force oil through it. The result of this decrease in porosity is the lowering of the pressure of the filtered oil.

With the progressive drop in pressure of the filtered oil a point is finally reached where the combined resistance offered by the by-pass valve spring and the oil leaving the element is insufficient to balance the pressure of the incoming oil bearing on the bottom face of the valve, and the valve is lifted off its seat, allowing unfiltered oil to be fed direct to the engine.

As can be seen from the previous paragraph, the balance valve ensures that, even where the changing of the element is neglected, the engine will get some oil although this will be unfiltered.

Maintenance of oil filter.

The maintenance of the oil filter is limited to the periodic checking of the tightness of the four securing bolts, the elimination of leakages if they occur and the changing of the filter cartridge each 10,000 miles.

It is important when removing the filter bracket and packing washer for any reason to ensure that the packing is refitted so that oil holes are in correct relation to those in cylinder block (*see Fig.* 36). *With the latest type of packing shown the correct assembly is foolproof.* (See also Page 50.)

Fig. 36. Correct fitting position for oil cleaner packing washer. The latest type of packing the fitting of which is fool-proof, is inset

FRAM OIL AND ENGINE CLEANER—TYPE FHMS.800 (Eng. No. V312E—V89332E. Less V89283E—V89294E)

Description.

The Fram oil cleaner differs from the Tecalemit in that it is of the by-pass type. It is necessary to understand clearly the precise meaning of the word " by-pass." The cleaner is provided with a restrictor by-pass which is shown in Fig. 37, and is so arranged as to control the quantity of oil actually filtered. The reason for restricting the oil is to ensure that the oil which is actually filtered is cleaned thoroughly and also that the pressure drop in the filtered oil is not too great. The restriction, however, is so arranged that the complete sump is filtered 1½ times in an hour at normal working temperature and a pressure of 60 lbs. per square inch. In this way all the oil in the system is preserved in a thoroughly clean condition.

The selection of size for the restrictor was only made after numerous experiments, which were carried out with a view to obtaining the best possible results on actual engines.

The cleaner contains a removable cartridge element, which is filled with filtering media consisting of closely packed cotton yarn treated with triethanolomene, which latter substance increases the absorbing qualities of the fabric material contained by the element.

From Fig. 37 it will be observed that the oil pressure release valve is contained in the filter bracket casting. The valve is of the spring loaded ball type and is adjusted to blow off at 60 lbs. per square inch.

The operation of the cleaner is as follows :—

All the oil from the annular space around the pump drive shaft (see previous remarks on lubrication) enters at the " inlet " gallery, and as long as the pressure of the oil is below 60 lbs. per square inch, a quantity of this oil flows around the container and leaves the cleaner assembly via the " outlet " gallery, which can be clearly seen in Fig. 37. A proportion of this oil, however, flows through the cleaner and is admitted to the " sump " gallery through the restrictor. When the speed of the engine is such as to deliver oil at a higher pressure than 60 lbs. per square inch, the release valve opens and a certain amount of oil is delivered to the sump through the same port as the filtered oil. The amount of oil so delivered is naturally a function of the pump delivery pressure.

The cleaner is capable of withstanding very high pressure without leaks, and tests have

shown that a hydraulic pressure of 600 to 800 lbs. per square inch is required before leakage occurs. The main gasket is located in a recess so arranged that when the body is forced into this recess by the centre bolt, the gasket is fully trapped, thus ensuring a very efficient joint.

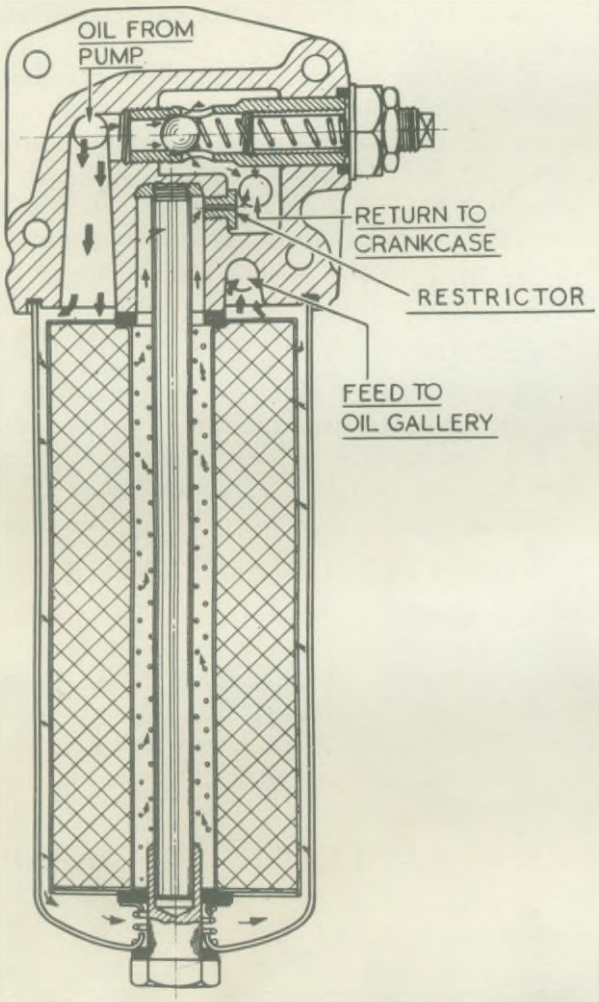


Fig. 37. Diagrammatic section of Fram filter

Maintenance attentions.

