Service Instruction Manual

Fourth Issue

STANDARD VANGUARD

SERIES I AND II

and

TRIUMPH "RENOWN" MODELS

ENGINE

SECTION B

THE STANDARD MOTOR COMPANY LTD., COVENTRY

ENGINE

INDEX

ILLUSTRATIONS

Series II Supplement

ENGINE — DIMENSIONS AND TOLERANCES

Parts and Description.	Dimensions, new.	Clearance, new.	Remarks.
Crankshaft.			
Journal Dia.	2.4790″ 2.4795″	.001″	
Bearing Internal Dia.	2.4815″ 2.4805″	to .002″	
Internal Dia. of Brg. Housing	2.6250″ 2.6255″		
Crankshaft End Float.			
Intermediate Journal Length	1.7507″ 1.7498″		
Intermediate Bearing Cap Width Plus thickness of two Thrust Washers	1.7450″ 1.7390″	.0048″ to .0117″	Clearance of .004″ to .006″ is specified and is obtained by selective assembly of thrust washers.
Main Bearing Width	1.5050″ 1.4950″		
Big End.			
Crank Pin Dia.	2.0866″ 2.0861″		
Bearing Internal Dia.	2.0860″ 2.0866″		
Internal Dia. of Bearing Housing	2.2327″ 2.2335″		
Bearing Width (Big End)	.965″ .975″		
Big End Float.			
Crank Pin Width	1.1915″ 1.1865″	.007″ to	
Con Rod Width	1.1795″ 1.1775″	.104″	
Ovality and Taper.			
Journals and Crank Pins			Min. diameter to be such that the permissible worn clearance for the bearing is not exceeded.
Small End.			
Bore for Bush	1.0000″ .9995″		

ENGINE — DIMENSIONS AND TOLERANCES

Parts and Description.	Dimensions, new.	Clearance, new.	Remarks.
Bush External Dia.	1.0000″ .9995″		Press fit in rod.
Internal Dia of Bush	.8752″ .8748″	.0002″ at 68° Fahr.	
Gudgeon Pin Dia.	.87510″ .87485″		
Piston Rings.			
Compression Ring Width	.0787″ .0777″	.001″ to .003″	Allow increase in side clearances of .003″ Mean.
Groove Width	.0807″ .0797″		
Scraper Ring Width	.1560″ .1550″	.001″ to .003″	
Groove Width	.1580″ .1570″		
Ring Gap in Cylinder Liners		.010″ to .015″	

Pistons and Cylinder Liners.

Parts and Description	F.	G.	H.	Clearance New
Bore Dia. of Liner	Min. 3.3460″ 3.3463″	Min. 3.3464″ 3.3467″	Min 3.3468″ 3.3471″	.002¾″ to .003¼″
Top Dia. of Piston Skirt (Pres. Face)	over 3.3430″ to 3.3433″	over 3.3433″ to 3.3437″	over 3.3437″ to 3.3441″	
Bottom Dia. of Piston	over 3.3445″ to 3.3448″	over 3.3448″ to 3.3452″	over 3.3452″ to 3.3456″	.001¼″ to .002″

Camshaft.			
Front Journal Dia.	1.8720″ 1.8710″	.002¾″ to .004¾″	Max. wear on camshaft journal .003″ and .003½″ in brg.
Front Journal Bearing Bore	1.8757″ 1.8752″		
External Dia. of Front Bearing	2.2498″ 2.2493″	Push fit in Cylinder Block	
Bore in Block for Front Bearing	2.2507″ 2.2498″		
2nd, 3rd and Rear Camshaft Journal	1.7157″ 1.7152″	.002½″ to .004½″	Max. wear on journal .003″ and .003½″ in cylinder block.
Bore in Cylinder Block for 2nd, 3rd and Rear Journals	1.7198″ 1.7183″		
End Float		.003″ to .0075″	

ENGINE — DIMENSIONS AND TOLERANCES

Parts and Description.	Dimensions, new.	Clearance, new.	Remarks.
Valves and Valve Guides.			
Inlet Stem Dia.	.3110″ .3100″	.001″ to	Distance from top of guide to upper face of cylinder head $\frac{25}{32}$″.
Guide Dia.	.3130″ .3120″	.003″	$\frac{11}{32}$″ dia. from V.171250E and TDC.1107E.
Exhaust Stem Dia.	.3400″ .3399″	.003″ to	Guide height as for Inlet.
Guide Dia.	.3440″ .3430″	.005″	$\frac{11}{32}$″ dia. from V.171250E and TDC.1107E.
Included angle of valve faces	90°		Included angle of seating in cylinder head 89°.
Inlet Valve Head Dia.	1.5020″ 1.4980″		
Width of Inlet Valves Seating Face	.0440″		
Exhaust Valve Head Dia.	1.2830″ 1.2790″		
Width of Exhaust Valve Seating Face	.0440″		
OIL PUMP. Outer Rotor			
Outside Dia.	1.5975″ 1.5965″	.0055″ .0075″	
Housing Internal Dia.	1.6040″ 1.6030″		
Depth of Rotor	1.4995″ 1.4985″	.0005″ to	A combined worn clearance of .004″ indicates the necessity for cover and housing face lapping.
Housing Depth	1.5010″ 1.5000″	.0025″	
Inner Rotor.			
Major Dia.	1.1720″ 1.1710″		
Minor Dia.	.7310″ .7290″		
Rotor Depth	1.4995″ 1.4985″	.0005″ to	
Housing Depth	1.5010″ 1.5000″	.0025″	
Clearance on Rotors	Maximum clearance new .001″ to .004″ Minimum clearance new .0025″ to .0005″		Where clearance in excess of .010″ exists, new parts should be fitted.

ENGINE — DIMENSIONS AND TOLERANCES

Parts and Description.	Dimensions, new.	Clearance new.	Remarks.
VALVE SPRINGS.			
Inner Spring.			
Fitted Length	1.31″		
Fitted Load	28 lbs. $^{+2\text{lbs.}}_{-1\text{lb.}}$		
Free Length (approx.)	1.81″		
Outer Spring.			
Fitted Length	1.63″		
Fitted Load	28 lbs. $^{+2\text{lbs.}}_{-1\text{lb.}}$		
Free Length (approx.)	1.97″		

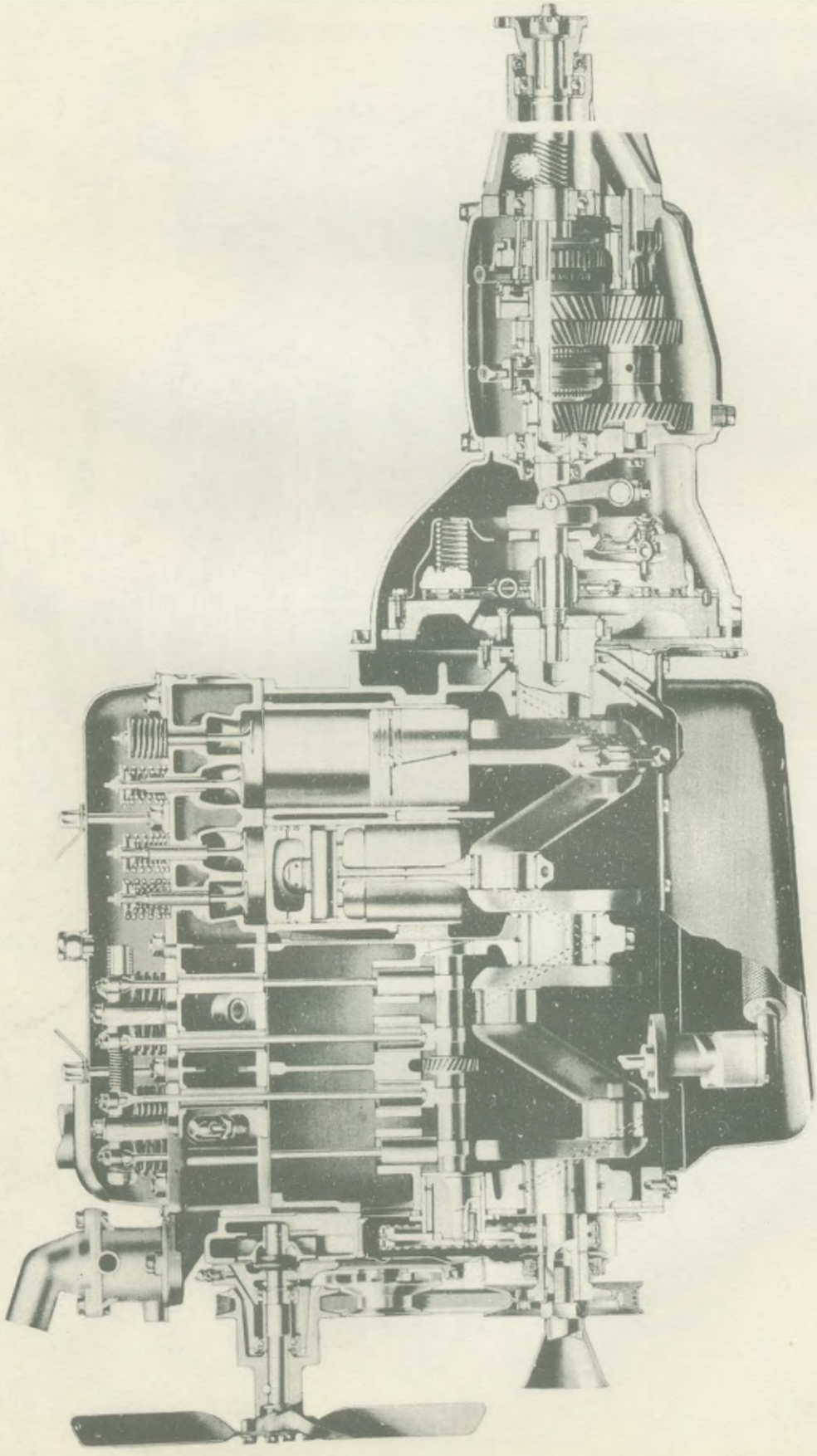


Fig. 1. Longitudinal section of engine and gearbox

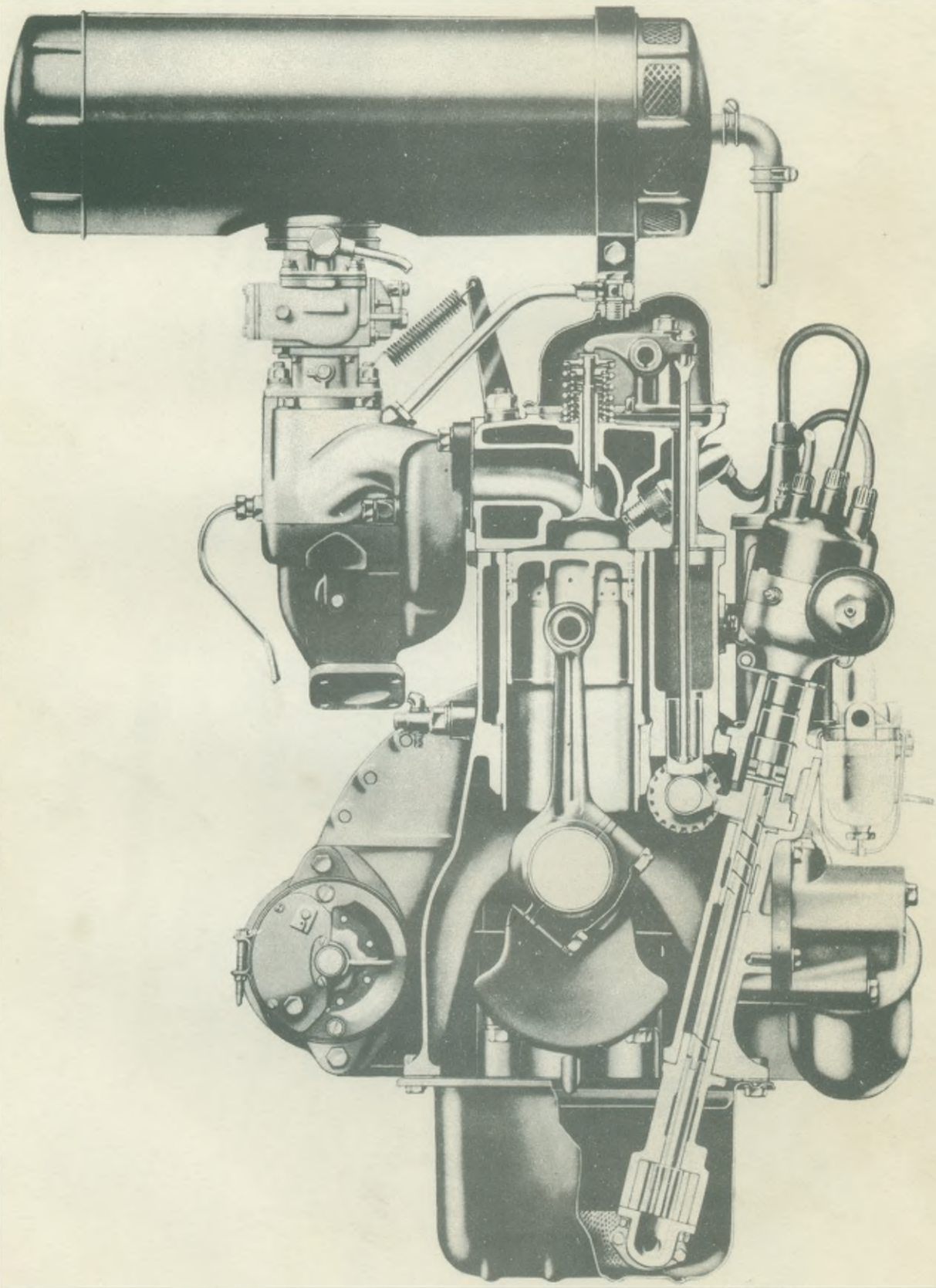


Fig. 2. Cross section of engine

ENGINE

(See Fig. Nos. 1 and 2)

GENERAL DESCRIPTION

The **engine** has four cylinders, 85 mm. bore and 92 mm. stroke, giving a cubic capacity of 2,088 cubic centimetres. The compression ratio is 6.7 ; the **cylinder block** is of cast iron and is provided with cylinder liners.

The **cylinder sleeves** are of the wet type, being centrifugally cast in nickel chrome iron and provided with flanged upper faces, having two pairs of flats at 90° to one another. These two pairs of flats provide alternative fitting positions to deal with piston slap which normally occurs due to wear along the axis of thrust. The sleeve is shown in Fig. 18.

