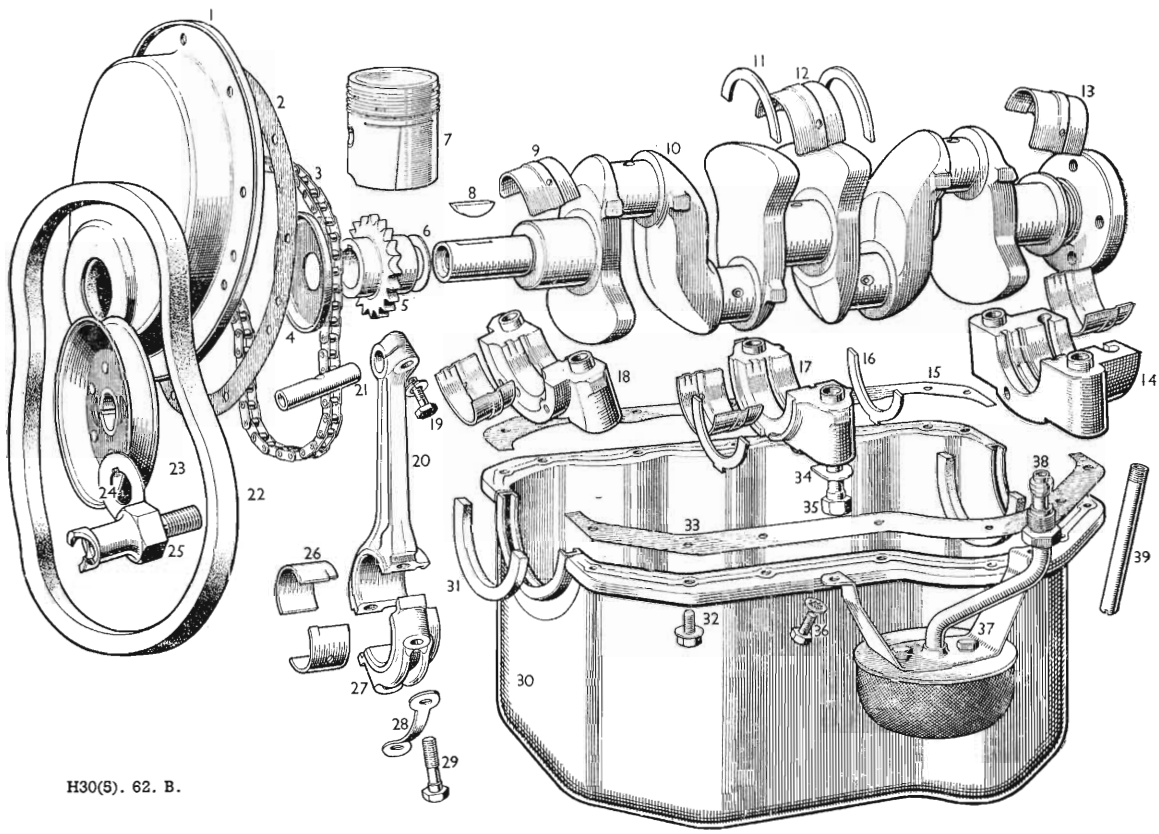


Fig. A.17. The crankshaft and sump assembly.

1. *Engine front cover.*
2. *Joint washer for cover.*
3. *Timing chain.*
4. *Crankshaft oil thrower.*
5. *Crankshaft gear.*
6. *Packing washers.*
7. *Piston.*
8. *Woodruff key.*
9. *Front main half bearing.*
10. *Crankshaft.*
11. *Thrust washer, upper.*
12. *Centre main half bearing.*
13. *Rear main half bearing.*
14. *Rear main bearing cap and dowels.*
15. *Oil sump joint washer, right.*
16. *Thrust washer, lower.*
17. *Centre main bearing cap and dowels.*
18. *Front main bearing cap and dowels.*
19. *Clamping screw and washer for* (20).
20. *Connecting rod, less cap.*
21. *Gudgeon pin.*
22. *Vee-belt for fan and pulley.*
23. *Crankshaft pulley.*
24. *Lockwasher.*
25. *Starting nut.*
26. *Connecting rod half bearing.*
27. *Connecting rod cap.*
28. *Lockwasher.*
29. *Setscrew for connecting rod.*
30. *Oil sump.*
31. *Cork sealing washer.*
32. *Set screw and captive washer.*
33. *Oil sump joint washer, left.*
34. *Main bearing cap lockwasher.*
35. *Setscrew for main bearing cap.*
36. *Setscrew and shakeproof washer for strainer bracket.*
37. *Oil strainer.*
38. *Suction pipe.*
39. *Drain pipe for rear main bearing cap*

Section A.21

VALVE GUIDES

(1) The valve guides are of a one-piece design. They are pressed into the cylinder head to allow $\frac{19}{32}$ in. (15·0812 mm.) of the guide to protrude above the machined face when fitted.

(2) To position each valve spring on the cylinder head, a stepped pressed steel seating collar is fitted over the part of the guide protruding from the cylinder head.

(3) Valve guides should be tested for wear whenever valves are removed, and if excessive side play is present, a close check should be made of the valve stem and the guide. In the event of wear being noticeable, the defective components should be renewed. If a valve is at fault the wear will be evident on the stem. It should be borne in mind that the valve stem and guide should be a running fit to avoid the possibility of an air leak.

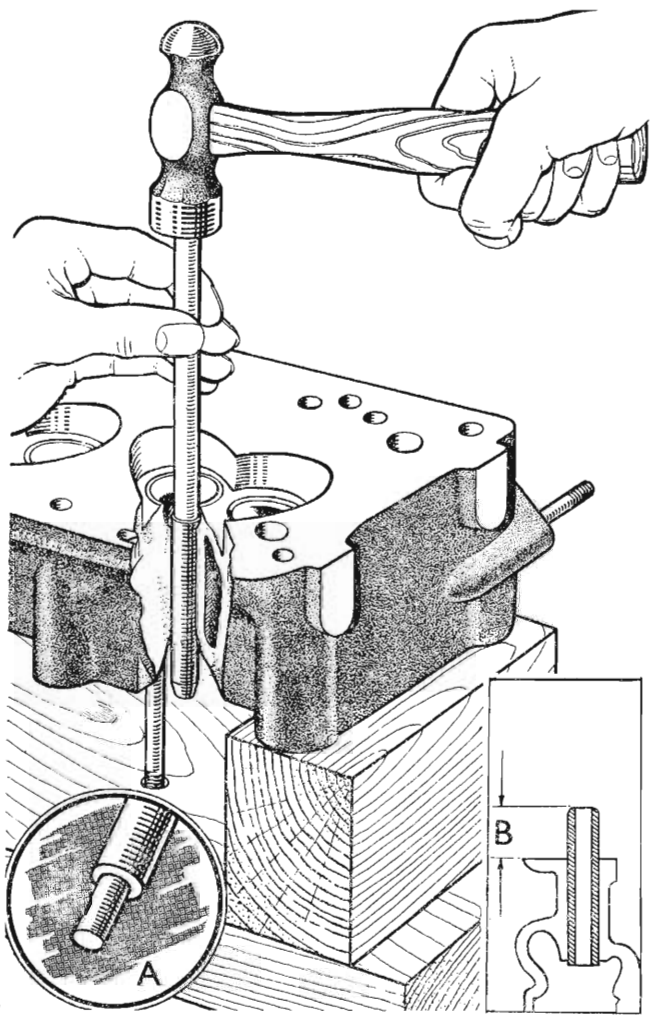
(4) If renewal is necessary due to wear, the valve guide may be driven out after removal of the

valve, as shown in Fig. A.18.

(5) The drift is stepped in order to ensure location and to obviate it slipping off the guide and damaging the port. Knock out the guide in the direction shown.

(6) A new guide should be driven into position in the same direction, that is, inserting it from the top of the cylinder head and knocked downwards.

(7) The final position of the guide is shown in Fig. A.18.