Under normal conditions, it has been found that the cartridge will efficiently clean the oil for a mileage of between 6,000 and 8,000. It should be understood that this figure is an arbitrary one and that the element need only be changed when the oil becomes dirty. Our normal recommendation for change of cartridge is 10,000 miles. When changing the element the following procedure is recommended :—

1. Unscrew centre bolt at bottom of container to free it from bracket casting.
2. Extract cartridge with top and bottom sealing washers.
3. Remove spring and centre bolt and wipe out cleaner body with a piece of fluffless cloth. Renew centre bolt gasket (provided in carton with new cartridge). Refit centre bolt and spring.
4. Fit new cartridge, ensuring that top sealing washer is fitting snugly in recess provided in top casting and also see that bottom sealing washer is seated correctly. (Top of cartridge can be identified by transfer.)
5. Refit body to bracket casting. Tighten centre bolt, ensuring that body locates squarely in cover casting and that centre bolt gasket is fitting snugly in recess provided.
6. Ensure that joints are oiltight by running engine for five minutes.

Particular care should be taken to ensure the maintenance of an oiltight fit between the cleaner body and cover casting.

It is scarcely necessary to point out the necessity for absolute cleanliness when changing the cartridge. The cleaner body should be carefully inspected, and the various joint faces cleaned before inserting the cartridge in the container.

It is important that only the Fram C.800 cartridge should be used, and on no account should a Tecalemit replacement element be fitted to this cleaner. The cleaner under consideration is of the by-pass type, whilst the Tecalemit is of the full-flow variety and the use of an element intended for the latter type would cause an excessive drop in pressure and result in no oil cleaning whatever.

It is important to appreciate that top and bottom sealing washers shown in Fig. 37 are of vital importance to the efficient working of the cleaner. If either of these two washers are faulty they should, of course, be changed. It will be seen from Fig. 37 that if either of the washers is faulty, oil could conceivably reach the sump without being filtered.

When the used cartridge is removed, it will be saturated with oil and as removal will result in the loss of approximately one pint, the sump should be correspondingly topped up with new oil. It is recommended, however, that the engine oil should be renewed at the same time as a new cartridge is fitted and hence the topping up process becomes automatic.

WHEN REMOVING FILTER BRACKET AND PACKING FOR ANY REASON, ENSURE CORRECT RELATION OF OIL

HOLES IN PACKING WITH THOSE IN CYLINDER BLOCK (SEE FIG. 36). WITH LATER PACKINGS CORRECT ASSEMBLY IS AUTOMATIC.

THE PUROLATOR "MICRONIC" OIL FILTER. TYPE MF.5102. (Eng. No. V89283E —V89294E and V89333E and future)

The Purolator 'Micronic' Oil Filter consists of a plastic impregnated paper "element" which removes the finest particles of abrasive which inevitably find their way into every engine. A filter of this type will stop not only the smallest micron sized particles of abrasive, but ensures a continuous supply of clean oil to the engine at all times. The only attention which the filter needs is to see that the element is changed at periods not exceeding 8,000 miles. It is essential that this operation be carried out at the specified periods to ensure maximum filtration; to renew the element proceed as follows :—

1. Clean the outside of the filter casing.
2. Unscrew the centre bolt and remove the filter casing and the element.
   Note: The paper element, its perforated outer cover and element tube form a complete element assembly.
   Ensure that the top seal is retained in position in the groove in the filter head.
3. Withdraw the old element and clean the inside of the filter casing.
4. Insert a new element into the filter casing.
5. Fit the filter casing and new element to the head, ensuring that the spigot formed on the head enters the centre tube of the element squarely; tighten the centre bolt only sufficiently to ensure an oil tight joint.
6. Run the engine for a few minutes and inspect the filter for leaks. If leakage is noted between the filter casing and the head, the centre bolt must be unscrewed, and the casing and element withdrawn, a new top seal should then be fitted. If leakage occurs at the bottom of the filter, withdraw the casing and element, remove the circlip from the centre bolt and withdraw the bolt from the casing, collect the element support, bolt seal, washer and spring. Ease the remaining seal out of the bottom of the casing and fit a new seal in its place. Insert the centre bolt and fit the spring, the washer, a new bolt seal and the element support onto the part; fit circlip into its groove in the bolt. Place the element inside the casing and offer up the assembly to the filter head, screw the centre bolt home.