The sleeves are machined all over and ground on their upper faces. The lower portion of each liner is provided externally with a reduced diameter, surmounted by a flanged face for spigotting into machined recesses in the cylinder block and a water seal provided by a composition packing.

The liners are held in position by the combustion head and gasket, the initial position of the liner allowing this to stand proud of the cylinder block .003″ minimum to .0055″ maximum. Selective assembly of pistons and liners being adopted, the symbols "F," "G" and "H" being used.

The sleeve bore dimensions are given on Page 2.

The **connecting rods** are manufactured from molybdenum manganese steel being provided with phosphor bronze small end bushes and precision type big end bearings. The connecting rod is drilled from the big end bearing end to the small end to provide for the passage of oil under pressure from the main supply. The big end bearing cap is somewhat unorthodox in design, the cap securing setscrews being inclined at an angle to the centre line of the connecting rod. The caps are dowelled to the connecting rods and located by these bushes. This form of cap provides a more convenient position for tightening and loosening bolts, and also has the added virtue of allowing the bearing caps to be removed progressively from below without the danger of their dropping into the repair pit immediately the nuts are withdrawn. This connecting rod design also permits the assembly to pass through the sleeve bores The arrangement also has an important advantage in reducing the stresses in the connecting rod bolts. The setscrews themselves are secured by a strip tab washer made from 20-gauge material. With the bearing cap removed, it is possible to push the connecting rod and piston through the sleeve.

Aeroflex compensating pistons are employed which are manufactured from special aluminium alloy and each provided with two compression and two oil scraper rings (see Fig. 3).

The **piston** skirt has a $\frac{1}{32}$″ slot on the non-pressure side. The gudgeon pin is located endwise in the piston by means of circlips ; it is important that when these pistons are fitted they are assembled on the connecting rods so that the split portion of the skirt faces towards the camshaft side of the engine and away from the point of maximum thrust. For piston and ring dimensions see Page 2.

The **crankshaft** is forged from molybdenum manganese steel, being provided with balance weights which are an integral part of the crankshaft throws, adjacent to the three main bearings.

This shaft is accommodated in three precision type, white metal lined, steel backed bearings, which are housed in the **cylinder block,** being secured in position by bearing caps and two $\frac{1}{2}$″ setscrews and spring washers per journal. The crankshaft thrust is taken by steel white metal covered washers which are fitted up in two halves on either side of the centre main bearing housing, being located circumferentially by means of projections on the lower half of each pair of washers.

The **valves** are overhead, push rod operated. The push rods are themselves one piece stampings. The **inlet valve** has a head diameter of $1\frac{1}{2}$″ and this is manufactured from a silico chrome steel stamping. The stem diameter is $\frac{5}{16}$″ (see also Page 3 for later models) and the valve face is inclined at 45°. The **exhaust valve** has a head diameter of $1\frac{9}{32}$″ and is manufactured from a XB valve steel stamping having the same face angle as for the inlet. The stem diameter is the same as for the inlet. Inlet valves are provided with two valve springs.

Two inner valve springs are used on the exhaust valves, the centre spring acting as an insurance against damage in case of a spring failure. The intermediate spring fits into the valve collar, which is provided with an elongated hole concluding in a circular opening which embraces the recessed portion of the valve stem (see Fig. 4). The slotted portion is utilised for sliding the valve collar into position and the spring tension locates the collar when it has reached the circular position to which reference has already been made. The outer spring is located by a cap which fits on top of the valve stem and is located in relation to the valve by a recess.

On the upperface of the outer spring collar is a projecting shoulder with a ground face which actually bears against the rocker. Fig. 5 shows the valve rocker clearance being checked. The shouldered projection to which reference has been made is provided with a slot for the insertion of a feeler gauge and thus enables tappet clearances to be checked. It will be seen that this outer spring carries out a double function, quietening the rocker gear and obviating the necessity for push rod springs. The close coiled portion of the outer spring is fitted nearest the combustion head (see Fig. 6).

The **camshaft** is of cast iron having chilled cam faces and is provided with four journals. The front journal is accommodated in a flanged cast iron bearing, whilst the other journals are mounted direct in the cylinder block, a method which we have used for many years very successfully with other models. The camshaft operates directly on flat based hollow cylindrical chilled cast iron tappets which in turn engage hardened spherical-ended push rods, the upper extremities of which are hardened and cup-shaped, accommodating hardened ball ended screws, which are mounted on the outer ends of the respective rockers. Camshaft end thrust is taken by the flanged front bearing, to which reference has been made, against the timing wheel and a shoulder on the shaft itself.

The **rockers** are of case hardened steel and provided with phosphor bronze bushes which are lubricated under pressure from the main oil supply. The eight rockers themselves are carried on a hollow rocker shaft which is in turn mounted on four pedestal brackets, the oil being fed along the rocker shaft to the various rockers.

The **cooling system** is thermostatically controlled with a pump to circulate the water and a generous system of water jacketing with careful consideration given to the important points,

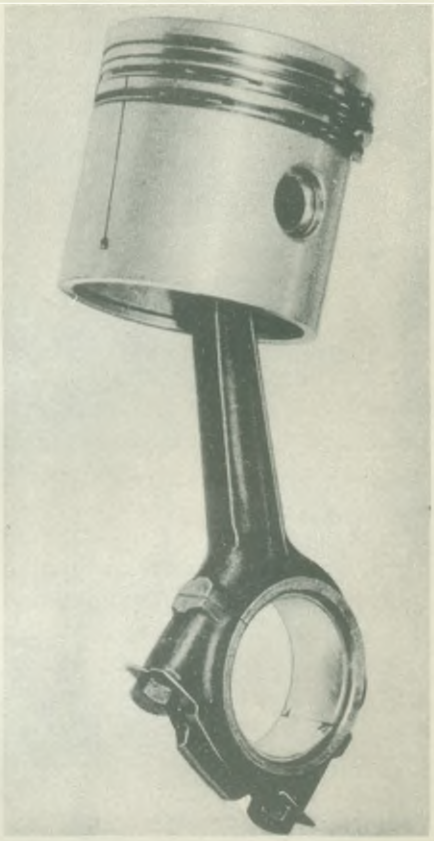


Fig. 3. Piston and connecting rod assembly

such as sparking plugs, etc., where adequate cooling is necessary. The water pump is also supplied with a fan blade assembly which is 14" in diameter and provided with four blades being driven in tandem with the dynamo by the fan pulley on the front end of the crankshaft.

Petrol is supplied by an A.C. mechanically operated pump to the Solex downdraught carburettor, hot spot heating being provided and all air is drawn through the combined air cleaner and silencer.

The **Hoburn-Eaton double rotor oil pump** (shown in Fig. 7) is of the submerged type being self-priming and obtaining its supply from the engine sump through a gauze filter. The oil is fed thence directly through the external filter. A portion of the oil, all of which must pass into the external filter, is forced through the filtering media and passes up an annular space around the holding bolt, and through a restrictor valve and is thence returned to the sump. The remainder of the oil passes into the oil gallery which runs longitudinally the entire length of the cylinder block, from whence it passes to the three main bearings and thence to the big end bearings. In the case of each of the mains,

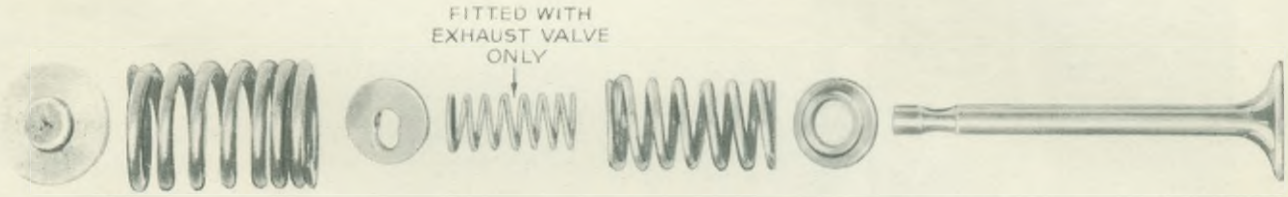


Fig. 4. Valve springs, collars and cap

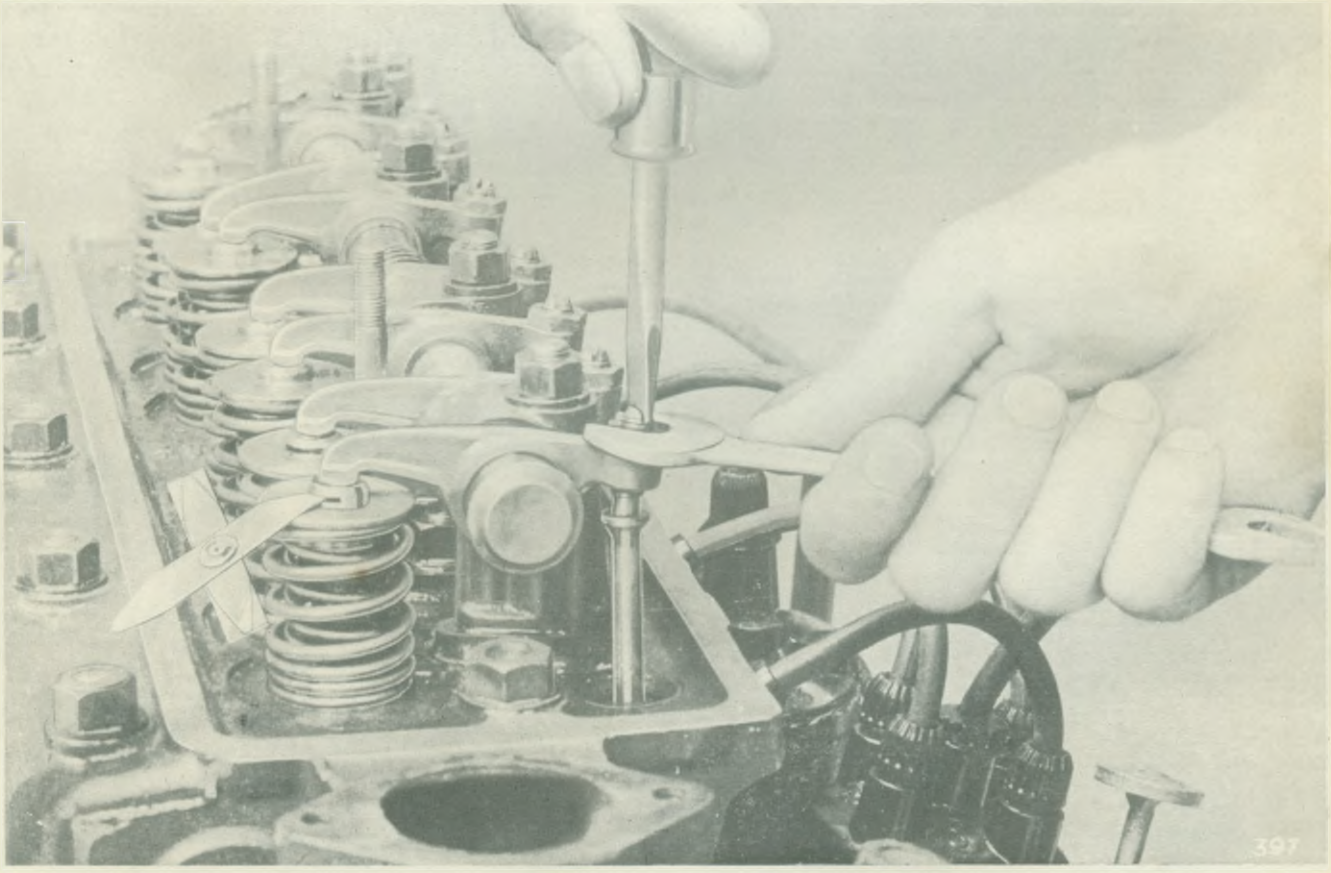


Fig. 5. Checking valve rocker clearance

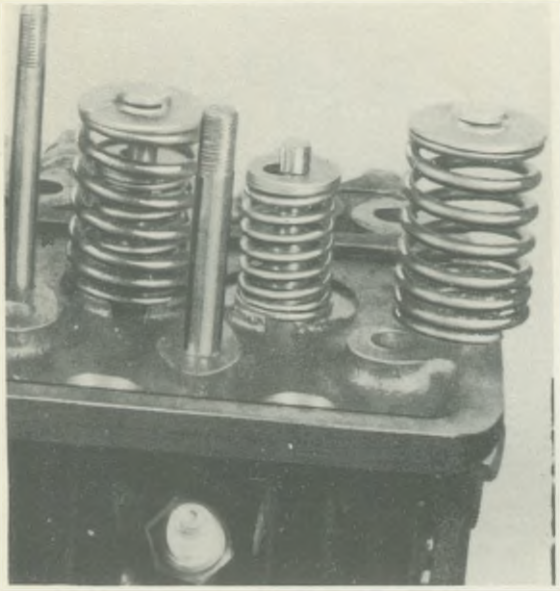


Fig. 6. Showing the position of the close-coiled portion of outer spring against the combustion head

oil is fed through a by-pass, $\frac{1}{8}$" in diameter, to the adjacent camshaft bearing. With the rear camshaft bearing, a by-pass passage upwards leads to the overhead rocker gear through a drilling in the rear pedestal bracket. The third camshaft bearing is fed directly through a $\frac{3}{32}$" restriction, cast in the block, from the oil gallery. The oil pressure is adjustable by means of a setscrew and locknut provided on the exterior of the filter assembly.

The lubrication of the **rocker gear** is provided for by a hollow mounting shaft which is provided with radial drillings to correspond with the position of the eight rockers, oil subsequently passing through a horizontal drilling in each rocker to the push rod cups and ball pins.

Coil ignition is employed, the distributor being supplied with a suction and centrifugal automatic advance, the correct timing allowing ignition to occur at 4° B.T.D.C., or at such earlier setting as the octane value of the fuel available permits.

The distributor is driven off the boss of the helical gear which also provides the drive for the oil pump. The helical gear is secured to this drive shaft by a Woodruff key. The recess in the boss for the distributor shaft dog is offset, thus fixing the position for ignition timing, this point is dealt with later under " Ignition Timing." The distributor is mounted on an adaptor, the bottom being spigotted into the cylinder block and its lower extremity limiting the upward thrust of the spiral gear. A Mills pin through the gear boss limits the downward travel of this part.