TH. 145. F.

Fig. A.18. Removing a valve guide.
The inset 'A' shows the form of the tool.
***B.** The valve guide should be ½ in. above the cylinder head.*

Section A.22

DECARBONISING

(1) Remove the cylinder head as described in Section A.18.

(2) Scrape off all carbon deposit from the cylinder head and ports. Clean the carbon from the piston crowns, care being taken not to damage the pistons, and not to allow dirt or carbon deposit to enter the cylinder barrels or push rod compartment.

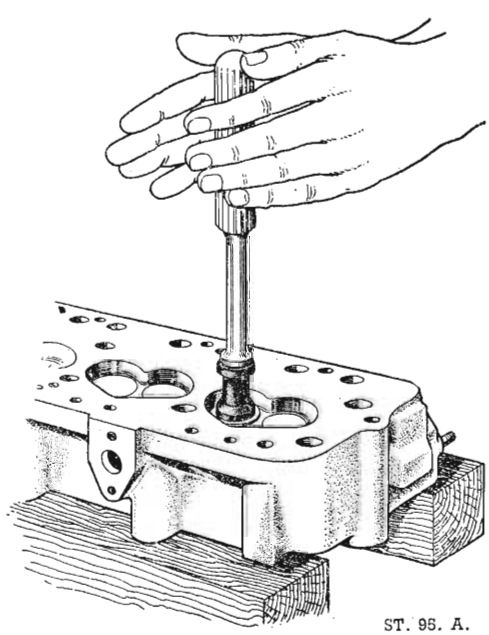
When cleaning the top of the pistons do not scrape right to the edge as a little carbon left on the chamfer assists in keeping down oil consumption; with the pistons cleaned right to the edge or new pistons, oil consumption is often slightly though temporarily increased.

(3) Blow out the oil passages and swill out the water passages using a water hose. The gasket contacting surfaces of the head should be checked for flatness with a straight-edge and the surfaces examined for scores. If the cylinder head is found to be badly out of true it should be renewed.

(4) Remove all carbon accumulation from the valves and thoroughly clean them. Inspect the valve bases and seats and if they are slightly pitted or rough, grind them in, as described in Section A.20. If the valves and seats show signs of excessive pitting, or the faces are not flat, the valves and seats should be replaced.

(5) Examine the valve guides, as described in Section A.21.

(6) Broken or weak valve springs should be renewed. The other valve springs should be tested and the results compared with figures given in Section A.19.



ST. 95. A.

Fig. A.19. Grinding in a valve.

(7) Clean the rocker shaft gear and blow out the oil passages as described in Section A.12.
(8) Inspect the rocker shaft, rockers and bushes for wear. Renew any worn rocker bushes as described in Section A.14.
(9) Reassemble and install the cylinder head assembly.

The following operations should be carried out with the engine removed, although in some cases it is possible to perform them with the engine in position.

Before removing or replacing any component it is important to ensure that all surrounding surfaces are perfectly clean, to prevent the entry of foreign matter into the engine. This can best be accomplished by the use of a paraffin bath and brush, and it is also important to note that fluffy rags should never be used, as there is danger of causing obstruction to small oil ways.

Section A.23

CONNECTING RODS AND BEARINGS

Removal

(1) Remove the cylinder head assembly as described in Section A.18.
(2) Drain and remove the sump (see Section A.5).
(3) Unlock and remove the nuts securing the caps and bearings to the connecting rods. Remove the caps and bearings.
(4) Withdraw the pistons and connecting rods upwards through the cylinder bores.
(5) It may be necessary to remove the carbon or ridge from the top of the bores prior to pushing the pistons upwards, to avoid piston-ring fracture.

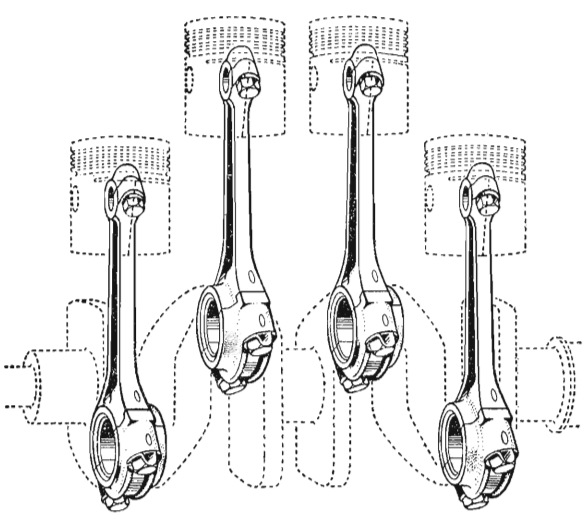


Fig. A.20. Showing the positions of the offsets and the correct method of assembly.

(6) Remove the pistons from the connecting rods by unscrewing the clamp bolt from the small end of the connecting rod and pushing the gudgeon pin out.
(7) Ensure that each connecting rod, cap and bearing is marked with the cylinder number from which it was removed.

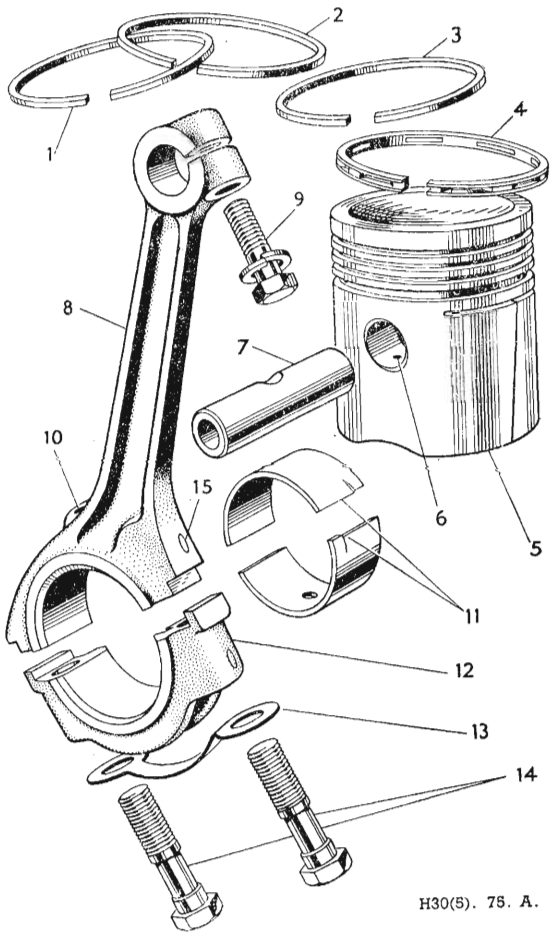


Fig. A.21. Connecting rod and piston assembly.

1. *Piston ring, parallel.*
2. *Piston ring, taper.*
3. *Piston ring, taper.*
4. *Piston ring, scraper.*
5. *Piston.*
6. *Gudgeon pin lubricating hole.*
7. *Gudgeon pin.*
8. *Connecting rod, less cap.*
9. *Clamping screw and washer.*
10. *Cylinder wall lubricating jet.*
11. *Connecting rod bearings.*
12. *Connecting rod cap.*
13. *Lockwasher.*
14. *Setscrews.*
15. *Mark on rod and cap.*

(8) The big ends are offset, and rods in numbers 1 and 3 cylinders are offset towards the front, with 2 and 4 cylinders offset towards the rear.
(9) The alignment of the connecting rods should be checked on an alignment fixture. On no account must the rods or caps be filed.
(10) Examine the bearing shells for wear and pits. Renew the bearing shell if necessary. Bearings

and pre-finished with the correct diametral clearance and do not require bedding in.

(11) Check the crankpins with a micrometer if they are worn oval or are scored, the crankshaft will have to be removed for regrinding, see Section A.29.

Replacing

Before installing the connecting rods and bearings it is assumed that the pistons and rings have been serviced, see Section A.24.

The pistons and connecting rods must be fitted in the same cylinder bores and the same way round as when removed.