A certain quantity of oil will be lost due to the removal of the filter casing and the sump should be topped up after assembly of the filter.

The filter casing should not be disturbed until element renewal is required, to do so invites the hazard that the accumulated dirt on the outside of the filter may be allowed to contaminate the inside and thus be carried into the bearings when the engine is re-started.

If at any time the entire filter unit is removed from the crankcase, take great care to fit the joint washer correctly, otherwise damage will be caused when next the engine is started, through the "blanking-off" of the oil passages. It is advisable to fit the washer to the crankcase and ensure that the holes in the washer match those in the crankcase before fitting the filter unit.

IMPORTANT.

Do not attempt to re-set the pressure relief valve which is incorporated in the filter head, this is the main engine pressure relief valve and is set by the vehicle manufacturers to a predetermined figure.

OIL CIRCULATION KNOCK.

As a result of a certain number of complaints of this description, with early Models, it was decided to modify the take off for the oil pressure gauge. This modification was advised in our Service Bulletins No. V.52G, copies of which may be had from our Service Department, upon application.

DIFFICULT STARTING OF ENGINE.

1. Insufficient fuel due to :—
   (a) Empty petrol tank.
   (b) Restricted pipe line from tank.
   (c) Dirty petrol pump filter.
   (d) Petrol pump not working properly.
   (e) Choked carburettor jets.
   (f) Incorrect carburettor level.
   (g) Incorrect jet setting. Refer to Page 1 "General Data" Section.
2. Air leaks to the induction system due to :—
   (a) Loose nuts on carburettor and induction manifold or distorted flanges.
   (b) Defective manifold or carburettor gaskets.
   (c) Leakage around crankcase ventilation adaptor in induction manifold.
   (d) Cracked induction manifold.
   (e) Worn throttle valve spindle and/or bearing point in carburettor body.
   (f) Worn valve guides.

3. Unsatisfactory grade or condition of petrol, particularly during cold weather.
4. Overdosing with petrol owing to injudicious use of strangler control or trying to start engine with sparking plug porcelains covered with moisture.
5. Defects in the electrical system as follows :—
   (a) Battery condition poor or this requires charging (see remarks under " Battery " in Electrical Section).
   (b) Incorrect ignition timing.
   (c) Weak or " earthed " condenser.
   (d) Incorrectly adjusted or dirty and pitted contact breaker points (see Electrical Section).
   (e) Sticking contact breaker arm due to seizure, weak or broken springs. Breaker arm " earthed."
   (f) " Earthed " low tension terminal on distributor head.
   (g) Poor ignition switch contacts.

Secondary circuit.

   (a) Poor contact between high tension terminals and sparking plugs.
   (b) Faulty insulation of high tension cables.
   (c) Defective high tension coil.
   (d) Moisture on distributor cover or leaks due to cracks.
   (e) Unsuitable sparking plug or incorrect setting of electrodes (.032").
   (f) Plug porcelains cracked or coated with moisture.
   (g) Corroded rotor contact or distributor segments. " Earthed " rotor.
   (h) Carbon brush for distributor to coil cable missing, damaged or stuck.
   (i) Starter motor in poor condition (see " Starter Motor " under Electrical System).
   (j) Starter motor switch not operating properly.
6. Starter motor pinion not engaging freely with flywheel ring and sticking in this gear.
7. Too heavy grade of engine or gearbox oil, preventing proper turning over of engine (see oil recommendations).
8. Engine compression poor owing to :—
   (a) Loose sparking plugs or defective plug C/A washers.
   (b) Damaged or improperly fitted cylinder head gasket.
   (c) Valves require regrinding and/or refacing. Valve seatings require attention (see Page 26).
   (d) Weak or broken valve springs causing partially sticking valves.
   (e) Bent valve stems.
   (f) Incorrect valve rocker clearances (see Page 21).
   (g) Piston rings broken, stuck or worn.
9. Water in cylinders due to poor cylinder head gasket or cracked cylinder block.
10. Initial tightness of engine due to recent overhaul. Such stiffness can also be explained by improper lubrication of unit.
11. Incorrect valve timing (see Pages 21 and 22).

ENGINE POWER POOR

1. Lack of compression due to following :—
   (a) Valves not closing properly due to inadequate valve rocker clearance (see Page 21).
   (b) Sticking valves due to stem deposits, broken heads or bent stems, and insufficient guide clearances.
   (c) Weak or broken valve springs.
   (d) Valve faces and/or seating in poor condition.
   (e) Worn or damaged cylinder bores, pistons and rings.
   (f) Piston rings improperly gapped and slack in piston grooves.
   (g) Faulty cylinder head gasket or incorrect part.
   (h) Sparking plug copper and asbestos washers defective.
2. Improper ignition timing.
3. Poor carburation.
4. Dirty filter reducing weight of mixture available.
5. Throttle valve not opening fully, owing to faulty adjustment of linkage.
6. Petrol pump not operating properly (see Fuel System).
7. Exhaust system clogged with carbon and causing back-pressure.
8. Engine overheating.
9. Pre-ignition.
10. Tight pistons and/or engine bearings.
11. Clutch slip.
12. Tight wheel bearings and transmission.
13. Brake drag.
14. Unsuitable back axle reduction gear or oversize tyres, indicating adjustments made outside this factory.
15. Incorrect valve timing (see Pages 21 and 22).
16. Speedometer not reading correctly.