The **engine mounting** is of flexible type, the front bearer being assembled on to rubber

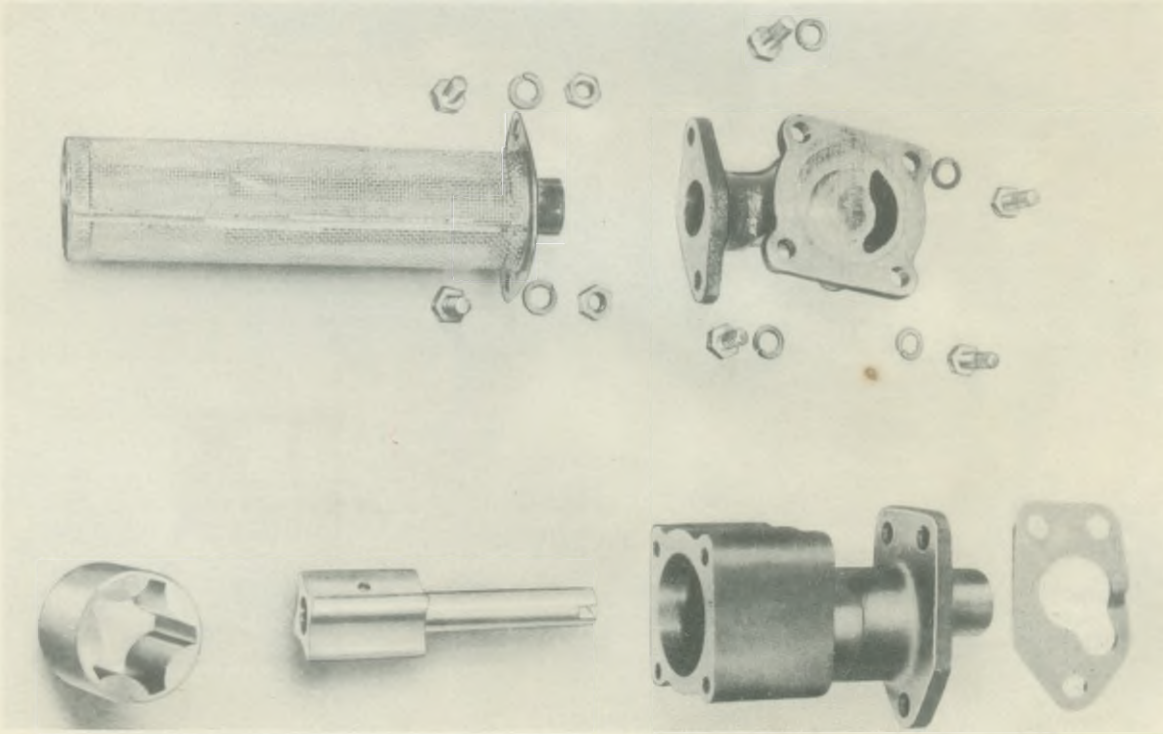


Fig. 7. Exploded view of oil pump details

blocks on either side of the frame, the gearbox itself being supported on a rubber pad secured to a cross member of the chassis frame.

The **flywheel** is of cast iron, being provided with a hardened steel starter gear ring which is shrunk on during heat treatment. Replacement starter rings are obtainable from our Spares Department (see Page 49). The flywheel is spigotted on to the end of the crankshaft and is located by means of a $\frac{3}{8}$" diameter dowel ; there being two dowel holes at 90° to each other.

Crankcase ventilation is arranged by means of the depression created in the induction manifold in conjunction with a sealed engine. A depression is created in the crankcase when the engine is running owing to the inter-connection of a special valve in the rocker cover with the induction manifold by means of a pipe attached to an adaptor in the latter. The depression in the induction manifold is conveyed to the crankcase and filtered air relieves this through a pipe connected at its upper end to the carburettor air silencer and at its lower extremity to an adaptor in the cylinder block. This system is discussed later in this manual.

ENGINE LUBRICATION

(See Fig. Nos. 8 and 9)

Description.

Lubrication of the engine is by a double rotor pump which is described in detail and illustrated later in this manual. The oil pump is driven by a short shaft which is mounted in a bush in the cylinder block and provided with a helical gear which engages with one on the camshaft. A boss on the drive shaft helical gear has an offset slot which engages the distributor dog, and a pin to prevent uplift of shaft.

Oil is drawn into the pump through a primary gauze filter and passes thence through a channel in the pump casting to the annular space around the oil pump shaft. The annular space around the drive shaft is closed by the bush, and the oil thus forced through a hole in the cylinder block into an external cleaner. The oil on its way into the cleaner assembly passes over a spring-loaded ball valve which is set to allow an oil pressure of 40-60 lbs. per square inch at normal engine speeds. The oil having been filtered, passes through matched holes in the filter bracket and cylinder block into the oil gallery which extends horizontally along the length of the cylinder block. A portion only of the oil, all of which circulates through the filter assembly, is forced through the filtering media and passes up an annular space around the bowl holding bolt and thence, through a restricter valve, to the engine sump. The Purolator Filter is described in detail on Page 32

The oil passes from the gallery mentioned above to the three main bearings and thence through drillings in the crankshaft to the big end bearings and through further drillings in the connecting rods to the small end bushes and gudgeon pins. Splash lubrication is further assisted by a drilling into the oil passage between the small end and the big end just below the piston skirt on each connecting rod.

By-passes from the channels leading to the three main bearings convey oil to the front, second and rear camshaft journals. In the case of the remaining camshaft journal, this is fed direct from the oil gallery through a $\frac{1}{8}$" restriction. A by-pass from the rear camshaft bearing conveys oil upwards to the combustion head and thence through a horizontal drilling to a smaller vertical drilling which is matched by a hole drilled in the rear rocker shaft pedestal bracket.

Oil passes down the hollow rocker shaft and through radial holes to the rockers, leaving each rocker by a hole drilled horizontally to each ball-ended rocker adjuster screw.

Oil from the front camshaft bearing lubricates the timing chain, there being four slots cut at 90° to one another on the face of the flange adjacent to the camshaft timing wheel to allow oil to escape on to the timing wheel. The oil is thrown out by centrifugal force on to the underside of the flanged portion of the wheel on which the teeth are cut. Six $\frac{3}{32}$" holes are drilled obliquely, alternatively from the back and the front of the wheel, at equal intervals from the underside of the flange into the space between the two toothed rings. These holes allow the oil to be thrown on to the underside of the timing chain, ensuring its lubrication.

OIL PUMP (see Fig. 7)

Description.

The oil pump is of the double rotor type, as shown in Fig. 7.

The smaller or centre rotor is driven by a short shaft on which it is pressed into position and pegged. The two rotors are contained in a housing at the base of the oil pump casting which is provided with a cover plate having a ground face, allowing only sufficient clearance on the two rotors to provide for lubrication. The centres of the two rotors are offset.

The rotor shaft is provided at its upper

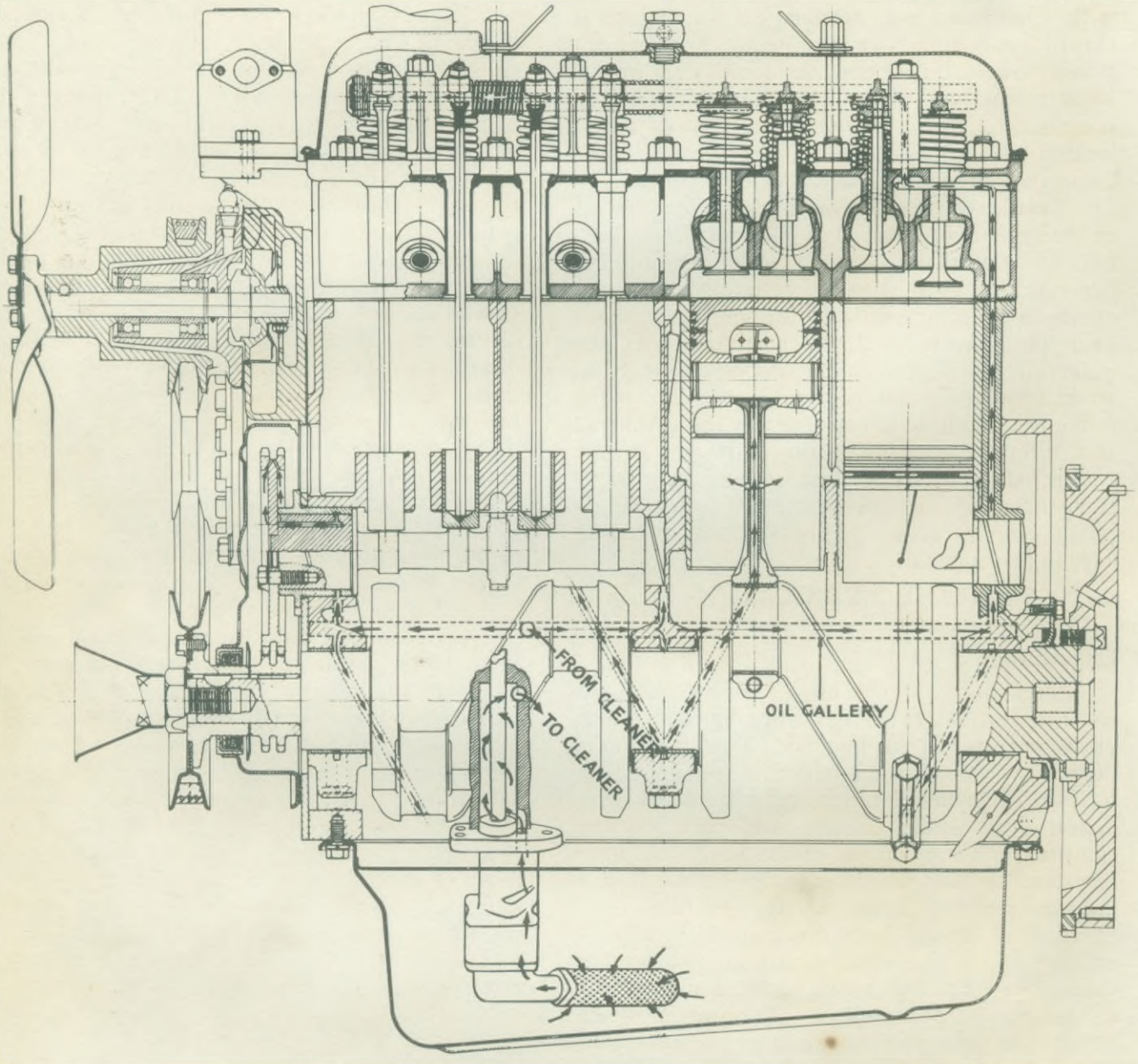


Fig. 8. Longitudinal view of oil circulation

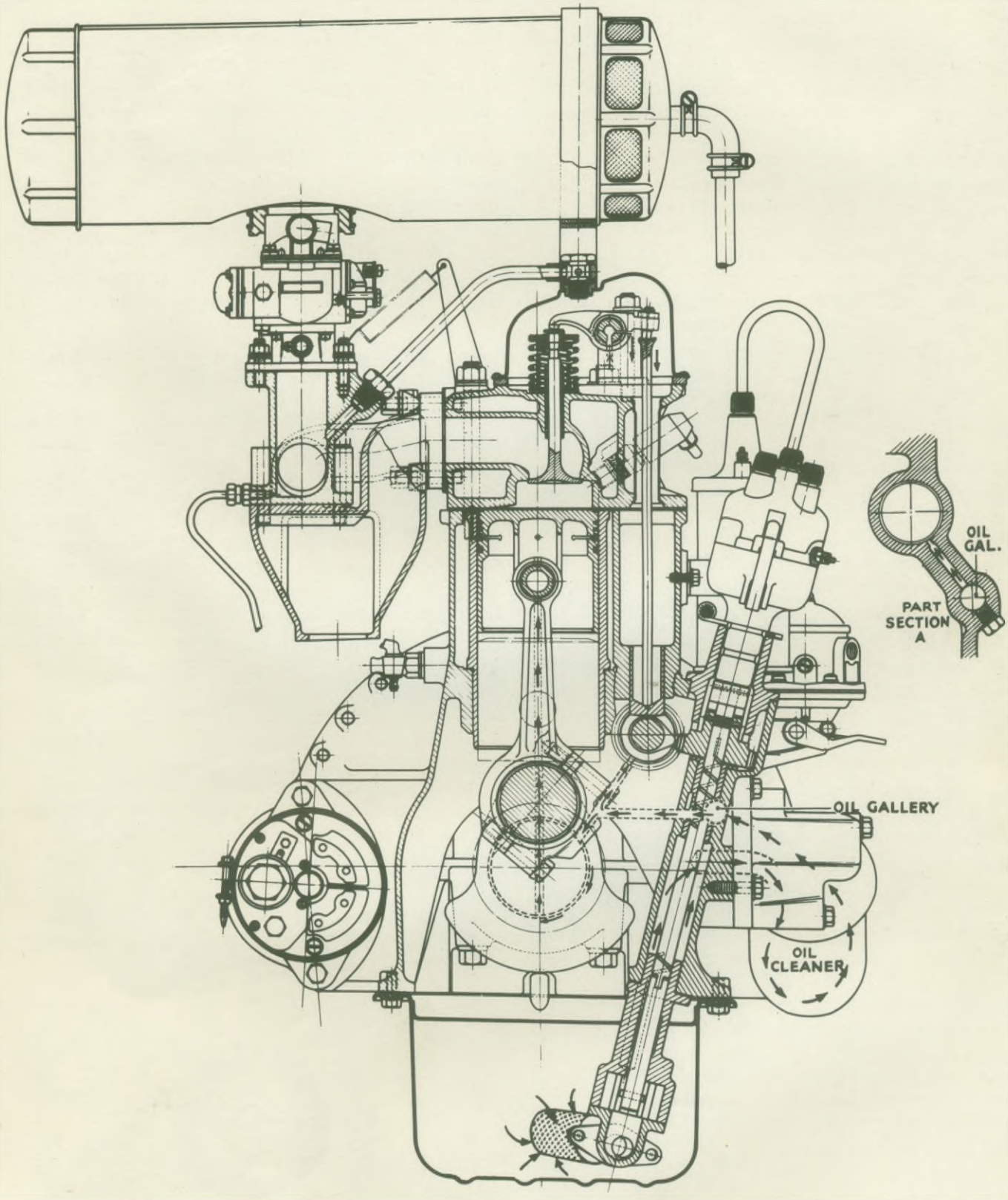


Fig. 9. End view showing oil circulation and Part "A" Section of oil feed to camshaft intermediate bearing

extremity with a recess, which engages a projecting tongue on the lower end of the driving shaft. The driving shaft is mounted in a phosphor bronze bush pressed into the cylinder block and at its upper extremity is provided with a helical gear which is secured by a key. The helical gear on this shaft is engaged by a similar gear, which is an integral part of the camshaft. As was mentioned under the description of the "Engine," the boss of the helical gear is provided with an offset slot, which accommodates the distributor driving shaft.