(1) Assemble the piston and the connecting rod to the gudgeon pin, so that the split in the piston skirt is adjacent to the split in the top of the connecting rod.

(2) Refit the piston rings very carefully, make quite sure that the pistons and bores are perfectly clean and smear the bores with clean engine oil.

(3) Use a piston ring clamp, Service Tool No. 18G 55, when replacing the pistons from the top of the bore, and make sure that the split in the piston faces the camshaft.

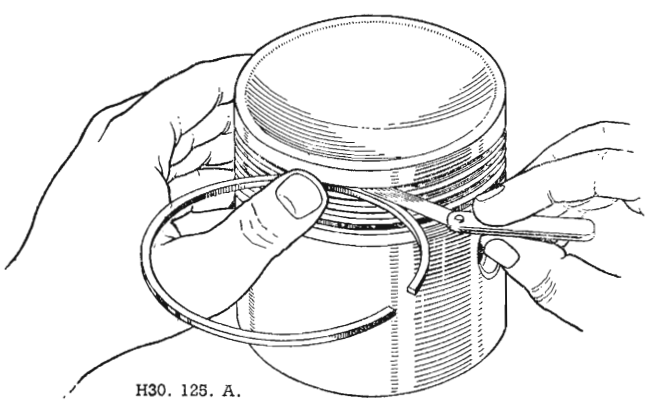


Fig. A.22. Checking the piston ring groove clearance.

(4) Clean the crankpins and both sides of the shell bearings, locate the feathered ends in the connecting rod and its cap, and smear the crankpins with engine oil.

(5) Before fitting the cap, check that the number stamped on the rod is the same as that on the cap. Note that the recess in the cap and rod must be on the same side. Tighten and lock the nuts. Turn the crankshaft after fitting each rod, to ensure that the bearing is not binding on the crankpin. Also check the side clearance of each rod, as given under 'General Data'.

(6) Refit the cylinder head assembly, see Section A.18.

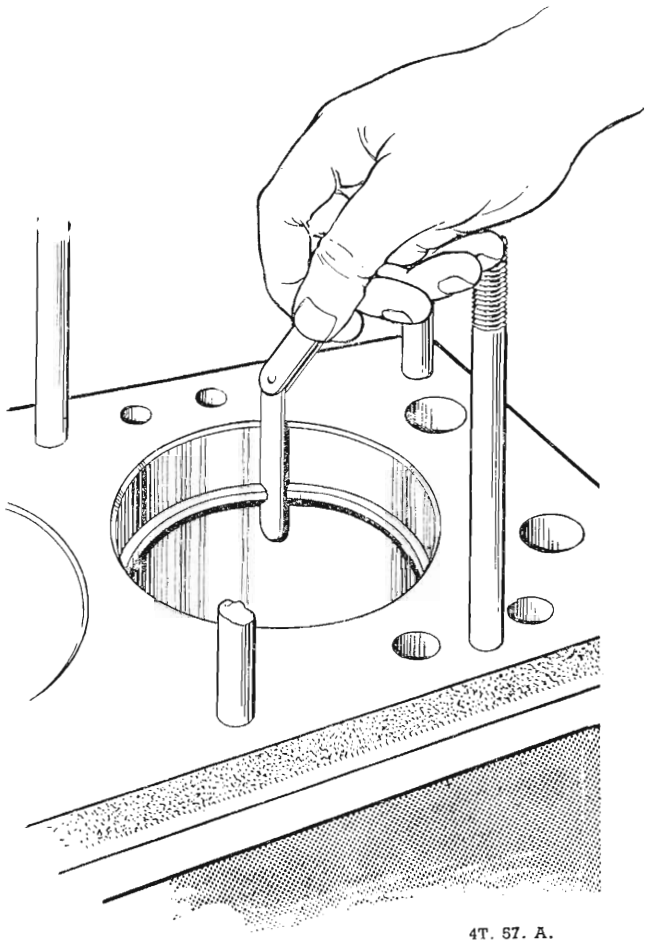


Fig. A.23. Measuring the piston ring gap.

(7) Refit the sump and refill with recommended grade of oil, see Section P.

Section A.24

PISTONS, RINGS AND GUDGEON PINS

Removal

The split-skirt pistons are of aluminium alloy material. Four rings are fitted above the gudgeon pin, the bottom ring being of the oil-control type. The pistons are fastened to the connecting rods by gudgeon pins which are clamped rigidly in the small ends of the connecting rods. Bushings are not needed in the gudgeon pin bosses of the pistons because the aluminium alloy material serves as a suitable bearing for the gudgeon pins, the bearing surfaces of which are lubricated by means of splash through the two holes drilled in each boss. To remove the pistons see Section A.23.

To view and overhaul

(1) Remove the rings over the tops of the pistons.

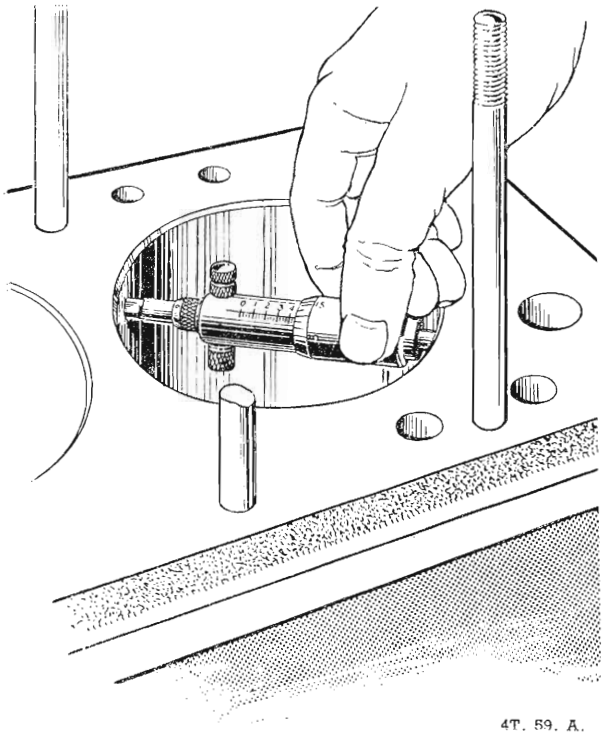


Fig. A.24. Checking the bore for ovality with an internal micrometer.

(2) Scrape all accumulation of carbon off the piston heads and, using a piston ring groove-cleaning tool or an old ring section, carefully scrape all carbon out of the ring grooves of the pistons. Clean the carbon out of the oil holes in the piston ring grooves.

(3) Thoroughly clean all the dismantled components in paraffin.

(4) Examine all parts for wear and damage, renew if necessary.

(5) If cylinder reconditioning is required, determine the amount of material to be removed (refer to Section A.25 concerning oversize pistons available).

(6) When fitting new or oversize pistons and rings to reconditioned cylinder bores, the clearances should be controlled within the limits given under 'General Data'.

Selective assembly is necessary, and for this purpose pistons are stamped with distinguishing symbols of grade and oversize.

(7) Piston rings should have a gap clearance (see 'General Data') when installed in the cylinder bores. If new rings are being installed, each ring should be checked in the cylinder bore to determine whether its gap clearance is within the range specified. To do this, use the bottom of a piston to insert the ring part way into the bore. The ring will be squared up in the bore to measure the gap clearance as shown Fig. A.23. To check the ring clearance in the piston grooves, install the rings on the pistons and determine the clearances with a feeler gauge. If the piston ring grooves are worn excessively, as indicated when comparing the actual clearances with those given under 'General Data', renew the rings and pistons.

(8) Gudgeon pins should be a hand-push fit in the pistons. The fit can be checked after the rod has been assembled by holding the piston with the connecting rod in an approximately horizontal position. The weight of the large end of the connecting rod should be just insufficient to turn the gudgeon pin in the piston. On no account must gudgeon pin piston bosses be reamed out as oversize gudgeon pins are not supplied or permitted.

Replacement

See Section A.23.