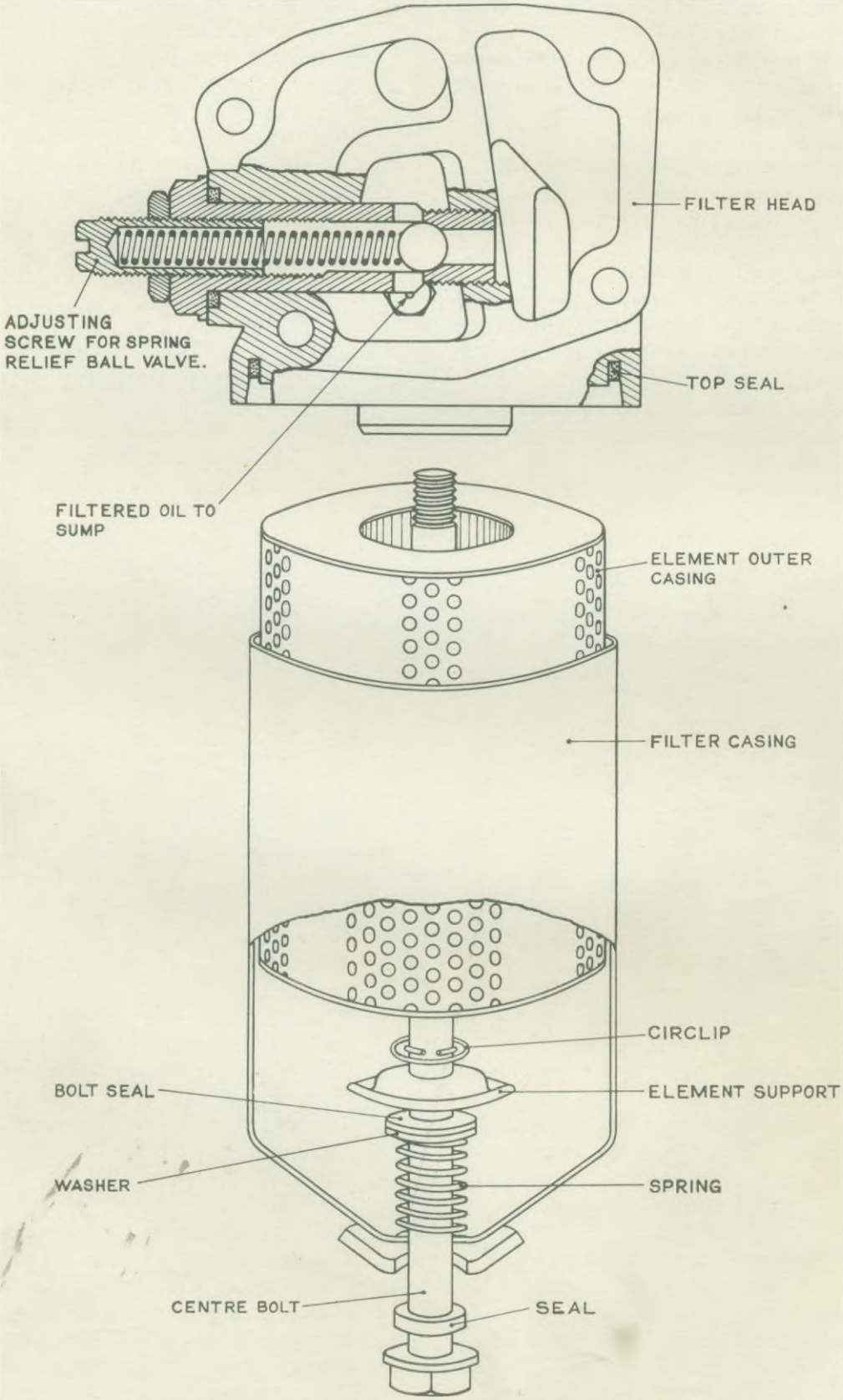


Fig. 38. Purolator "Micronic" oil filter, type MF. 5102

ENGINE MISFIRES AT LOW SPEED AND WHEN IDLING

The following possible causes for the difficulty should be investigated :—

1. Incorrect carburettor level.
2. Partially restricted main jet or pilot and its air bleed.
3. Air leaks due to badly made joints in carburettor or in its attachment to the induction manifold.
4. Badly fitting throttle valve and/or spindle.
5. Air leaks due to badly made manifold joints and defect in crankcase ventilator valve in manifold.
6. Cracked induction manifold.
7. Electrical leakages due to insulation failures.
8. Defective ignition coil.
9. Defects in sparking plugs.
10. Poor engine compressions.
11. Air leaks around inlet valves due to worn guides.
12. Incorrect contact breaker gap and bad condition of points.