The small rotor, by its engagement with the outer rotor, drives the latter round at a slightly slower speed owing to the difference in sizes.

Owing to the relative movement of the centre rotor around the outer rotor, and the close fit of the cover plate, oil is forced round between the arms of the rotor and forced out of a hole in the top of the rotor casing and upward through a drilled passage to the annular space around the distributor driving shaft. From this annular space the oil is circulated around the engine as described under " Engine Lubrication."

To remove oil pump from engine.

To remove the oil pump from the engine, the sump should be drained of oil, preferably when the oil is warm. It is then merely necessary to remove the sump and three securing setscrews ($\frac{1}{2}$" A/F spanner) and to withdraw the pump as a unit with its paper packing.

To dismantle oil pump.

Remove the two $\frac{1}{4}$" bolts ($\frac{7}{16}$" A/F spanner) securing the primary oil filter to the flange on the oil pump elbow. Take note of the position of the primary filter in relation to the elbow for reassembly, *i.e.*, the tube projecting inwards should be as near as possible to the bottom of the sump, thus ensuring that there is clearance on the bottom of the sump.

To complete the dismantling of this unit it is merely necessary to remove the four $\frac{5}{16}$" setscrews utilizing a $\frac{1}{2}$" A/F spanner for the purpose. The inner rotor and shaft and the outer rotor can now be removed and the dismantling of the unit is complete.

Servicing the oil pump.

As this pump provides a generous surplus of oil to that which is necessary for the engine's proper lubrication and, owing to the design of the unit, very little wear is likely to occur in service, few maintenance attentions are required to the unit during a car's normal life.

In actual practice, excepting the remote possibility of failures due to defective material, no adjustments are likely to be required until approximately 200,000 miles have been covered and then is likely to be limited to the elimination of end float in the rotors and can be satisfactorily dealt with by lapping the joint faces of the pump body and the cover. The clearance new between the rotors and the cover plate should be from .0005"—.00025" and where a serious drop in oil delivery from the pump is associated with development of excessive end float, steps should be taken to lap the cover plate and body.

ENGAGEMENT OF OIL PUMP AND DISTRIBUTOR DRIVING GEAR

As previously indicated, the boss of the helical gear on the oil pump driving shaft has an offset slot which engages with the driving dog on the lower extremity of the distributor shaft.

The offset is provided to ensure the correct ignition timing when the distributor and adaptor bracket are removed from the engine and such being the case, the correct engagement of the helical gears is important.

When correctly engaged, the slot on the driving gear boss, with the engine at T.D.C. of the compression stroke, *i.e.*, firing point, should assume a position at approximately " Five Minutes to Five " and be offset towards the rear of the engine as shown in Fig. 10. In this position the slot will point directly towards the exhaust valve push rod sealing tube, the distributor rotor will face No. 1 sparking plug, and the keyway in the helical gear will be aligned with the oil dipstick when fitted.

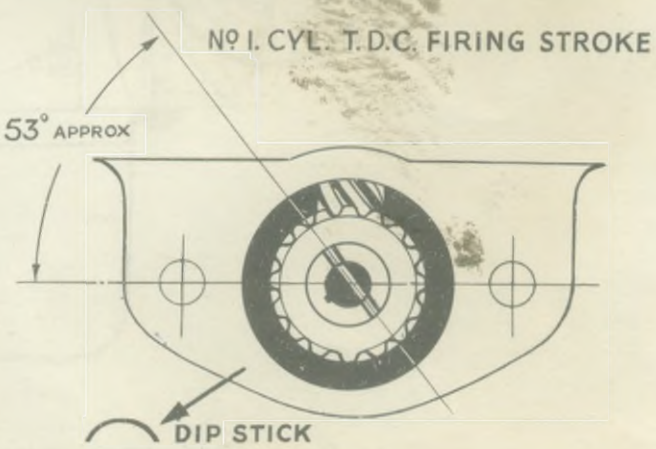


Fig. 10. Position of slot in distributor driving gear for ignition timing

CRANKSHAFT AND MAIN BEARINGS

The crankshaft is of molybdenum manganese forging with ground journals and crankpins.

The main and big end bearings are of the precision type, being steel backed and white metal lined. No hand fitting is required and *under no circumstances should the bearing caps be filed with a view to taking up wear.* The filing of bearing caps will make the caps unserviceable for future use when new bearings are ultimately required.

Where big end bearing caps have been filed, it will be necessary to ream these out to the size given on list of dimensions given on Page 0. Where main bearing caps have been filed, the only satisfactory method of dealing with the difficulty is to have the three bearings "line reamed" to the size given in list of dimensions on Page 1. Where excessive bearing wear has occurred, the only satisfactory cure is to replace worn bearings, ensuring first, however, that the crankshaft journals and pins are in good order and that there is no question of a regrind being required. Where a crankshaft journal or crankpin is worn, scored or tapered in excess of .002", regrinding is necessary (for dimensions of journals see Page 1).

Where a regrind is found to be necessary a decision will have to be made as to the suitable undersize bearings which will meet the particular case. The reduced diameter of journal or crankpin to suit the various undersize bearings may be calculated by subtracting —.020", —.030" or —.040", the sizes of undersized bearings available, from the original dimensions on Page 1 for the journals and crankpins.

Main bearing clearances.

The crankshaft journal diameter and the internal dimensions of the bearings for these is given on Page 1. The clearance new for these bearings is .001"—.002", if the worn clearance exceeds .006", or if the journals have become scored, the crankshaft will require regrinding and undersized bearings will have to be fitted.

The crankshaft should be measured with a micrometer gauge and if the reading is less than 2.477" (for a crankshaft which has not previously been reground) the crankshaft is due for reconditioning.

With regard to the main bearings, when the worn internal dimensions exceed 2.483" (for standard size bearings), replacements should be fitted undersized to suit the amount which has

Fig. 11. Measuring crankshaft end float

Fig. 12. Reducing thickness of thrust washer

to be removed and the undersizes available, *viz.*, —.020", —.030" and —.040".

Crankshaft end float.

The end float preferred for this crankshaft is .004"—.006" which should be measured as shown in Fig. 11. Where, after the fitting of new thrust washers, end float does not reach the figure specified above, the steel face of the thrust washer should be rubbed down on a piece of emery cloth placed on a surface plate as shown in Fig. 12.

After a considerable mileage, where wear occurs to the face of the crankshaft abutting the thrust washer, it may be necessary to fit oversized washers, and although these are very rarely likely to be required, they may be obtained +.005", by a special order on the Spares Department, under their normal Detail Number 45918/9, specifying the oversize above mentioned.

Big end bearing clearances.

The clearance between the crank pin and the big end bearing, when new, should be .0005" to .002½" and the connecting rod side clearance .007½" to .011½".

Where the crankpin dimension is found, on measuring with a suitable micrometer gauge, to be less than 2.084", the pins should be reground and undersized bearings should be fitted. *Under no circumstances should the bearing caps be filed with a view to taking up wear as such procedure renders the connecting rods unfit for further use.*

The small end bushes, the dimensions for which are given on Page 2, should be pressed into the rod and subsequently reamed to ⅞" ± .0005", and the gudgeon pin selected to leave a clearance of .0002" at 68° Fahr. This clearance will be indicated by a light finger push fit, with the piston warmed by immersion in hot water.

The connecting rod centres are 6¼" ± .002" and there is no offsetting of the rod in relation to the bearing housing. The connecting rod cap is located in relation to the rod by means of dowel bushes as can be seen from Fig. 13.

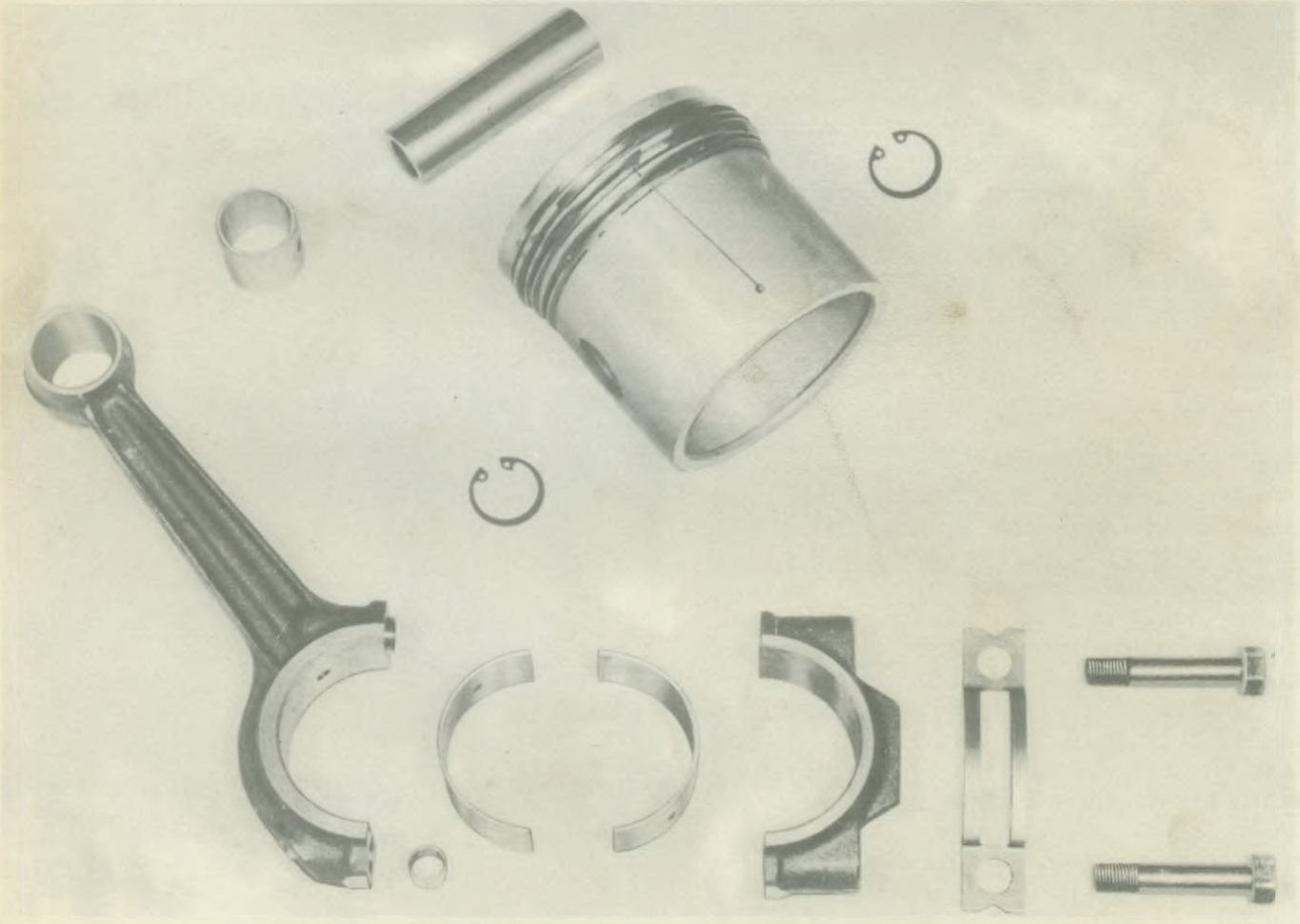


Fig. 13. Exploded view of connecting rod and piston assembly

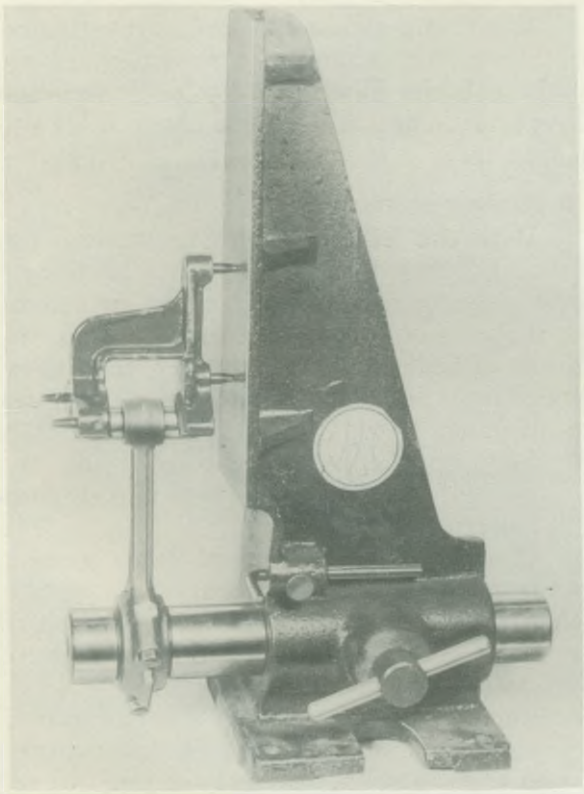


Fig. 14. Testing connecting rod for bend

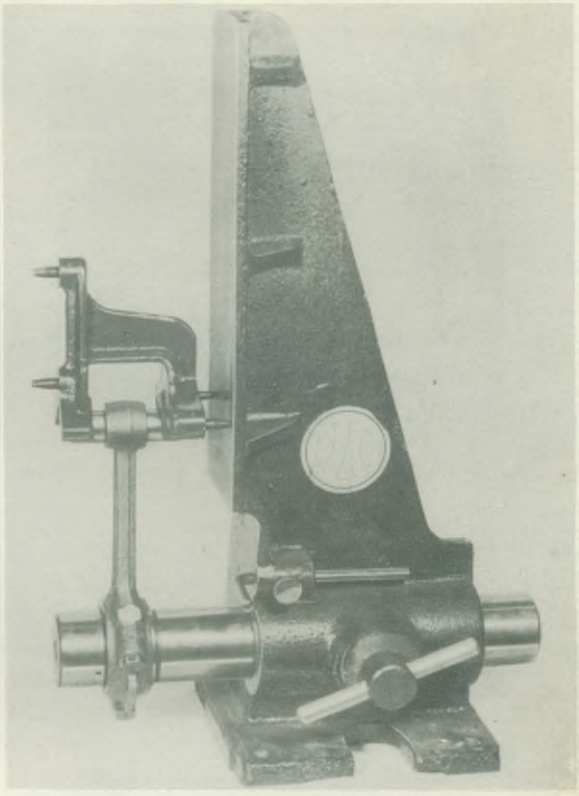


Fig. 15. Checking connecting rod for twist

Before installing a connecting rod it should be checked for alignment after first removing the bearing shell. The rod should be checked for a bend, in which case the piston will not be perpendicular to the crankshaft journal, or if the gudgeon pin is not in the same plane as the journal then the rod is twisted (see Figs. 14 and 15). Appropriate action should be taken to deal with the various causes of misalignment with a suitable bending rod.