Section A.25

PISTON SIZES AND CYLINDER BORES

In production pistons are fitted by selective assembly, and to facilitate this the pistons are stamped with identification figures on their crowns.

The number enclosed in a diamond, e.g. a piston stamped with a figure 2, is for a bore bearing a similar stamp.

In addition to the standard pistons there is a range of four oversize pistons available for service purposes. Oversize pistons are marked with the actual oversize dimensions enclosed in an ellipse. A piston stamped ·020 is suitable only for a bore ·020 in. (·508 mm.) larger than the standard bore, and similarly, pistons with other markings are suitable only for the oversize bore indicated.

The piston markings indicate the actual bore size to which they must be fitted, the requisite running clearance being allowed for in the machining.

After reboring an engine, or whenever fitting pistons differing in size from those removed during dismantling, ensure that the size of the piston fitted is stamped clearly on the top of the cylinder block alongside the appropriate cylinder bore.

Pistons are supplied in the sizes indicated in the following table.

Piston marking	*Suitable bore size*	*Metric equivalent*
STANDARD	2·4778 in. to 2·4781 in.	62·935 mm. to 62·940 mm.
OVERSIZE		
+·010 in. (·254 mm.)	2·4878 in. to 2·4881 in.	63·189 mm. to 63·194 mm.
+·020 in. (·508 mm.)	2·4978 in. to 2·4981 in.	63·443 mm. to 63·448 mm.
+·030 in. (·762 mm.)	2·5078 in. to 2·5081 in.	63·697 mm. to 63·702 mm.
+·040 in. (1·016 mm.)	2·5178 in. to 2·5181 in.	63·951 mm. to 63·956 mm.

Section A.26

TIMING COVER

Removal and Replacement

(1) Drain the cooling system as described in Section C.
(2) Remove the radiator (see Section C.).
(3) Slacken the generator attachment bolts and remove the belt.
(4) Bend back the tab on the crankshaft pulley nut locking washer. Unscrew the nut.
(5) Pull off the crankshaft pulley.
(6) The timing cover is secured by four large setpins and six small ones. Each setpin has a shakeproof washer and a plain washer. Unscrew all ten setpins with their washers and remove the timing cover.
(7) Take care not to damage the timing cover gasket. If it is damaged, clean the face of the cover flange and the engine front mounting plate and fit a new gasket when reassembling.
(8) The felt washer situated in the timing cover should also be renewed if necessary.

It should be noted that the oil thrower, which is located behind the crankshaft pulley, is fitted with its concave side facing forward.

(9) When the special aligning tool (Service Tool 18G 138) is not available the crankshaft pulley should be assembled to the cover before the cover is refitted to the engine. This will ensure that the timing cover and oil seal are concentric with the crankshaft. Lubricate the hub of the pulley and, with a rotating movement to avoid damage to the oil seal, insert it in the cover. Push the pulley and timing cover on to the crankshaft, lining up the pulley bore keyway with the Woodruff key fitted to the crankshaft. Replace the cover set screws and tighten them up evenly.
(10) Reassembly is now a reversal of the removal procedure.

Section A.27

TIMING CHAIN AND WHEELS

Removal

(1) Remove the timing cover and oil thrower as described in the previous Section.
(2) Unlock and remove the camshaft chain wheel nut and remove the nut and lockwasher. Note that the locating tag on the lockwasher fits into the keyway of the camshaft chain wheel.
(3) Remove the camshaft and crankshaft chain wheels, together with the timing chain, by easing each wheel forward a fraction at a time with suitable small levers. Note the packing washers immediately behind the crankshaft gear wheel.

Replacement

(1) Unless new camshaft or crankshaft components have been fitted, replace the same number of packing washers behind the crankshaft gear wheel. If adjustment is necessary, however, it is required to determine the thickness of packing washers. This is achieved by placing a straight-edge across the sides of the camshaft wheel teeth and measure with a feeler gauge the gap between the straight-edge and the crankshaft gear.

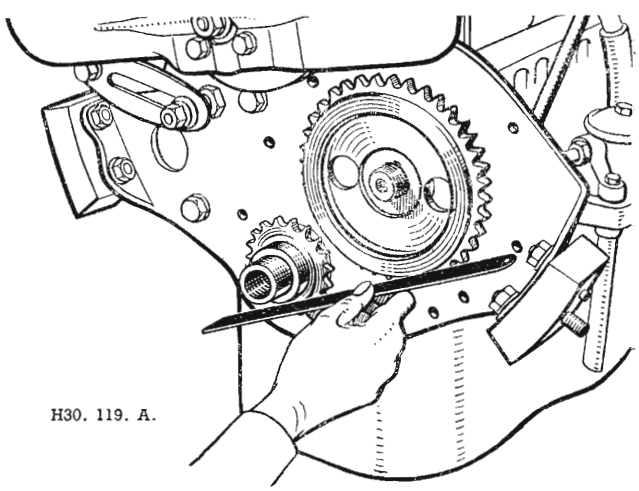


Fig. A.25. Lining up the crankshaft and camshaft gear teeth with a straight-edge.

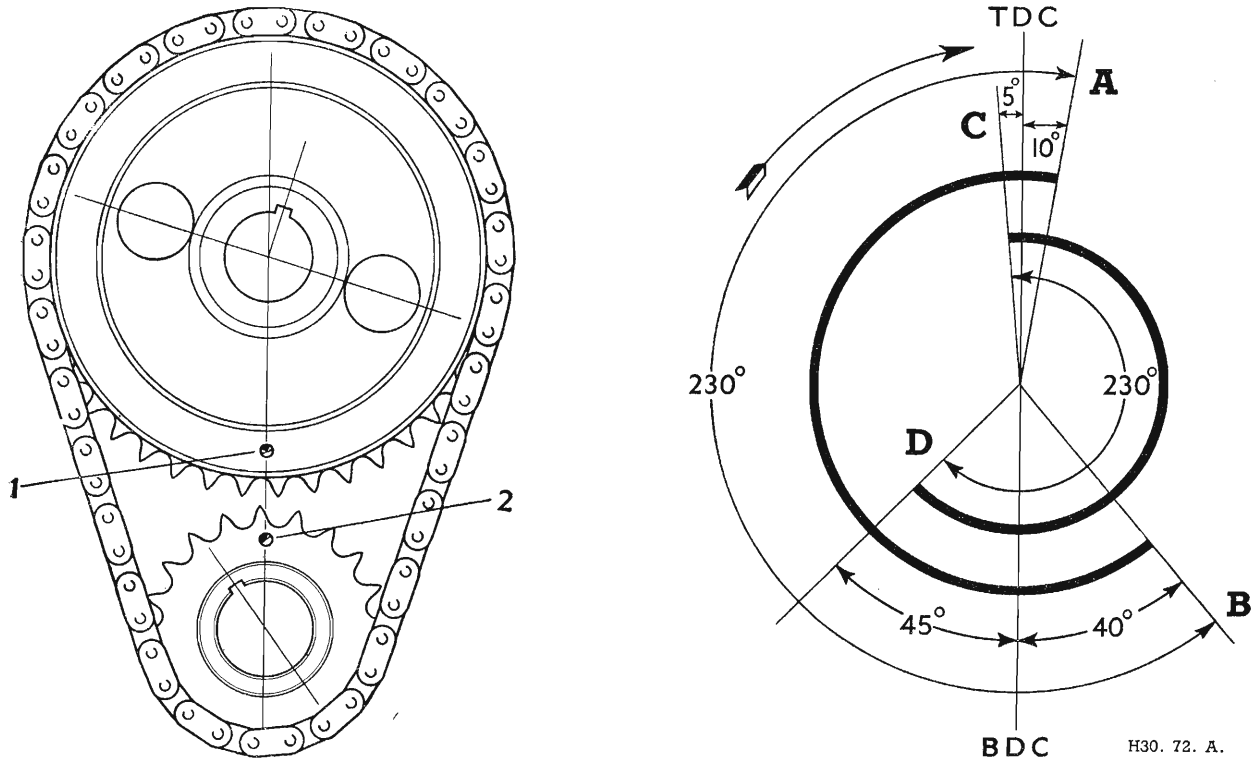


Fig. A.26. Showing timing diagram and position of timing gears. 1 and 2. Timing marks. A. to B. Exhaust open, C. to D. Inlet open, with the valve rocker clearances set at 0·019 in. (for checking purposes only)

(2) Set the crankshaft with its keyway at T.D.C. and the camshaft with its keyway approximately at the one o'clock position when seen from the front.