ENGINE NOISES

Main bearing knock.

Main bearing knock can usually be identified by its dull heavy metallic sound which increases in frequency as the engine speed and load rises. A bearing knock is also particularly noticeable when the engine is running very slowly and consequently unevenly and is more pronounced with an advanced ignition than when this is retarded.

When main bearing knock is experienced, it can be explained by one of the following, and should be treated accordingly :—

1. Excessive bearing clearance (see Page 1).
2. Worn crankshaft journal and/or bearings.
3. Insufficient oil.
4. Low oil pressure.
5. Unsuitable grade of oil or badly diluted supply.

Crankshaft end float.

Where a knock is being caused by the development of end float, it will be found to be most noticeable when the engine is running at idling speeds. The knock caused by crankshaft end float will be found to be eliminated by operations of the clutch pedal.

Big end bearing knock.

A big end bearing knock is a lighter thud than that experienced with a loose main bearing, being evident with the engine idling and increasing when the engine speed is increased somewhat. A big end bearing knock will probably be found most noticeable at speed corresponding to 30 m.p.h. (48 km.p.h.).

The best test for a big end knock is to detach a lead from each sparking plug in turn, cutting out and reconnecting this whilst flicking open the throttle. On reconnection of lead, a light thud should be heard with the cylinder where bearing slackness or connecting rod misalignment exists and can be investigated accordingly. The following causes for big end bearing knock should be investigated :—

1. Excessive bearing clearance (see Page 1).
2. Worn crankshaft journal and/or bearings.
3. Insufficient oil.
4. Low oil pressure.
5. Unsuitable grade of oil or badly diluted supply.

Piston knock.

Piston " slap " can frequently be cut out by " shorting " the sparking plug relating to the cylinder concerned, but not in every case.

The best method of locating the offending cylinder is to engage a gear, and with the hand-brake hard on, just let the clutch in sufficiently to apply a load with the engine running at fast idling speed. By detaching a sparking plug lead and thus putting the cylinder concerned out of action, it is usually possible to cut out the knock on the offending cylinder.

Piston slap will increase with the application of load up to approximately 30 m.p.h. (48 km.p.h.) and only in very bad cases does it continue to be audible over that speed. In some cases piston slap will be evident when the engine is started up from cold, but disappears as the engine becomes warm. In such cases, it is not suggested that any adjustments are necessary.

The following causes for piston and ring noise should be investigated :—

1. Excessive piston clearance (see Page 2 for dimensions and clearances) due to wear on pistons and sleeves or an unsuitable replacement part in use.
2. Connecting rod misalignment.
3. Piston or rings striking ridge at top of sleeve after fitting a replacement. Such ridges should always be removed before fitting new parts.
4. Collapsed pistons.
5. Broken piston rings or excessive clearance in grooves.

Connecting rod small end knocks.

As the gudgeon pin with this model is able to float in the piston and the bearing, a knock may arise owing to slackness in the small end bush or the piston bosses. The knock will make itself heard either under idling conditions or at road speeds between 20-30 m.p.h. (32-48 km.p.h.).

To test for a gudgeon pin knock, cut out each cylinder in turn by disconnecting leads. The offending gudgeon pin will be identified by the fact that a double knock is caused when disconnecting the plug lead referring to the offending cylinder.

In complaints of this nature, the following possible causes should be examined :—

1. Gudgeon pin slack in connecting rod bush or piston bosses (see Page 2 for gudgeon pin clearance).
2. Misalignment of connecting rod allowing connecting rod bush to foul piston bosses.
3. A tight gudgeon pin will cause piston slap.

Noisy valve rockers or tappets.

Noise due to valve rockers may be identified fairly easily owing to the fact that as these are operated by the camshaft, which revolves at half engine speed, it will occur at a lower engine speed that most of the other engine noises. Valve rocker noise has a characteristic clicking sound which increases in volume as the engine speed rises.

Where valve rocker noise is caused by excessive clearance, it can be eliminated by the insertion of a feeler gauge between the stem of the valve and outer spring cap, in the recess provided for checking clearances, with the engine idling. Where this complaint is experienced, and is found to be caused by incorrect rocker clearances, the rockers should be adjusted as indicated on Page 21.

Push rod noise may be caused by worn or rough rocker ball pins and push rod cups.

Worn cams and tappet faces can give rise to noise which will, of course, occur at half engine speed.

Ignition knock.