The connecting rod and piston aligning fixture which is shown is obtainable from Messrs. V. L. Churchill & Co. Ltd., 27/34 Walnut Tree Walk, Kennington, S.E.11.

PISTON ASSEMBLY AND CYLINDER SLEEVES

The piston and cylinder bore dimensions are given on Page 2. As indicated in this list of tolerances and limits, three sizes of pistons are used in conjunction with suitable bore dimensions. The three sizes of pistons and cylinder sleeves are indicated by the stamping of " F," " G " or " H " on the crown of each piston and on the upper flanged face of each sleeve as shown in Fig. 16.

Piston ring dimensions and clearances are given on Page 2. Where the worn clearance between the piston skirt and cylinder sleeve bore exceeds .007" at the top and .005" at the bottom, reboring or replacement becomes necessary if a satisfactory repair is to be executed.

The connecting rod should be fitted to the piston assembly with its bearing cap towards the split portion of the piston skirt, as shown in Fig. 3.

Cylinder sleeves. (Fig. 18)

The pistons and connecting rods should be assembled into the cylinder sleeves with the gudgeon pins in diametrical relation to pairs of opposite flats on the upper flanged faces of the liners. When assembling the sleeve and piston into the cylinder block, position the split portion of the piston and hence also the cap side of the connecting rod towards the camshaft side of the engine, or away from the point of maximum engine thrust. A piston ring compressor should be utilized when fitting pistons into sleeves as shown in Fig. 17.

Where cases of light wear occur and cause piston knock, an improvement can be effected by withdrawing the sleeve and rotating this through 90° and employing the alternative pair of flats shown in Fig. 18.

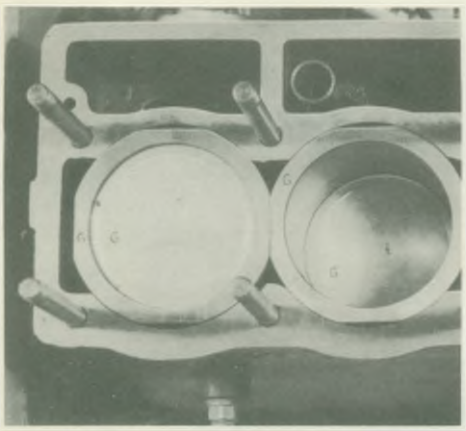


Fig. 16. Showing markings on piston crown and cylinder sleeves

The importance of using cylinder sleeve retainers, to prevent relative movement of these parts, is stressed. In addition to the danger of sleeve movement if retainers are not fitted, when the crankshaft is turned, there is the possibility of these moving when the combustion head is broken, particularly where jointing compound has been used on both sides of the gasket.

To minimize the possibility of sleeve movement, due to combustion head removal, it is recommended that jointing compound should only be used on the underside of the head gasket and grease applied to the upper face. The cylinder sleeve "figure of eight" packings should be similarly treated for the same reason.

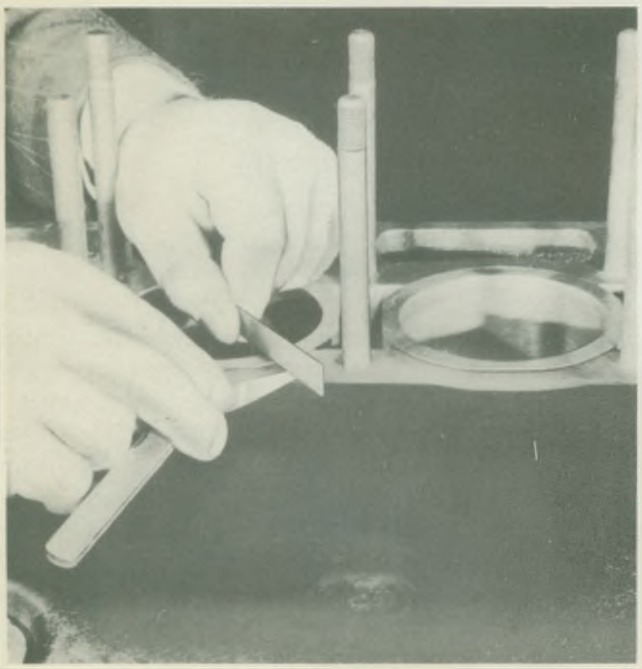


Fig. 16A. Checking cylinder liner projection above cylinder block

When the cylinder sleeves are installed in the block, the flanged face should stand proud of the cylinder block face by .003" minimum—.0055" maximum and can be checked as shown in Fig. 16A.

To remove starter motor.

With the left-hand steering models, this is a straightforward operation, but with the right-hand steering cars, owing to the proximity of the starter motor to the steering column, this is a more difficult job. If, however, the following procedure is adopted the removal should present no difficulty :—

1. Jack up the front right-hand side of the car and remove road wheel and disconnect battery.
2. Disconnect the electrical lead connection from the solenoid terminal.
3. Release the starter cable from retaining clips.
4. Disconnect solenoid cable from its push in attachment with rubber sleeve.
5. Remove bolt attaching $\frac{3}{8}$" stay rod to bracket on chassis, subsequently slackening the nut at the top of the rod and rotating out of the way for starter's withdrawal.
6. Remove the two starter bolts and manoeuvre the starter out through space between the chassis side member and wing valence.

To top up brake master cylinder.

Access to the brake master cylinder is best obtained by removing the road wheel and utilizing the aperture mentioned under "Starter Motor Removal" on the right-hand or left-hand side of the car, depending on whether this is for a right-hand or left-hand steering model.

Removals of exhaust and inlet manifolds.

To remove this assembly, the employment of the aperture mentioned in the previous two adjustments, to obtain access for the withdrawal of the bottom two rear securing nuts, will greatly facilitate what would otherwise be a difficult task. In other respects this is a straightforward operation.

CAMSHAFT AND TIMING GEARS

Description.

The camshaft is driven by a double roller silent chain which engages with a sprocket on the crankshaft and one which is spigotted on to the end of the shaft and secured thereto by two setscrews.

Four holes are provided in the camshaft timing gear, which are equally spaced, but offset from a tooth centre. When the chain wheel is

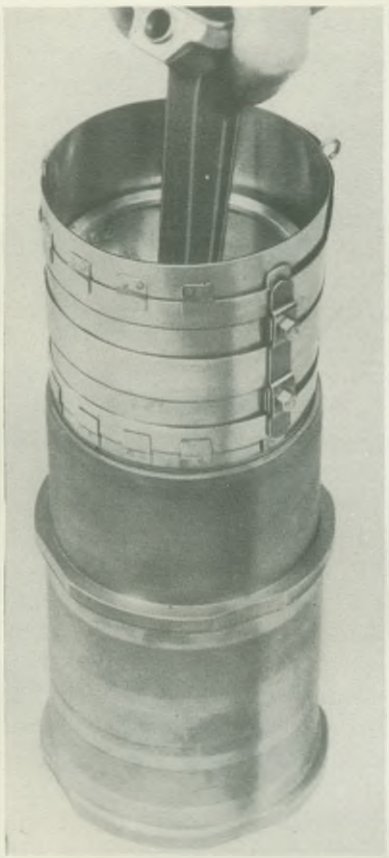
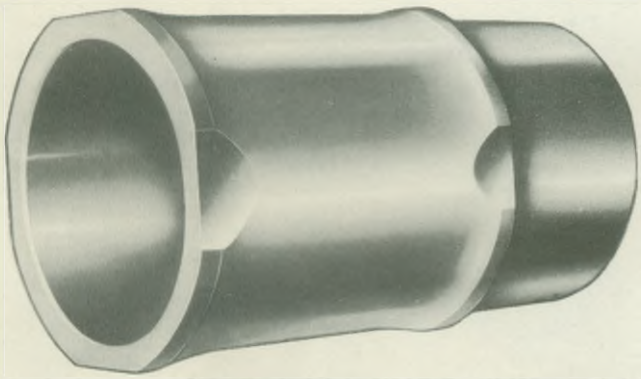


Fig. 17. Fitting piston into cylinder sleeve employing a ring compressor



CYLINDER BORE & PISTON MARK	CYLINDER BORE DIAMETERS
"F"	3·3460" TO 3·3463"
"G"	3·3464" TO 3·3467"
"H"	3·3468" TO 3·3471"

Fig. 18. Cylinder sleeve

fitted at 90° to its initial position, which initial location we will hereafter identify as position " A," a half tooth of adjustment is obtained. If, on the other hand, the wheel is turned " Back to Front " from position " A," a $\frac{1}{4}$" tooth of adjustment is provided, whilst a 90° movement in the reversed position will give $\frac{3}{4}$" of a tooth variation from that given by position " A."

When the timing has been correctly set (as explained later under " Valve Timing ") the faces of the two gears are marked with a scribed line drawn radially in such a manner that if the lines were produced outwards on the respective gears, they would pass through the centres of the two gears. In addition, to avoid any possibility of the camshaft position being incorrect, a centre punch mark is made on the end of the camshaft through an unoccupied setscrew hole and on the face of the timing wheel adjacent to the setscrew hole ; Fig. 19 shows the marking of these timing wheels.

The camshaft used is cast iron, having chilled faces for the cams and journals. With the camshaft a cast iron flanged front bearing is used, the other three journals making direct contact with the cylinder block.

The camshaft, after grinding operations have been completed, is degreased, bonderised and, whilst still warm, immersed in a solution of " Dag " (Colloidal Graphite). This process considerably improves the bearing surfaces and gives additional wearing properties.

The helical gear for the distributor drive, and the cam for operating the petrol pump, are integral parts of the camshaft. The distributor driving gear is copper coated.

End float of the camshaft is taken between a flange on the camshaft, the bearing, and the rear face of the timing wheel.

To remove camshaft.

The camshaft can be removed from the engine with this unit in the chassis, after removal of radiator block in the following manner :—

1. Proceed to remove the cylinder head as described under " Decarbonizing and Valve Grinding " on Page 24, but it is unnecessary to remove the rocker shaft or valves. When removing the cylinder head there is the possibility of cylinder sleeve movement when the head is lifted, particularly if jointing compound has been used on both sides of the gasket. When reassembling engine, jointing compound should be used on one side only of the gasket and grease applied to

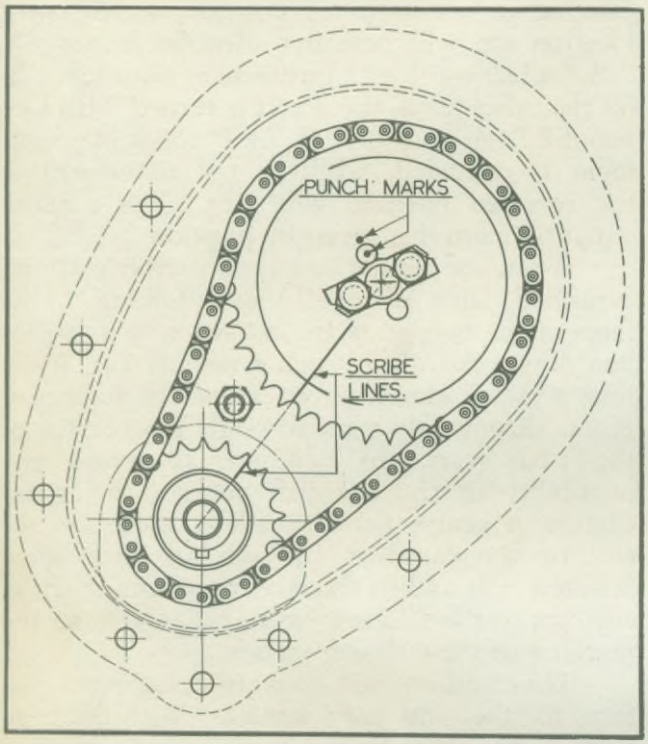


Fig. 19. Showing wheel markings for valve timing

the other face. Immediately after removal of the cylinder head sleeves, retainers should be applied as shown in Fig. 20. In the event of sleeve movement, when the cylinder head is lifted, new figure of eight packings should be fitted, the undersides of which should be treated with jointing compound to prevent their being lifted by sleeve movements, if such movement occur. Remove push rods and tappets.

2. Remove distributor adaptors from cylinder block by detachment of two $\frac{5}{16}$" nuts with $\frac{1}{2}$" A/F spanner. Do not slacken clamp bolt.
3. Remove distributor and oil pump helical driving gear.
4. Detach petrol pump after withdrawal of two $\frac{5}{16}$" nuts ($\frac{1}{2}$" A/F spanner).
5. Remove fan belt.
6. Unscrew starting handle dog nut and guide, utilizing a $1\frac{7}{16}$" A/F spanner.
7. Extract crankshaft fan pulley utilizing a suitable extractor. Fig. 21 shows the employment of Churchill Extractor Tool No. 6312 on fan extension bracket.
8. Remove timing cover by withdrawal of four bolts, one nut and seven setscrews utilizing $\frac{1}{2}$" A/F spanner.
9. Note timing markings on gear-wheels and camshaft as shown in Fig. 19 for reassembly. In the absence of these markings, proceed as directed under "Valve Timing." (Page 21.)
10. Remove camshaft timing wheel and timing chain after releasing locking plate and withdrawing two $\frac{5}{16}$" setscrews, utilizing a $\frac{1}{2}$" A/F spanner.
11. Withdraw two $\frac{5}{16}$" setscrews securing front bearing to cylinder block ($\frac{1}{2}$" A/F spanner).
12. The camshaft can now be withdrawn.

Refitting of camshaft.