(3) Assemble the gears into the timing chain with the two marks on the gear wheels opposite each other, Fig. A.26.

(4) Keeping the gears in this position, engage the crankshaft gear keyway with the key on the crankshaft and rotate the camshaft until the camshaft gear keyway and key are aligned.

(5) Push the gears onto the shafts and secure the camshaft gear with the lockwasher and nut.

(6) Replace the oil thrower, concave side forward, and the remaining components as detailed in Section A.26.

Section A.28

CAMSHAFT AND BEARINGS

Removal

(1) Drain the sump and release it from the engine. Remove the rocker assembly.

(2) Remove the push rods and take out the tappets, see Section A.13.

(3) Remove the timing cover, timing chain tensioner, chain and gears, see Sections A.26 and A.27.

(4) Detach the oil pump, see Section A.8.

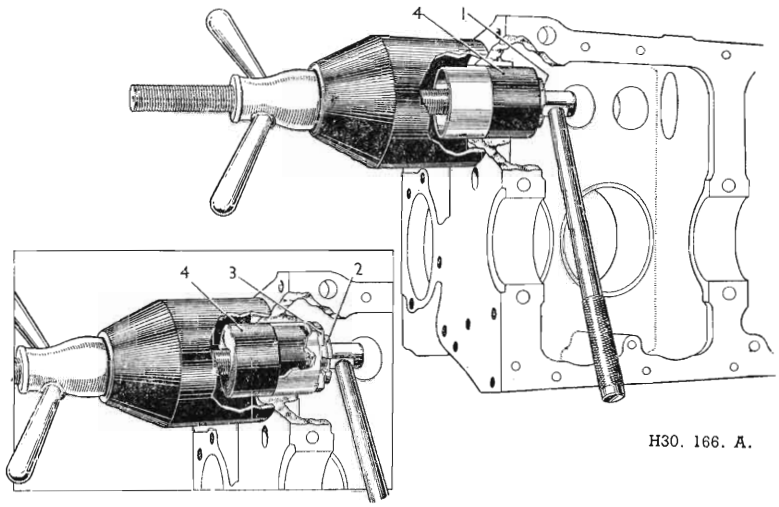
(5) Remove the distributor and spindle drive, see Section B. Do not slacken the clamping plate bolt or the ignition timing setting will be lost.

(6) Take out the two setscrews which secure the camshaft locating plate to the cylinder block.

(7) Withdraw the camshaft forward, rotating it slowly to assist the withdrawal.

(8) Inspect the camshaft bearing journals and cams for signs of scoring. If the journals are not within the required diameter limits (see under 'General Data'), the camshaft should be renewed.

(9) Examine the camshaft front bearing for scores, pits or evidence of failure. If the bearing has to be renewed it will necessitate the removal of the engine back plate as described in Section A.29. The old bearing can then be withdrawn and a new one installed, using Service Tool 18G 124A with 18G 124K.
Oil holes must be lined up carefully and the front bearing reamed in line to give ·001 to ·002 in. (·025 to ·051 mm.) clearance, using Service Tool 18G 123 with 18G 123AH.
The centre and rear camshaft bearings are cast in the block and are therefore non-renewable.



H30. 166. A.

Fig. A.27. Removing a camshaft front bearing using Adaptor 18G 124K in conjunction with Service Tool 18G 124A.

1. *'C' washer.*
2. *'C' washer.*
3. *'D' washer.*
4. *Adaptor 18G 124K.*

Inset shows the bearing being replaced.

(10) Inspect the tappet cam contacting surfaces for wear. New tappets should be installed wherever evidence of unusual wear is found.

(11) The installation of the camshaft and tappets is a reversal of the procedure **'Removal'.** Lubricate the camshaft journals with engine oil.

Camshaft Liner Removal

When reconditioning cylinder blocks it is usual to renew the camshaft liner. From within the cylinder block place adaptor 18G 124K inside the liner, pass the screw of 18G 124A through the body of the tool and adaptor from in front of the cylinder block.

Position the 'C' washer on the flat at the end of the screw, fit the handle into the hole (to prevent the screw from turning) and screw up the wing nut. Continued tightening of the wing nut will quickly withdraw the liner.

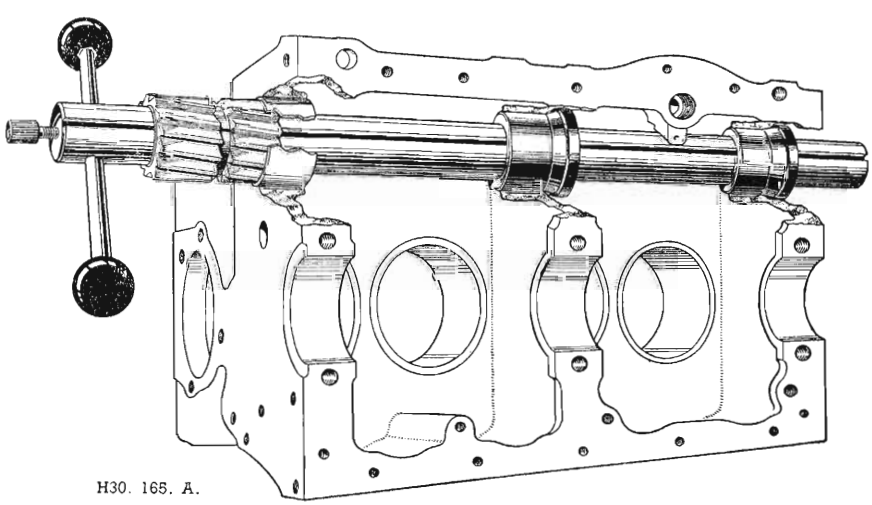
Camshaft Liner Replacement

Place the new liner on the smaller diameter of adaptor 18G 124K and from inside the cylinder block position the adaptor in the camshaft liner bore.

Line up the oil holes in the camshaft liner bore and liner, place the 'D' washer in position behind the liner, pass the screw of Tool 18G 124A through the adaptor, liner and 'D' washer, then fit the 'C' washer and tighten the screw. Secure the handle in the hole in the rear end of the screw to prevent if from turning; tighten the wing nut to draw the liner squarely into position.

Reaming the Liner

Fit the two pilots 18G 123AH into the centre and rear camshaft bores, pass the cutter on to the arbor of Tool 18G 123 and locate it in position '8'. A peg retained in the centre groove of the cutter by means of a spring clip, locates in a hole in the arbor, thus holding the cutter in the desired position.



H30. 165. A.

Fig. A.28. Camshaft liner reamer and pilots, 18G 123AH, being used in conjunction with the arbor of 18G 123 to ream the front camshaft bearing shell in line with the centre and rear bearings.

As the tool is made up of roughing and finishing cutters care must be taken to see that it is placed on the arbor with the roughing cutter towards the liner to be reamed.

Carefully pass the arbor through the camshaft bore and two pilots, then when the cutter comes up to the liner, commence to ream, always turning in a clockwise direction. Do not attempt to force the reamer through the liner, but proceed gently. Swarf should be frequently cleared away during the cutting operation.

When the cutter has passed right through the liner, disconnect it from the arbor and hold it inside the cylinder block whilst the arbor is carefully withdrawn.

Note: On no account must the cutter be brought through the reamed hole, on the arbor. Finally, before refitting the camshaft, thoroughly clean the block of all swarf.