An ignition knock causes a metallic ringing sound, usually occurring when the engine is labouring or accelerating. It can also be caused by over-heating.

Ignition knocks can be caused either by detonation or pre-ignition. Detonation is caused by a rapid rise in pressure in the explosive mixture, this causing the last portion of the charge in the cylinder to be spontaneously ignited, resulting in this striking the cylinder wall with a ringing sound, this noise being the familiar "pinking," well known to motorists. Pre-ignition may arise as a result of detonation owing to the heat generated thereby, but may also be caused by sharp edges or points in the combustion space and where it arises should be treated accordingly.

Where ignition knock is experienced, the following possible causes should be investigated :

1. Excessive carbon in combustion spaces.
2. Too early an ignition timing.
3. Faulty automatic advance and retard mechanism due to incorrect or weak centrifugal control springs.
4. Incorrect or faulty sparking plugs causing incandescence.
5. Sharp edges or pockets in combustion space.
6. Hot engine valves due to incorrect seating width, insufficient valve rocker clearances, unsuitable valve material, or valve edges thinned excessively by refacing.
7. Engine overheating.
8. Unsatisfactory state or grade of fuel.
9. Too weak a carburettor mixture, causing delayed combustion and consequently overheating.

Engine popping back into carburettor.

It is in order that with a cold engine popping back into the carburettor should sometimes occur, but this should cease when the engine reaches normal working temperature. If back firing persists in spite of warming up, the following possible causes should be investigated :—

1. Incorrect ignition timing (see Page 24).
2. Valves not seating properly, particularly the inlet ones.
3. Valve timing incorrect.
4. Pre-ignition due to various causes.
5. Too weak a mixture or a very rich one.
6. Air leaks into induction system, giving rise to a weak mixture.
7. Defective cylinder head gasket.
8. Poor quality fuel.
9. Incorrect wiring of sparking plugs.
10. Centrifugal advance and retard mechanism not functioning properly.

EXCESSIVE ENGINE OIL CONSUMPTION

Excessive oil consumption is usually associated with a generally dilapidated engine, but can, of course, arise as a result of external leakages and due to other factors with comparatively new engines. (See also Page 51.)

Where an engine is actually burning too much oil it will be indicated by the emission of bluish grey smoke from the exhaust when the engine is " raced " up after a period of idling.

If excessive oil consumption is established before commencing to dismantle the engine, a check for external leakage should be carried out. This check can be conveniently carried out by spreading paper on the garage floor underneath the forward part of the car and running the engine for a few minutes at fast idling speed. In this way it will be possible to locate the position of serious leaks which, without the engine running, otherwise would not be evident.

The following possible causes of excessive oil consumption are recommended for attention as necessary :—

1. External leakages caused by one or more of the following :—
   (a) Poor sump packing or cracked pressing.
   (b) Flanged face of sump not true.
   (c) Drain plug loose or defective plug gasket.
   (d) Defective filter bracket packing or loose securing bolts or poor joint faces.
   (e) Timing cover oil seal defective.
   (f) Rear oil seal defective or badly fitted.
   (g) Poor timing cover gasket or loose securing bolts. Cracked timing cover.
   (h) Valve rocker cover gasket defective or distorted flanged face.
   (i) Petrol pump insecurely mounted or defective packing.
   (j) Defective front engine plate packing or joint faces.
   (k) Oil pressure gauge pipe line leaking.
   (l) Leakage round camshaft welch plug.
2. Unsuitable grade of oil being used or excessive dilution of this.
3. Employment of too high an oil level.
4. Excessive oil pressure.
5. Arduous driving conditions.
6. Excessive piston clearances in sleeves due to incorrect replacement or wear in sleeves and on part itself.
7. Worn or damaged piston rings.
8. Piston rings stuck in grooves.
9. Excessive vertical movement of piston rings in grooves due to wear or unsuitable replacements.
10. Insufficient piston ring end gap (see Page 2).
11. Piston rings exercising insufficient radial pressure.
12. Excessive diameter and axial clearance due to wear associated with the possibility of oval and worn crankpins.
13. Excessive diameter clearance in main bearings and/or worn journals (see Page 1 for dimensions and clearances).
14. Excessively high crankcase temperatures.

Low oil pressure.

The correct oil pressure is 40-60 lbs. per square inch for top gear for road speeds between 30-40 m.p.h. (48-64 km.p.h.). With complaints of low oil pressure the following possible causes should be investigated :—

1. Insufficient oil in engine sump.
2. Use of an unsatisfactory grade of oil.
3. Oil supply badly diluted.
4. Suction oil filter restricted owing to dirty sump oil.
5. Oil release valve out of adjustment.
6. Dirt or grit on release valve seating.
7. Broken or weak release valve spring.
8. Oil pump packing defective or unit securing nuts loose.
9. Badly worn and damaged oil pump rotors or spindle shaft.
10. Loose external oil filter bracket or defective packing washer ; poor joint faces.
11. Loose connections on pressure gauge pipe or defective pipe line and/or flexible connections.
12. Worn engine bearings and/or crankshaft journals and pins.
13. Incorrect oil pressure gauge.