Reassembly is the reverse procedure to the foregoing. It is considered desirable, however, to describe certain operations as follows :—

1. When resetting the valve timing, the engine should be turned until the pistons in Nos. 1 and 4 cylinders are at T.D.C., this position exists when the fan pulley and crankshaft timing wheel keyways are pointing vertically downwards as shown in Fig. 19. Now rest the camshaft chain wheel on the camshaft spigot and line up the scribed lines. Turn the camshaft until the centre punch mark on the camshaft end appears at the punch marked hole on the camshaft chain wheel. The setscrew holes of the chain wheel should be exactly aligned with those on the camshaft. Next engage chain with crankshaft chain wheel, afterwards removing camshaft chain wheel, without altering the position of the camshaft, and fit to chain. The camshaft chain wheel should now be positioned on the camshaft so that the scribed lines on the two wheels are in line and the driving side of the chain is tight. The tabwasher can now be fitted and the two setscrews, but *do not bend up* the tabwasher until after

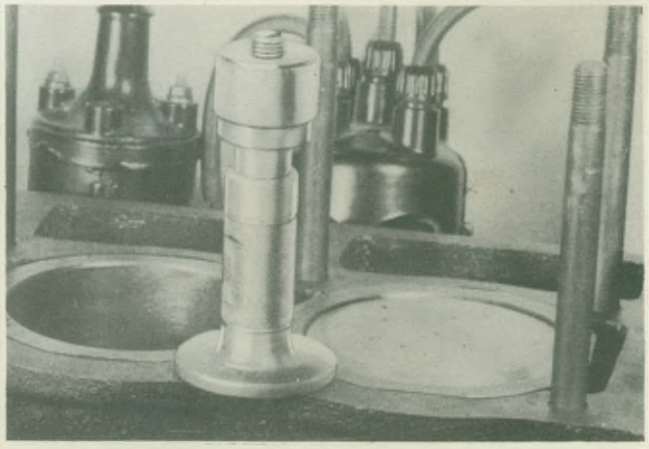


Fig. 20. Showing one of the two retainers required to prevent sleeve movement

re-checking the position of the markings. In the absence of timing wheel markings, proceed as directed under " Valve Timing."

2. When refitting the oil pump and distributor driving helical, ensure that No. 1 cylinder, that cylinder nearest the radiator, is at T.D.C. of the firing stroke. In this position the correct engagement of the helical gear should allow the keyway in the boss to be towards the front of the engine and point in the direction of the dipstick as shown in Fig. 10. Before it is possible for the helical gear to engage with its counterpart on the camshaft, the oil pump driving shaft must be right home in its recess in the oil pump. If the correct procedure has been regarded with the removal of the distributor, and the clamping bolt has not been slackened, the ignition timing is assured by the fact that the slot for distributor driving dog is offset. Where it is necessary to re-time the ignition for any reason, refer to " Ignition Timing."
3. Before refitting the cylinder head, ensure that no movement of the sleeves has occurred and if doubt exists on this point, withdraw such sleeves and replace figure of eight packings, applying jointing compound sparingly to the flanged face in the cylinder block only.
4. When fitting the combustion head, slacken off the valve rocker adjustment screws and ensure the proper location of the outer valve spring caps on their respective valve stems, otherwise the push rods may become bent as shown in Fig. 22. When tightening up cylinder head nuts, regard the sequence for tightening given in Fig. 24.
5. Having refitted the combustion head and rocker shaft, **it is important to apply oil to the ground faces on the valve caps where these contact the rockers. This is necessary as they will not immediately receive a supply of oil from normal system.**

To set valve rocker clearances.

Remove rocker cover and turn engine round until the valve which is to be set has just closed, then continue to turn the engine through a further half revolution, and set inlet valves to a .010" feeler gauge and exhaust valves to .012" (see Fig. 5). Continue in the same manner for the other cylinders. This procedure ensures that the tappet is on the base of the cam when clearance is set, as shown in Fig. 25.

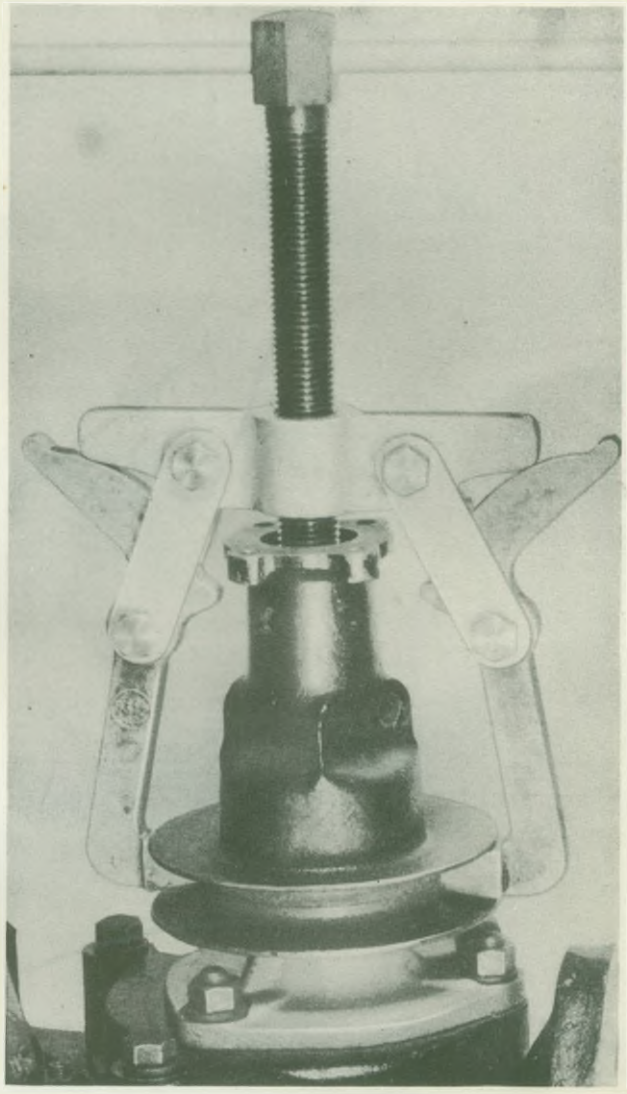


Fig. 21. Drawing fan pulley with Churchill extractor. This extractor may also be used on crankshaft pulley.

To set valve timing in the absence of wheel markings.

It is assumed that for the purpose of this instruction the camshaft, the cylinder head and the valve gear, etc., are already fitted, but the timing gear has yet to be fitted. The following procedure is recommended :—

1. Remove the rocker shaft and withdraw outer valve springs, but not spring caps on Nos. 1 and 4 cylinders. Refit rocker shaft, taking steps to ensure that the outer spring caps register properly with the valve stem as the pedestal brackets are tightened down and that damage is not caused by misplacement of these caps as indicated in Fig. 22.

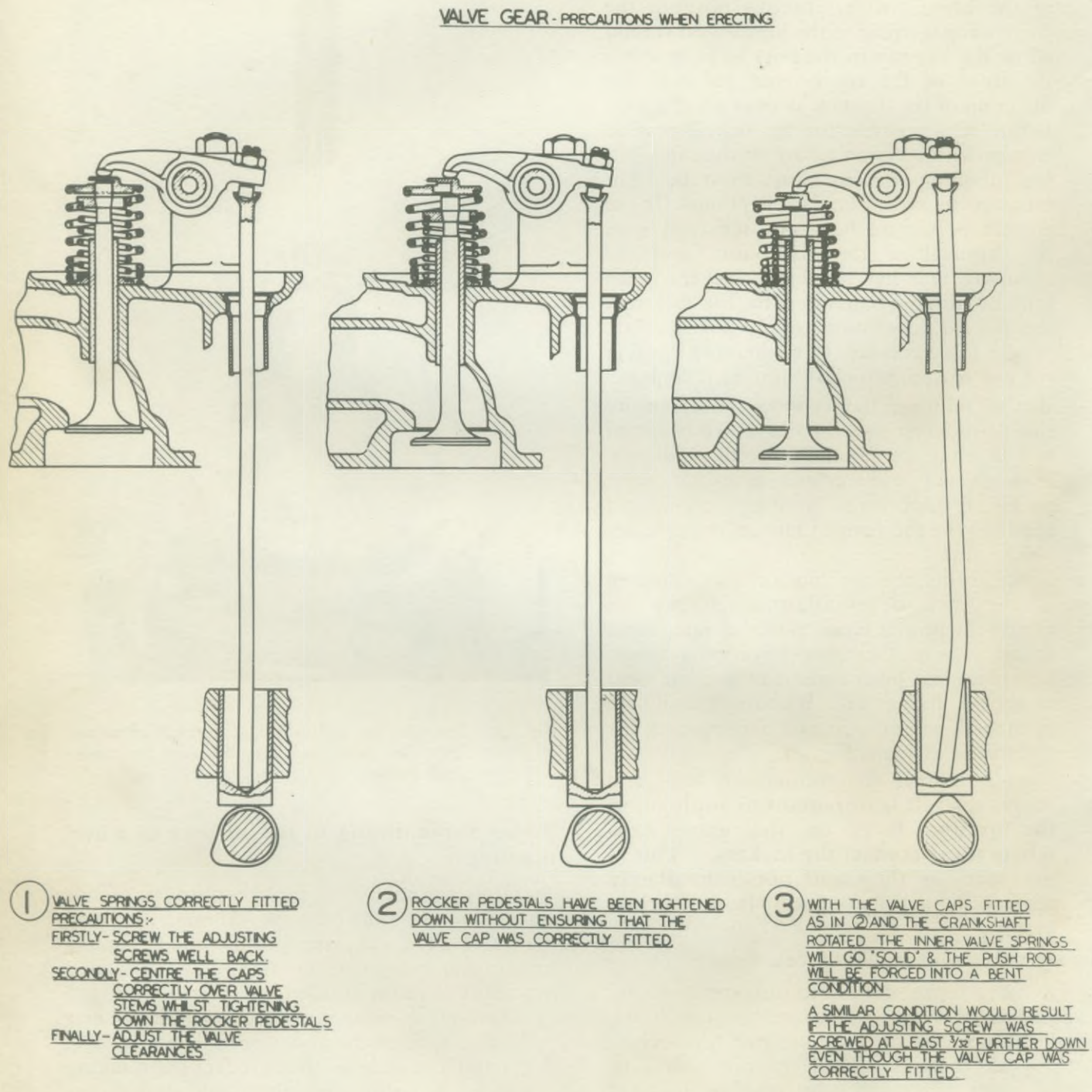


Fig. 22. Precautions required when fitting valve rocker shaft assembly

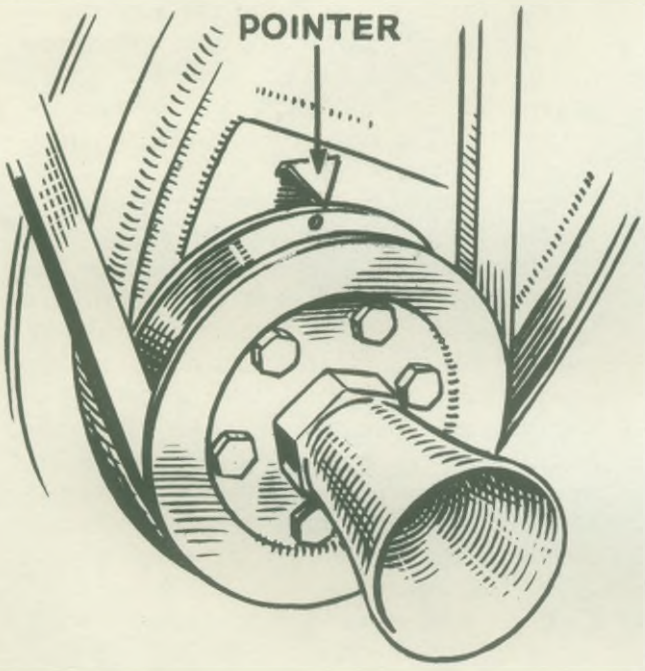


Fig. 23. Top dead centre indicating device

2. Set valve rocker clearances for Nos. 1 and 4 cylinders to .014″, which is the valve timing clearance.
3. Turn the crankshaft round until Nos. 1 and 4 pistons are on T.D.C. This position may be found, either by placing the keyway in the crankshaft vertically downwards, or alternatively, placing the hole in the fan pulley at T.D.C. and in alignment with the pointer on timing cover (see Fig. 23).
4. Rotate the camshaft until the exhaust valve and inlet valve are at the point of balance in which the tappets will be in the position shown in Fig. 27. In this position the exhaust valve will just be about to close and the inlet valve be just commencing to open. From Fig. 26, which gives the valve timing diagram, it will be observed that the inlet valve opens 10° before T.D.C. and the exhaust valve closes 10° after that point (.035″ on piston stroke).
   When setting the valve timing, the actual opening and closing points for the inlet and exhaust valves respectively is not so important as that these should occur an equal amount before and after T.D.C.
5. Having set the valve timing correctly, the timing gears and camshaft end should be marked as described in operation 32 on Page 43.
6. Having set the timing and marked the gearwheels and camshaft, the engine may be reassembled taking care to ensure the appropriate precautions when refitting the rocker shaft after re-installation of outer valve springs, to prevent damage to the push rods as previously mentioned.
7. Reset valve rocker clearance for Nos. 1 and 4 to working clearances, *viz.*, .010″ and .012″, inlet and exhaust respectively.

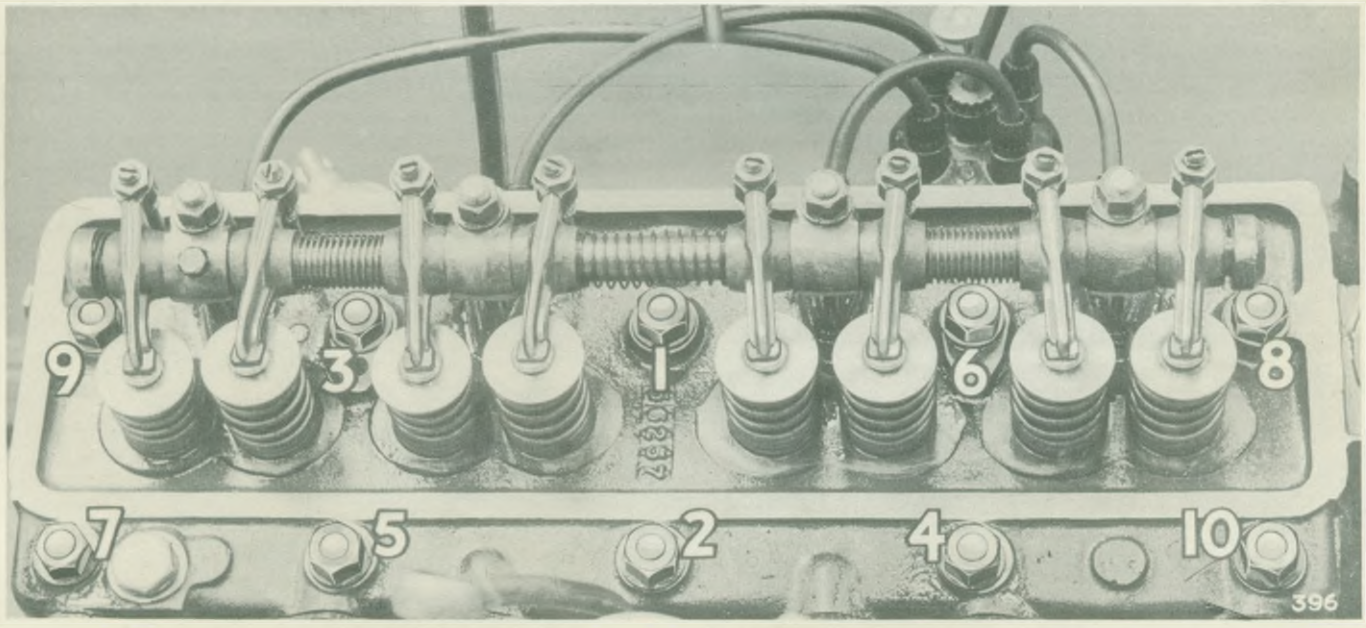


Fig. 24. Order for tightening cylinder head nuts

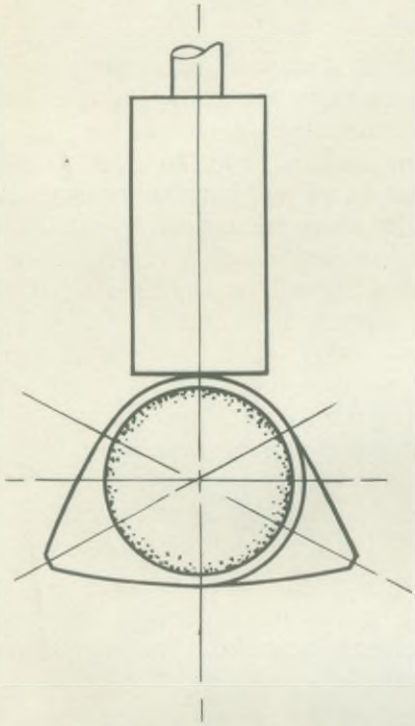


Fig. 25. Tappet on base or concentric portion of cams

To set ignition timing.