Section A.29

FLYWHEEL AND ENGINE REAR PLATE

To Remove

The flywheel complete with starter ring is secured to the flange on the rear of the crankshaft by four set bolts, which are locked in position by two lockplates. The engine rear plate is secured to the crankcase by set bolts and lockwashers. To remove the flywheel and rear plate, after the engine is removed from the vehicle, proceed as follows:

(1) Remove the gearbox from the engine (see Section F).

(2) Remove the clutch (see Section E).

(3) Knock back the tabs of the lockplates, unscrew the bolts and withdraw the flywheel.

(4) Unscrew the set bolts and withdraw the engine rear plate.

(5) Examine the flywheel teeth and friction face for excessive wear. If the teeth on the starter ring are damaged or badly worn, a replacement flywheel and ring should be fitted.

Note: The fitting of a new starter ring only, requires special workshop equipment for heating the ring evenly to shrink it onto the flywheel. If these facilities are available, heat the ring to a temperature of 1616° to 1652° F. (880° to 900° C.) before fitting.

(6) Examine the engine rear plate for distortion and damage and clean the joint faces of the plate and crankcase and check for scores.

To Install

(1) Refit the engine rear plate to the crankcase, using a new joint washer. Tighten the securing bolts evenly and firmly with a torque wrench to 22 lb. ft. (3·042 kg. m.).

(2) Place the flywheel over the flange and flange bolts of the crankshaft so that the timing mark '1/4' is at T.D.C. when the first throw of the crankshaft is at T.D.C. The joint faces should be perfectly clean. Fit the lockplates and nuts on the bolts and tighten them in diagonal sequence with a torque wrench to 40 lb. ft. (55 kg. m.).

Section A.30

CRANKSHAFT AND MAIN BEARINGS

To Remove

The forged-steel crankshaft is statically and dynamically balanced and is supported in the crankcase by three renewable main bearings of the sintered copper and lead steel-backed type. Crankshaft end float is controlled by thrust washers fitted on both sides of the centre main bearing.

(1) Remove the engine from the vehicle (see Section A.4) and place it upside-down in a dismantling fixture.

(2) Remove the sump and oil strainer (see Section A.7).

(3) Remove the timing chain (see Section A.27).

(4) Remove the flywheel and engine rear plate (see Section A.29).

(5) Check the crankshaft end float to determine whether the renewal of the thrust washers is necessary (Fig. A.29).

(6) Remove the connecting rod bearing caps and shells, keeping the shells with their respective caps for correct replacement, and release the connecting rods from the crankshaft. Remove the sparking plugs from the cylinder head to facilitate the turning of the crankshaft.

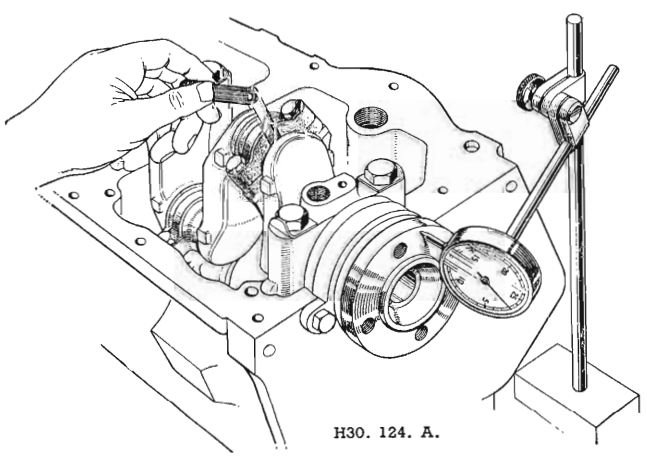


Fig. A.29. A feeler gauge being used to measure connecting rod side clearance and a dial gauge to check crankshaft end float.

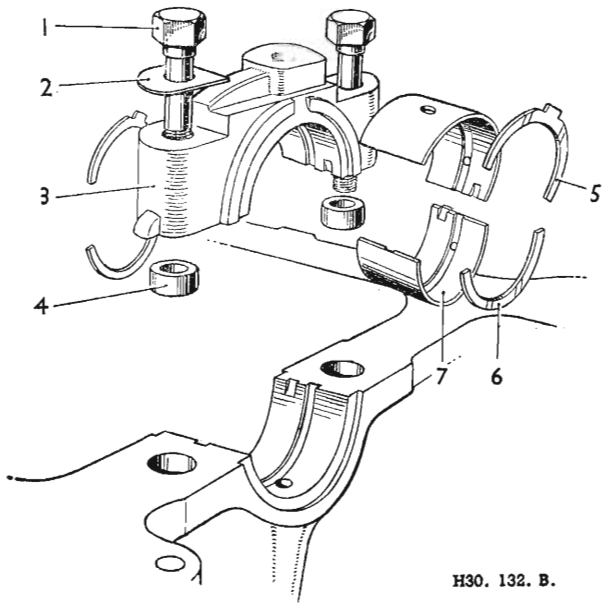


Fig. A.30. Centre main bearing assembly.

1. *Main bearing setscrews.*
2. *Lockwasher.*
3. *Main bearing cap.*
4. *Dowels.*
5. *Thrust washer, lower.*
6. *Thrust washer, upper.*
7. *Main bearing shell.*

(7) Withdraw the main bearing caps complete with bearing bottom shells. Caps and both bearing half-shells should be kept together. Remove the screwed plug from the rear bearing cap oil return pipe and withdraw the pipe. Note that each main bearing is stamped with a common number, which is also stamped on the centre web of the crankcase near the main bearing. The bottom halves of the two thrust washers will be removed with the centre main bearing cap.

(8) Remove the crankshaft, the two remaining halves of the thrust washers and the top half-shells of the main bearings from the crankcase.

(9) Inspect the crankcase main journals and crankpins for wear, scores, scratches and ovality. If necessary the crankshaft may be re-ground to the minimum limits shown under 'General Data'. Main bearings for re-ground crankshafts are available in sizes shown under 'General Data'.

(10) Clean the crankshaft thoroughly, ensuring that the connecting oilways between the journals and crankpins are perfectly clear. They can be cleaned out by applying a pressure gun containing petrol or paraffin. When clean, inject a thin oil in the same manner.

(11) Thoroughly clean the bearing shells, caps and housings above the crankshaft.

(12) Examine the bearing shells for wear and pitting, and look for evidence of breaking away or picking-up. Renew the shells if necessary.

(13) Bearings are pre-finished with the correct diametral clearance, and do not require bedding in. New bearings should be marked to match up with the marking on the cap, and **on no account should they be filed to take up wear or to reduce running clearance.**

(14) Check the thrust washers for wear on their bearing surfaces, and renew if necessary to obtain the correct end float.

To Install

The installation of the crankshaft and main bearings is a reversal of the procedure **'To Remove',** noting the following points:

(1) Ensure that the thrust washers are replaced the correct way round, the oil grooves should face outwards, and locate the bottom half tab in the slot in the bearing cap.

(2) The bearing shells are notched to fit the recesses machined in the housing and cap.

(3) Remember to fit the packing washers behind the crankshaft timing chain wheel.

(4) Lubricate the bearings freely with engine oil.

(5) The rear main bearing cap horizontal joint surfaces should be thoroughly cleaned and lightly covered with WEL-SEAL (manufactured by Messrs. Wellworthy Ltd.) sealing compound before the cap is fitted to the cylinder block. This ensures a perfect oil seal when the cap is bolted down to the block.

(6) Tighten the main bearing nuts, see 'General Data' for torque spanner settings.

Section A.31

CYLINDER BLOCK

To Remove and Dismantle

(1) Remove and dismantle the engine (see Section A.4).

(2) Remove all studs, unions and screwed plugs, etc., if necessary.

(3) If an expansion plug has blown, or leaks, remove the plug by drilling a hole in its centre and lever it out with a screwdriver or other suitable tool.

To View and Overhaul

(1) Scrape as much sediment as possible from the water passages and thoroughly swill out with a water hose.

(2) Clean all gasket surfaces.