High oil pressure.

1. Use of too heavy a grade of oil.
2. Faulty adjustment of oil pressure gauge, stuck oil pressure release valve or too heavy a relief valve spring.
3. Faulty oil pressure gauge.

MISCELLANEOUS ENGINE NOISES

A number of engine knocks and noises will be experienced which are not covered in this manual, as it is obviously impossible to predict all the possible causes for complaint in this connection.

In view of the possibility of elusive knocks and noises being experienced with an engine unit, the wise repairer will have some form of sound detector available to assist in the location of such sounds.

REMOVAL OF ENGINE

Removal of the engine from the car should be carried out in the following manner :—

1. Remove front carpets. Disconnect one lead from accumulator to break electrical circuit.
2. Disconnect thermometer capillary tube from engine, and petrol pipe from pump. Detach heater connections where fitted.
3. Withdraw the 19 setscrews and the 5 which secure pedal plates, after first disconnecting the dipper switch from the toe-board and likewise the wire fitted to the throttle lever. The removal of the floor pressing requires detachment of seat frame from runners by removal of six nuts and withdrawal of four bolts securing seat adjuster. The withdrawal will be best arranged by pushing the front of this pressing downwards and raising the rear subsequently manipulating it past the brake and clutch pedals.
4. Detach the six bolts (three on each of two brackets) which secure the bonnet to the hinge mechanism and remove the assembly.
5. Disconnect top and bottom water hose connections, the three bolts on each side flange of radiator block and lift out assembly.
6. Detach propellor shaft from gearbox flange by removing four bolts and Simmonds self-locking nuts.
7. Disconnect speedometer cable from gearbox by unscrewing knurled collar.
8. Disconnect the two change speed operating shafts from their attachment to the selector levers, by withdrawing the two bolts from each extremity of the " T " shaped flanges, and then push these shafts outwards towards the chassis frame to provide clearance.
9. Disconnect clutch rods from their attachment to the levers on the clutch housing and tie them together out of the way.
10. Remove front section of the exhaust downpipe by detachment of four nuts on the flange joint and the pinch bolt gripping the rear end of the pipe.
11. Withdraw the two bolts securing the extension flanged bracket to the rubber mounting on the chassis cross member.
12. Remove the two engine bearer bolts, one on each side member bracket ($\frac{9}{16}$" A/F spanner), and detach earthing wire.
13. Remove starter motor.
14. Remove the engine by employment of a double sling, one round the fan pulley and the other round the back of the unit as shown in Fig. 39. Alternatively, employ lifting bracket as illustrated by Fig. 40 after removal of rocker cover. The removal of the engine and gearbox will require a certain amount of manipulation if overloading of the gearbox extension, by its pressure on the cross member, is to be avoided when lifting, as it is necessary to clear body details. The removal of the engine will be facilitated by raising the back of the car from floor level. A suitable lifting bracket, as shown in Fig. 40 may be obtained from Messrs. V. L. Churchill & Co.

TO DISMANTLE ENGINE.

1. Detach the clutch housing and then withdraw the clutch from the flywheel after removal of the six $\frac{1}{2}$" A/F headed setscrews. Remove starter motor where still fitted—after withdrawal of two $\frac{3}{8}$" bolts ($\frac{9}{16}$" A/F).
2. Remove the flywheel by complete withdrawal of two of the four $\frac{5}{8}$" A/F headed setscrews and partial slackening of the other two and employment of two levers as shown in Fig. 41.
3. Remove air filter and two brackets by which it is attached to the rocker cover and cylinder block.
4. Remove carburettor and composition packing by detachment of two $\frac{5}{16}$" nuts ($\frac{1}{2}$" A/F) and spring washers, after detachment of suction pipe.
5. Detach fuel pump and packing after removal of two $\frac{5}{16}$" setscrews ($\frac{1}{2}$" A/F) and spring washers.
6. Remove crankcase ventilator adaptor from cylinder block and that screwed into induction manifold.
7. Withdraw rocker cover and gasket after removal of two self-locking nuts ($\frac{1}{2}$" A/F), two fibre and two plain washers.
8. Remove coil and high and low tension leads from distributor.
9. Remove sparking plugs after detachment of distributor leads.
10. Remove distributor complete with cover and sparking plug leads by removal of suction pipe and two nuts ($\frac{7}{16}$" A/F) and spring washers. Do not slacken clamp bolt so that