Under normal circumstances it is rarely necessary to set the ignition timing, providing that when removing the distributor bracket the clamp bolt is not slackened. Small variations of timing can be made quite readily by slackening the two $\frac{1}{4}$" nuts which secure the distributor bracket to the adaptor ($\frac{7}{16}$" A/F spanner), and rotating the head towards "A" or "R", to advance or retard respectively, afterwards re-tightening the nuts. Following an adjustment of ignition timing, the car should always be tested on the road and any adjustment required attended. The ignition should be adjusted to give the best possible performance and to suit the grade of fuel in use. Where a new distributor head has to be fitted, or has been removed for any reason, the following procedure is recommended :—

1. Set No. 1 piston on T.D.C. of the firing stroke, *i.e.*, with both valves closed, utilizing timing indicator on chain cover and hole in pulley to find this position.
2. Remove the distributor adaptor by detachment of two nuts, utilizing $\frac{1}{2}$" A/F spanner, and ensure that with the engine in this position the slot in the helical gear is correctly positioned as indicated on Page 14, under "Engagement of Oil Pump and Distributor Driving Gear." If the slot does not assume the position indicated, the helical gear's engagement is incorrect and should be corrected. The necessity for such an alteration should rarely arise.
3. Having ensured the appropriate position of the slot for the distributor driving dog, fit the distributor into its bracket, leaving the clamp bolt loose. Rotate the distributor head in relation to its bracket until the flat portion of the distributor head, in the bracket's fitted position, will be parallel to the cylinder block and the rotor arm is on No. 1 segment with the points just commencing to open. Fit distributor and bracket into cylinder block adaptor, securing thereto with the two $\frac{1}{4}$" nuts employing a $\frac{7}{16}$" A/F spanner.
4. Fit distributor and adaptor to cylinder block, engaging the driving dog with the slot in the helical gear, making corrections of relative position by movement of the distributor head permitted by the loose clamping bolt. Having secured distributor assembly to cylinder block, centralize clamping bracket in relation to "A" and "R" and tighten clamp bolt. Test on road and make final adjustments to timing.

TO DECARBONIZE AND GRIND VALVES

We recommend the removal of the cylinder head for decarbonizing and valve grinding

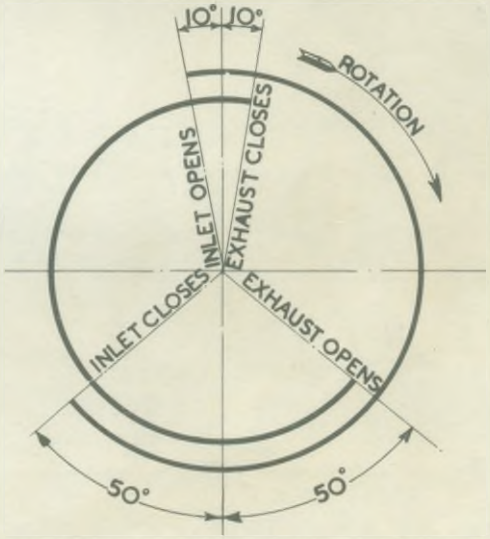


Fig. 26. Valve timing diagram (10° crank movement before or after T.D.C. is equivalent to 0.035" piston movement)

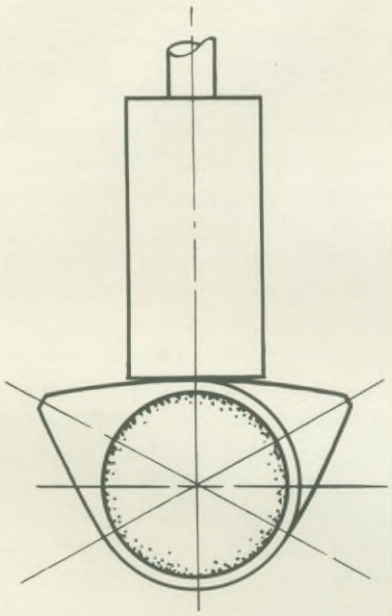


Fig. 27. Tappet at point of rock

after the first 5,000 miles. Attention after this running has the advantage of allowing the initial casting stresses to have resolved themselves and permits the consequent valve seating distortion to be countered by valve grinding. Failure to carry out this initial valve grinding is a frequent cause of excessive petrol consumption on new cars. Subsequent attentions will not normally be required until a further considerable amount of running has been done —normally after 20,000 miles (32,000 kms.). Further attention in this respect may be left until there is a noticeable falling off in power associated with a lack of compression and a marked tendency to "pink." It is permissible to retard the ignition to some extent to deal with a dirty engine, but there is naturally a limit to the amount of retard an engine will stand, and when this point is reached the necessary work should be carried out without further delay in the interests of economy in running and to avoid destruction of valves and/or seatings.

The procedure we recommend is as follows :—

1. Disconnect one of the accumulator leads to prevent the possibility of " shorting " when dismantling the engine.
2. Drain cooling system, preserving any anti-freeze solution for future use.
3. Remove carburettor air silencer after detachment of its connection with crankcase ventilating pipe.
4. Disconnect top water hose pipe and by-pass on thermostat.
5. Remove thermometer bulb from thermostat after unscrewing gland nut.
6. Remove heater hoses where fitted.
7. Detach carburettor controls and fuel pipe.
8. Disconnect inlet manifold drain pipe.

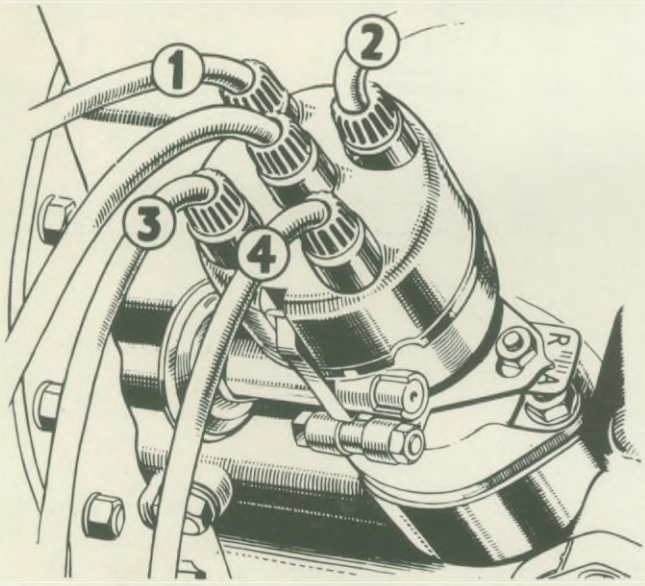


Fig. 28. Showing ignition timing adjuster and wiring of distributor

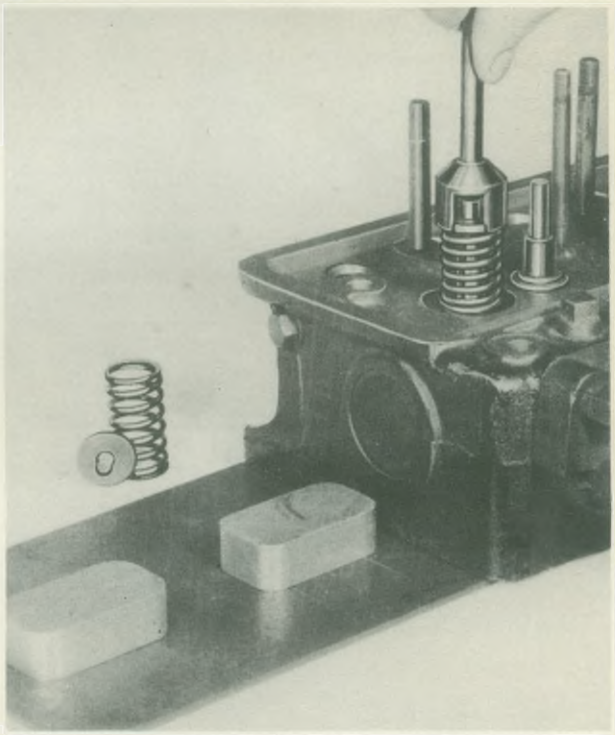


Fig. 29. Showing removal of valve springs

9. Remove sparking plug leads.
10. Remove rocker cover after detachment of crankcase ventilation suction pipe.
11. Remove rocker shaft complete with four pedestal brackets, each bracket being secured by a single nut to the cylinder head ($\frac{9}{16}$" A/F spanner).
12. Remove outer valve springs, valve caps and push rods.
13. Disconnect exhaust pipe from manifold by detachment at flange joint and four $\frac{9}{16}$" A/F nuts.
14. Remove cylinder head by unscrewing ten $\frac{11}{16}$" A/F nuts, watching for any signs of cylinder sleeve movement and where such occurs ensure that damage has not occurred to figure of eight sleeve packings. Deal with sleeve packing damage by fitting replacements and applying jointing compound to the bottom faces to fix in position (see remarks regarding removal of cylinder head gasket under "Reassembly"). Fit cylinder liner retainers shown in Fig. 20 to prevent sleeve movement if, or when, the engine has to be turned by hand. *Do not attempt to "break" the seal of the cylinder head by turning the crank as this will possibly cause the sleeves to move.*
15. Remove inlet and exhaust manifold as a unit from the cylinder head.

Valve grinding.

Proceed to remove the valves and springs. The inner valve spring exerts only a light load and can be compressed by hand to enable collar removal, or employ the special compressor as shown in Fig. 29. The cylinder head should be placed flat on the bench with suitable packings to support the valves whilst the springs and collars are removed (see Fig. 29). The position of the valves should be perpetuated when refitting and they will be found to be numbered from the front of the engine consecutively. Before removing the carbon from the tops of the piston, turn the engine until two cylinders are near their T.D.C. position and fill the remaining two cylinders and push rod chambers with clean rag to prevent any carbon chips entering. It is recommended that a ring about $\frac{1}{8}$" (3 mm.) wide is left round the outside edge of each piston, thus ensuring a good oil seal when the engine is reassembled. An old piston ring inserted into each bore on top of the piston will assist in the preservation of the necessary carbon ring. Do not allow pieces of carbon to enter between the sleeves into the cylinder block.

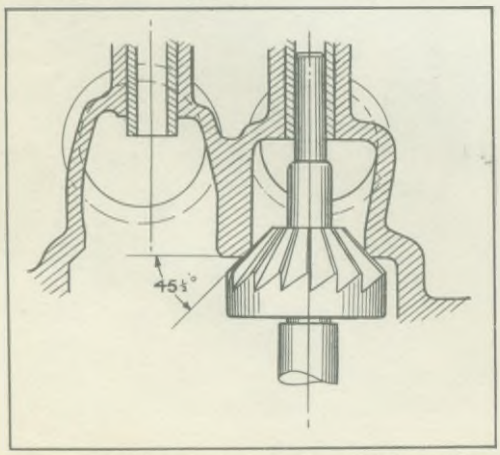


Fig. 30. Recutting valve seating with 44½° cutter

Turn the engine until the other two pistons reach a similar position and treat in a similar manner. Remove the sparking plugs and scrape off the carbon from the combustion head subsequently wiping the chambers clean. Scrape the valve ports clear, being careful, however, not to mark the valve seatings, and when cleared of carbon, use a petrol-moistened rag to wipe clean, having first blown out with a compressed air line. The use of emery cloth, or other abrasive, for polishing purposes is not recommended, as particles of such abrasives may enter the bores after reassembly causing serious damage.

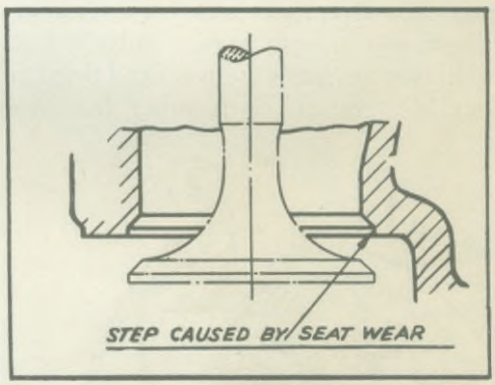


Fig. 31. Embedded valve seating

Clean sparking plugs, test and replace as required. The correct sparking plug gap is .030". The normal life of a sparking plug is 10,000 miles (16,000 kms.).

Clean the carbon off the underside of the valve heads as well as off the top, using a blunt scraper and finishing with a petrol-moistened rag. Where the existing combustion head gasket is to be used again, carbon should be carefully removed from both faces. A new gasket should normally

be fitted. Grind the valves into their appropriate seatings, the valves being numbered consecutively from front to rear. Where valve faces are badly pitted, they should either be renewed or refaced. No attempt should be made to grind the badly pitted valve into its seating or this will be unduly reduced.