(3) Inspect for cracks and scores on gasket surfaces.

(4) It may be advisable to remove the ridge above the ring travel at the top of the cylinder bores before checking the fit of the pistons.

(5) Wipe the cylinder bores clean and examine them for scores, out-of-round and taper. If the cylinders are found to be out-of-round or excessively tapered when measured with a dial test indicator, they should be reconditioned.

(6) If cylinder reconditioning is required, determine accurately the amount of material to be removed (refer to 'General Data' concerning oversize pistons available).

(7) Make sure that all traces of abrasives are cleaned from all parts of the cylinder block after the cylinder reconditioning operation is completed.

(8) Check the camshaft bearings (see Section A.28).

To Reassemble and Install

(1) Install all studs, unions and screwed plugs, etc.

(2) When installing new expansion plugs, coat the edge of the plug with a sealing compound and insert the plug with the 'bulge' on the outside. A carefully aimed blow at the centre of the plug with a small hammer direct or with a blunt punch will expand the plug sufficiently to make a water-tight joint. If too heavy a blow is used, the plug will be useless and must be replaced by another new one.

(3) Reassemble, install and test the engine (see Section A.4).

Section A.32 FAULT DIAGNOSIS

Symptom	No.	Possible Fault
(a) Will Not Start	1	Defective coil
	2	Faulty condenser
	3	Dirty, pitted, or incorrectly set contact breaker points
	4	Ignition wires loose or leaking
	5	Water on sparking plugs leads
	6	Corrosion of terminals or discharged battery
	7	Faulty starter
	8	Wrongly connected plug leads
	9	Vapour lock in fuel line
	10	Defective fuel pump
	11	Over-choking
	12	Under-choking
	13	Choked petrol filter or jets
	14	Valves leaking
	15	Sticking valves
	16	Valve timing incorrect
	17	Ignition timing incorrect
(b) Engine Stalls		In (a), check 1, 2, 3, 4, 10, 11, 12, 13, 14 and 15
	1	Plugs defective or incorrect gap
	2	Retarded ignition
	3	Mixture too weak
	4	Water in fuel system
	5	Petrol tank breather choked
	6	Incorrect valve clearance
(c) Poor Idling		In (b), check 1 and 6
	1	Air leak at manifold joints
	2	Incorrect slow running adjustment
	3	Air leak in carburetter(s)
	4	Slow running jet choked
	5	Over-rich mixture
	6	Worn piston rings
	7	Worn valve stems or guides
	8	Weak exhaust valve springs

Symptom	No.	Possible Fault
(d) Misfiring		In (a), check 1, 2, 3, 4, 5, 8, 10, 13, 14, 15, 16 and 17 In (b), check 1, 2, 3 and 6
	1	Weak or broken valve springs
(e) Overheating		See Section C
(f) Low Compression		In (a), check 14 and 15 In (c), check 6 and 7 In (d), check 1
	1	Worn piston ring grooves
	2	Scored or worn cylinder bores
(g) Lack of Power		In (a), check 3, 10, 11, 13, 14, 15 and 16 In (b), check 1, 2, 3 and 6 In (c), check 6 and 7 In (d), check 1 Check (e) and (f)
	1	Leaking joint washers
	2	Fouled sparking plugs
	3	Automatic advance not functioning
(h) Burnt Valves or Seats		In (a), check 14 and 15 In (b), check 6 In (d), check 1 Check (e)
	1	Excessive carbon around valve seat and head
(j) Sticking Valves		In (d), check 1
	1	Bent valve stem
	2	Scored valve stem or guide
	3	Incorrect valve clearance
(k) Excessive Cylinder Wear		Check 11 in (a) Check (e)
	1	Lack of oil
	2	Dirty oil
	3	Dirty air cleaner
	4	Gummed up or broken piston rings
	5	Badly fitting piston rings
	6	Misalignment of conrods
(l) Excessive Oil Consumption		In (c), check 6 and 7 Check (k)
	1	Ring gap too wide
	2	Oil return holes in piston choked with carbon
	3	Scored cylinders
	4	Oil level too high
	5	External oil leaks
	6	Ineffective valve oil seal

Symptom	No.	Possible Fault
(m) Crankshaft and Connecting Rod Bearing Failure	1	In (k), check 1
	2	Restricted oilways
	3	Worn journals on crankpins
	4	Loose bearing caps
	5	Extremely low oil pressure
		Bent connecting rod
(n) Internal Water Leakage		See Section C.
(o) Poor Circulation		See Section C
(p) Corrosion		See Section C
(q) High Fuel Consumption		See Section D
(r) Engine Vibration	1	Loose generator bolts
	2	Fan blades out of balance
	3	
	4	
	5	Exhaust pipe mountings too tight

Section A.33

MODIFIED VALVE SHROUDS AND OIL SEALS

From Engine No. 9C/U/H 1397 valve packing rings (Part No. 2A879) of circular cross-section are fitted in place of the valve oil seals previously used. The oil seal retainer has been deleted from the valve guide shroud. The part number of the shroud without the oil seal retainer is 2A545. This modification involves changes in the inlet and exhaust valves and the valve spring caps.

If it is desired to fit the new valve packing rings on earlier engines the modified shrouds (Part No. 2A545), valves (Part Nos. 2A877 [inlet] and 2A878 [exhaust]), and valve spring caps (Part No. 2A880) must be used.

These modifications necessitate certain differences in valve removal and replacement procedure as detailed in Section A.19.

Removal

Remove the valve circlip. Compress the valve spring, using Service Tool 18G 45, and remove the two valve cotters. Release the valve spring and remove the compressor, valve spring cap, shroud, and spring.

Remove the valve packing ring from the cotter groove and withdraw the valve from its guide.

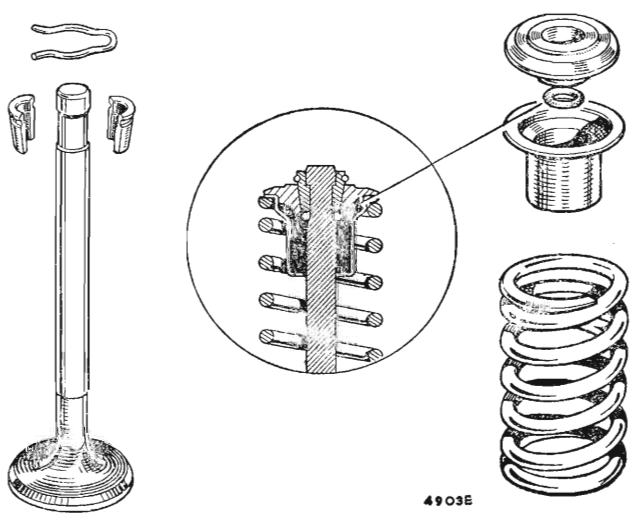


Fig. A.31

Parts of the valve assembly, showing the valve, cotters, circlip, spring, shroud, packing ring, and spring cap. The inset shows the valve packing ring fitted correctly at the bottom of the cotter groove below the cotters.

Replacement

Place each valve into its guide and fit the springs, shrouds, and caps. Compress the valve spring and push a new synthetic rubber packing ring over the tip of the valve stem down to the bottom of the cotter groove (see Fig. A.31). Refit the two valve cotters and remove the compressor. Replace the valve circlip.

NOTE.—Do not fit old valve packing rings, or oil sealing may suffer. The rings are fitted more easily if they have been soaked in clean engine oil for a short period before use.

Section A.34

MODIFIED CYLINDER HEAD GASKET

From Engine No. 9C/U/H 6733 onwards a modified cylinder head gasket (Part No. 2A971) having ferrules around all the water holes is fitted. The new gasket is interchangeable with that previously used and is introduced to improve water sealing.

Section A.35

MODIFIED OIL PUMP

On later engines the Hobourn Eaton alternative oil pump (Part No. 2A341) is replaced by a Hobourn Eaton pump of modified construction (Part No. 2A962).