When refacing valves, only sufficient metal should be removed as is necessary to clean up the valves, otherwise the valve edge will become too thin and tend to curl in service. Where the head thickness above the seat edge is less than $\frac{1}{32}$" (1 mm.) the valve should be replaced.

Where valve seats are badly worn or pitted, they should be re-cut with a seating cutter having an included angle of 89°, utilizing a $\frac{5}{16}$" pilot as shown in Fig. 30. Where a valve seating has become embedded in the cylinder head, as shown in Fig. 31 it will become necessary to employ first a 15° cutter (Fig. 32) to provide a clearance for the incoming and outgoing gases, following this up with one of $44\frac{1}{2}$°. (Fig. 31 shows effect of a sunken valve.)

When the necessity for re-cutting a valve seating arises, it is important that the valve guides are concentric with the valve seatings themselves. In other words, where a valve guide is badly worn it should be replaced before the seating is re-cut.

The valve and valve guide data is given on Page 3. (See also Page 52.)

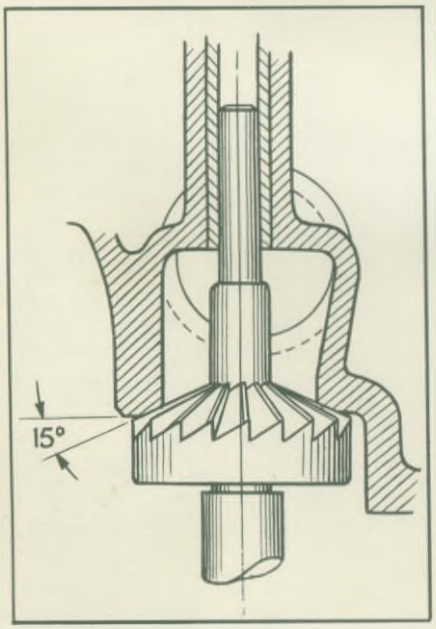


Fig. 32. Use of 15° valve seating cutter to provide clearance of gases

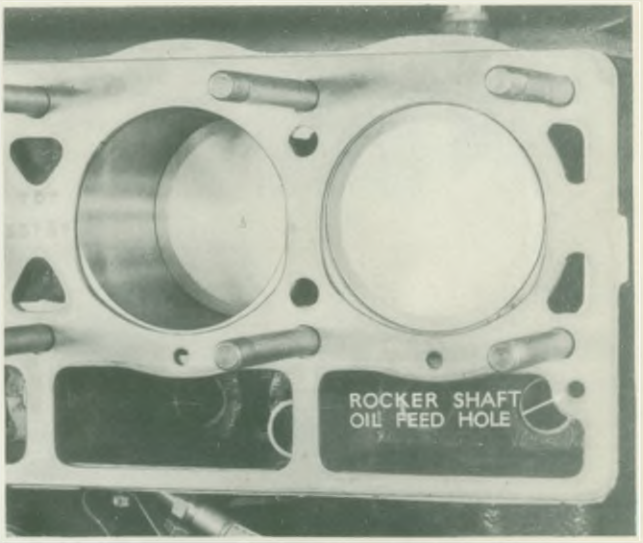


Fig. 33. Showing the correct fitting position for the cylinder head gasket (Eng. Nos. V.1—V.29707E)

REASSEMBLY OF ENGINE

Having paid the requisite attentions to the valves and their seatings, the valves can be re-assembled into the combustion head, first smearing the valve stems with oil. *In the case of the outer springs, one end of these are close coiled as shown in Fig. 6 and it is important that this end is fitted against the cylinder head.*

Before replacing the gasket on the cylinder face, the bottom face should be treated with jointing compound and the upper face with grease. The reason for the use of jointing compound on the lower face only is to minimize the possibility of sleeve movement when subsequent removal of the combustion head is carried out. Where the gasket is not to be replaced, it may be left in position on the cylinder head whilst decarbonizing the engine. Sleeve retainer may be fitted over the gasket.

When fitting the cylinder head gaskets to units prior to Engine No. V.29708, it is important to use only Gasket Detail No. 56759 and to position it with the word " TOP " uppermost, as shown in Fig. 33. A modified gasket, having two oil feed holes, was introduced at the engine number quoted and used in conjunction with a modified lug at the forward end to match that used at the rear end for the oil feed hole. The later gasket should be assembled with the " seamed " side towards the cylinder head.

When refitting the cylinder head nuts, tighten them up progressively and symmetrically as indicated in Fig. 24. The tightness of the nuts should be rechecked after the engine has been

thoroughly warmed up and a further tightening down carried out after a few days' running of the car.

Before re-installing the rocker shaft, slacken the lock nuts and screw back the adjusting screws thus facilitating assembly. *When tightening down the rocker pedestals, ensure that the valve caps are locating properly on the valve stems, thus avoiding damage shown in Fig.* 22. *Provide for initial lubrication of valve cap ground faces with an oil can.*

Adjust valve rocker clearances as described on Page 21 and when reassembling rocker cover, ensure that the cork washer is in good order, replacing it if doubt exists as to its condition.

The following is a list of the gaskets which will normally be required when decarbonizing.

Detail No.	*No. off*	*Item*
61312	1	Cylinder head gasket.
(56759 before Eng. No. V.29708E).		
60535	1	Carburettor gasket.
57924	1	Exhaust pipe gasket.
60256	2	Manifold gaskets.
56286	2	Sleeve gaskets (only required if sleeves are withdrawn).

CRANKCASE VENTILATION

(Fig. 34) (Series I and early Series II Models)

Description.

Crankcase ventilation is of considerable importance if the maximum possible life is to be obtained from an engine. Such ventilation is necessary to expel "blow-by" gases which contaminate and dilute the oil, create varnish deposits, give rise to corrosion, contribute to engine fumes in the car's body and eject into the crankcase particles of carbon and other foreign matter.

With the "Vanguard," the depression in the induction manifold is employed to operate the system. This system depends on the maintenance of a sealed engine which is provided by careful attention to oil sealing.

With this system a depression is created in the crankcase by suction from the induction manifold. A short pipe connects an adaptor containing a metering orifice, which adaptor is screwed into the rocker cover with another adaptor in the rocker cover induction manifold.

As a depression is created in the crankcase, it is relieved by filtered air drawn through a pipe from a connection fitted in the carburettor air silencer as is shown in diagram in Fig. 34.

The calibration of the metering orifice is of paramount importance and should under no circumstances be tampered with after the car leaves these works. The small pin in the orifice is intended to keep the hole clear of carbon, etc.

Maintenance.

As previously stated, this system's proper working depends upon a sealed engine and for this reason the oil seal in the timing cover and that at the rear of the crankshaft must be properly maintained.

It is further important, quite apart from the question of oil leakage, that all joints should be perfectly made and unions and connections airtight.

Although it will become necessary to clear the metering orifice and clean out accumulations of carbon from time to time, this should not often be required, and on such occasions when it is done no attempt should be made to alter the size of this orifice.

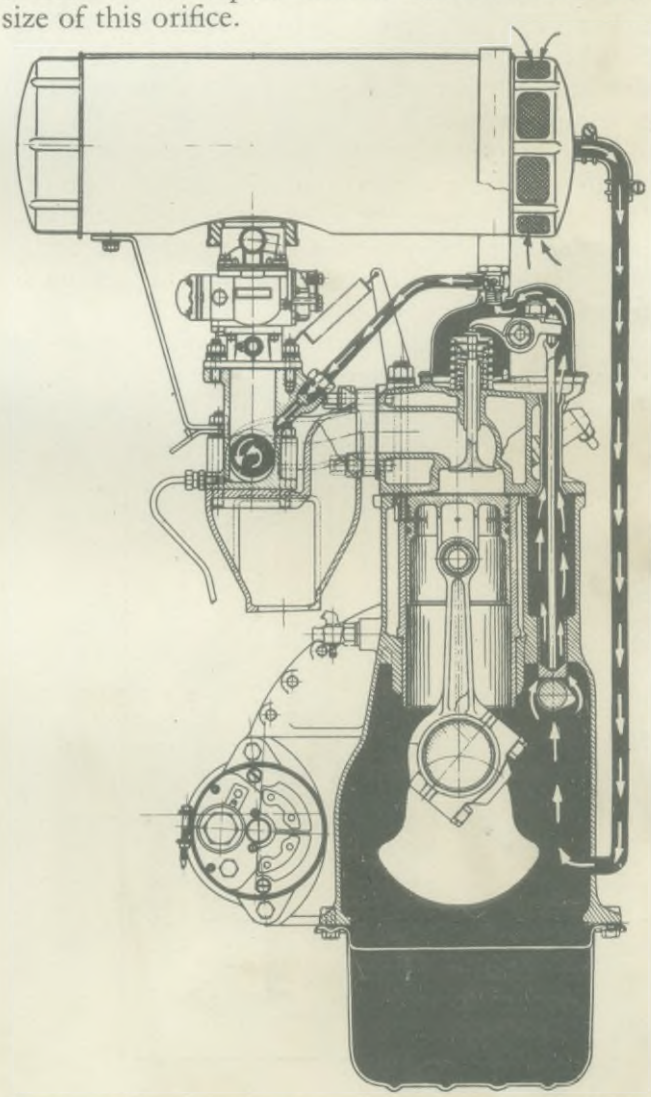


Fig. 34. Showing crankcase ventilation system. (Eng. No. V.152,890 and early to Series II only).

OIL FILTER ASSEMBLY

Very early Models of the Vanguard employed the Tecalemit Oil Filter Assembly, this Assembly, however, was replaced fairly early in production by the Fram Oil Cleaner which has now, in turn, been replaced by the Purolator Micromic Filter. Details for all three of these arrangements are given in this Manual. (See also Page 50.)

TECALEMIT OIL FILTER (Eng. No. V1E—V311E)

Description (see Fig. 35).

A slightly different form of this filter has been used for some years on various of our models and an understanding of the operation of these will cover the present assembly.

As already described under " Lubrication," oil is forced from the annular space around the oil pump driving shaft, through the filter assembly. The oil entering the filter assembly passes first over the relief valve orifice. This relief valve regulates the oil pressure and when a pressure of 60 lbs. per square inch is exceeded, the ball leaves its seating and oil is returned to the sump unfiltered until the pressure has dropped appropriately.

The delivery of oil from the pump will increase with engine speed. At high engine speeds the engine bearings will not require the total output of the pump and thus cause back-pressure, which is of sufficient magnitude to operate the release valve, returning surplus oil to the engine sump. The bulk of the oil passes under pressure to the outside of the filter element, which is located in a detachable container.

By the design of the cleaner, the oil has to enter the element from its periphery, being forced through the felt material of which it is composed, and leaving sludge on its outer surface. The clean oil passes up the centre of the element, passing round the annular space between centre bolt and bracket, finally leaving by a hole, which is matched by another in the cylinder block, which leads to the main oil gallery.

A spring-loaded balance valve is provided on the underside of the bracket above the element, which is subject to the full pressure of the oil entering the cleaner from the engine. The slightly lower pressure of the clean oil passing out of the filter element acts on the other side of the valve and assists the spring to keep the valve on its seating, resisting the pressure of the oil as it enters the cleaner prior to being filtered. Thus all oil passing to the engine is forced through the element so long as this is not clogged with dirt.

After some thousands of miles the filter becomes clogged with dirt, thereby decreasing its porosity and increasing the pressure required to

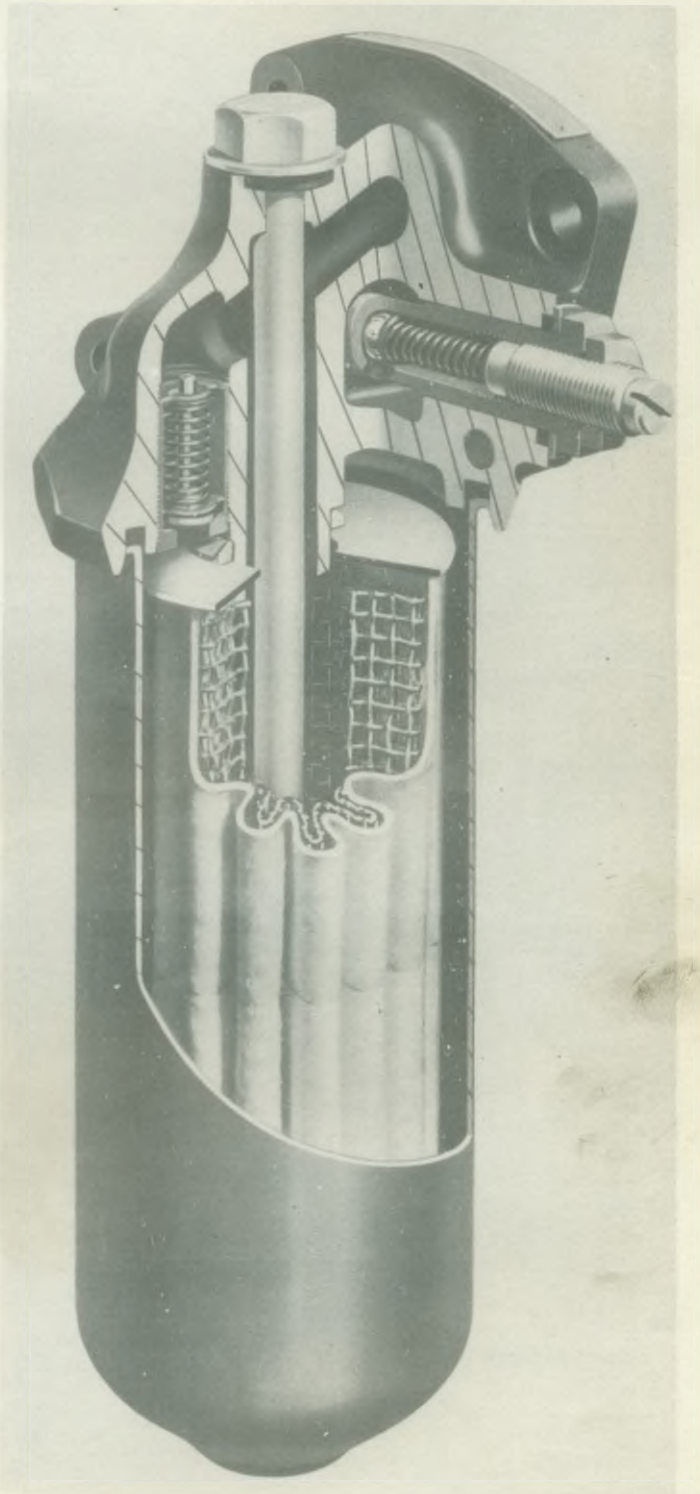


Fig. 35. Tecalemit filter employed on early models