The cover and body of the new pump are now dowelled together, being located in the correct position in relation to each other by a $\frac{3}{16}$ in. countersunk screw. The assembly is held securely together by the three cylinder block attachment bolts. The pump cover now embraces the outer rotor and the combined oil pump shaft and inner rotor.

The new oil pump can be identified by the fact that the manufacturer's name and the patent number are cast on the outer flange of the cover instead of appearing around the centre of the cover. It may be interchanged as a unit with the oil pump originally used.

To dismantle and assemble

When the pump has been removed from the engine (see Section A.8) the $\frac{3}{16}$ in. countersunk screw can be removed from the engine side of the pump. It will now be possible to pull the body and cover of the pump apart, exposing the inner and outer rotors, which may be removed.

Reassembly is a reversal of the above procedure.

Section A.36

FITTING FLYWHEEL STARTER RINGS

To remove the old starter ring from the flywheel flange split the ring gear with a cold chisel, taking care not to damage the flywheel. Make certain that the bore of the new ring and its mating surface on the flywheel are free from burrs and are perfectly clean.

To fit the new ring it must be heated to a temperature of 300 to 400° C. (575 to 752° F.), indicated by a light-blue surface colour. If this temperature is exceeded the temper of the teeth will be affected. The use of a thermostatically controlled furnace is recommended. Place the heated ring on the flywheel with the lead of the ring teeth uppermost. The expansion will allow the ring to be fitted without force by pressing or tapping it lightly until the ring is hard against its register.

This operation should be followed by natural cooling, when the 'shrink fit' will be permanently established and no further treatment required.

Section A.37

FITTING VALVE SEAT INSERTS

Should the valve seatings become so badly worn or pitted that the normal workshop cutting and refacing tools cannot restore them to their original standard of efficiency, special valve seat inserts can be fitted.

The seatings in the cylinder head must be machined to the dimension given in Fig. A.32. Each insert should have an interference fit of ·0025 to ·0045 in. (·063 to ·11 mm.) and must be pressed and not driven into the cylinder head.

After fitting, grind or machine the new seating to the dimensions given in Fig. A.32. Normal valve grinding may be necessary to ensure efficient valve seating.

Section A.38

FITTING CYLINDER LINERS

Should the condition of the cylinder bores be such that they cannot be cleaned up to accept standard oversize pistons, dry cylinder liners can be fitted. This operation may be carried out by the use of specialized proprietary equipment or with a power press using pilot adaptors to the dimensions shown in Fig. A.33. The press must be capable of 3 tons (3048 kg.) pressure to fit new liners and 5 to 8 tons (5080 to 8128 kg.) to remove old liners.

Remove the engine from the vehicle as detailed in Section A.4. Dismantle the engine, and remove the

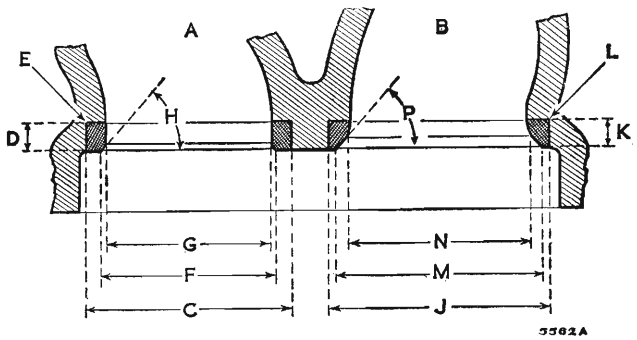


Fig. A.32. Valve seat machining dimensions.

	Exhaust (A)		Inlet (B)
C.	1·124 to 1·125 in. (28·55 to 28·58 mm.).	J.	1·187 to 1·188 in. (30·16 to 30·17 mm.).
D.	·186 to ·188 in. (4·72 to 4·77 mm.).	K.	·186 to ·188 in. (4·72 to 4·77 mm.).
E.	Maximum radius ·015 in. (·38 mm.).	L.	Maximum radius ·015 in. (·38 mm.).
F.	1·0235 to 1·0435 in. (25·99 to 26·50 mm.).	M.	1·0855 to 1·1055 in. (27·58 to 28·07 mm.).
G.	·844 in. (21·43 mm.).	N.	1·000 to 1·006 in. (25·4 to 25·55 mm.).
H.	45°.	P.	45°.

cylinder head studs. If liners have not previously been fitted the bores must be machined and honed to the dimensions given in the table below.

To remove worn liners

Place the cylinder block face downwards on suitable wooden supports on the bed of the press, making sure that there is sufficient space between the block and the bed of the press to allow the worn liner to pass down. Insert the pilot in the bottom of the liner and carefully press the liner from the bore.

To press in new liners

Thoroughly clean the inside of the bores and the outside of the liners. Stand the cylinder block upright on the bed of the press, insert the pilot guide in the top of the liner, and position the liner with its chamfered end in

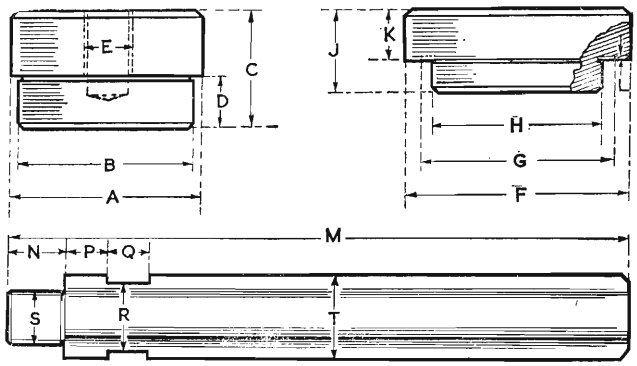


Fig. A.33. Cylinder liner pilots should be made to the above dimensions from 55-ton hardening and tempering steel and hardened in oil at a temperature of 550° C. (1,020° F.).

Pressing-out pilot

A. $2\frac{37}{64}\ ^{+\cdot005}_{-\cdot0}$ in. (65·48 $^{+\cdot127}_{-\cdot0}$ mm.).
B. 2·465 $^{+\cdot0}_{-\cdot005}$ in. (62·61 $^{+\cdot0}_{-\cdot127}$ mm).
C. $1\frac{3}{4}$ in. (31·75 mm.).
D. $\frac{3}{4}$ in. (19·05 mm.).
E. $\frac{3}{4}$ in. BSW thread.

Pressing-in pilot

F. 3 in. (76·20 mm.).
G. $2\frac{5}{8}$ in. (66·68 mm.).
H. 2·455 $^{+\cdot0}_{-\cdot005}$ in. (62·35 $^{+\cdot0}_{-\cdot127}$ mm.).
J. $1\frac{1}{4}$ in. (31·75 mm.).
K. $\frac{3}{4}$ in. (19·05 mm.).
L. ·015 in. (·38 mm.).

Pilot extension

M. $14\frac{1}{2}$ in. (36·83 cm.).
N. $\frac{7}{8}$ in. (22·22 mm.).
P. $\frac{5}{8}$ in. (15·87 mm.).
Q. $\frac{5}{8}$ in. (15·87 mm.).
R. 1 in. (25·4 mm.) flats.
S. $\frac{3}{4}$ in. BSW thread.
T. $1\frac{1}{4}$ in. (31·75 mm.).

the top of the bore. Make certain that the liner is square with the top of the block and that the ram of the press is over the centre of the pilot. Press the liner fully into the bore.

Each liner must be machined to the dimensions given in the table below after pressing into position.

Engine type	*Liner Part No.*	*Machine bores of cylinder block to this dimension before fitting liner*	*Outside diameter of liner*	*Interference fit of liner in cylinder block bore*	*Machine liner bore to this dimension after fitting*
'A' (948 c.c.)	2A784	2·6035 to 2·604 in. (66·128 to 66·14 mm.)	2·606 to 2·60675 in. (66·19 to 66·21 mm.)	·002 to ·00325 in. (·05 to ·08 mm.)	2·477 to 2·4785 in. (62·915 to 62·954 mm.)