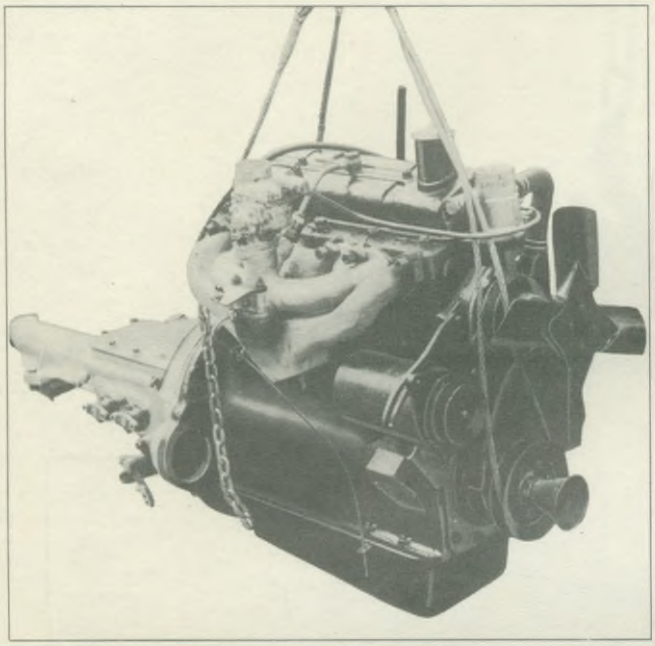


Fig. 39. Correct position of sling for engine lifting

ignition timing may be preserved for reassembly, which can be arranged owing to the offsetting of driving dogs (see instructions on Page 14 for reassembly).

11. Remove distributor drive shaft and helical drive gear.
12. Remove thermostat assembly, hose pipe and thermostat packing after withdrawal of two nuts ($\frac{1}{2}$" A/F).
13. Remove water pump amd packing after withdrawal of three $\frac{3}{8}$" bolts, with $\frac{9}{16}$" A/F heads.
14. Withdraw inlet and exhaust manifolds and gaskets after removal of eight nuts ($\frac{9}{16}$" A/F), and two bolts ($\frac{9}{16}$" A/F).
15. Remove oil filter assembly and packing after withdrawal of four bolts ($\frac{1}{2}$" A/F), and pressure pipe.
16. Withdraw dynamo and bracket after removal of three setscrews and one bolt ($\frac{1}{2}$" A/F). Remove dynamo pedestal ($\frac{7}{8}$" A/F and $\frac{13}{16}$" A/F nut).
17. Remove starter dog nut and handle guide and fan pulley after disengaging tabwasher and unscrewing with a $1\frac{7}{16}$" A/F open-ended spanner. The fan pulley can be extracted with Churchill Tool No. 6312 with "V" shaped claws, as shown in Fig. 21 for fan extension. Note the shims between crankshaft sprocket for gear alignment and those between megaphone attachment and tabwasher for starting handle relation to compression.
18. Remove timing cover with chain tensioner and cover packing. The chain tensioner can be removed if necessary after withdrawal of split pin and distance washer.
19. The oil seal may be removed from the timing cover if the necessity to replace this arises, noting the inward position of the lip of the seal for replacement.
20. Note the radial scribed markings on the face of the camshaft and crankshaft timing wheels, when No. 1 is on T.D.C. of the firing stroke. These markings, when produced in both directions, should pass through the centre of each wheel. A centre punch mark is made on the face of the camshaft wheel adjacent to a similar marking made on the end of the camshaft through a setscrew hole. If these markings are matched up on reassembly, the correct valve timing will be ensured. The appropriate markings are shown in Fig. 19.
21. Remove camshaft timing wheel and timing chain after withdrawing two setscrews with $\frac{1}{2}$" A/F spanner, and also tap off crankshaft timing wheel and place aside shims for reassembly of latter wheel.
22. Withdraw the two Woodruff keys from crankshaft.
23. Remove rocker shaft assembly and push rods after unscrewing four $\frac{9}{16}$" A/F nuts securing pedestal brackets.
24. Remove the combustion head after withdrawal of the ten $\frac{11}{16}$" A/F nuts afterwards removing studs.
25. Remove the eight tappets.
26. Withdraw engine sump and packing after removal of nineteen $\frac{5}{16}$" setscrews employing a $\frac{1}{2}$" A/F spanner.
27. Remove camshaft flanged front bearing by withdrawal of two $\frac{5}{16}$" setscrews employing a $\frac{1}{2}$" A/F spanner, and extract camshaft.
28. Remove two halves of rear oil retainer by withdrawal of the eight $\frac{1}{4}$" setscrews ($\frac{7}{16}$" A/F spanner).
29. Withdraw pump assembly after removal of three $\frac{7}{16}$" A/F nuts and spring washers.
30. Remove front engine plate and packing after withdrawal of four $\frac{5}{16}$" setscrews and spring washers with a $\frac{1}{2}$" A/F spanner.
31. Remove three bearing caps with bottom halves of precision type bearings and thrust washers after unlocking tabwashers and unscrewing six $\frac{1}{2}$" setscrews with $\frac{11}{16}$" A/F spanner.

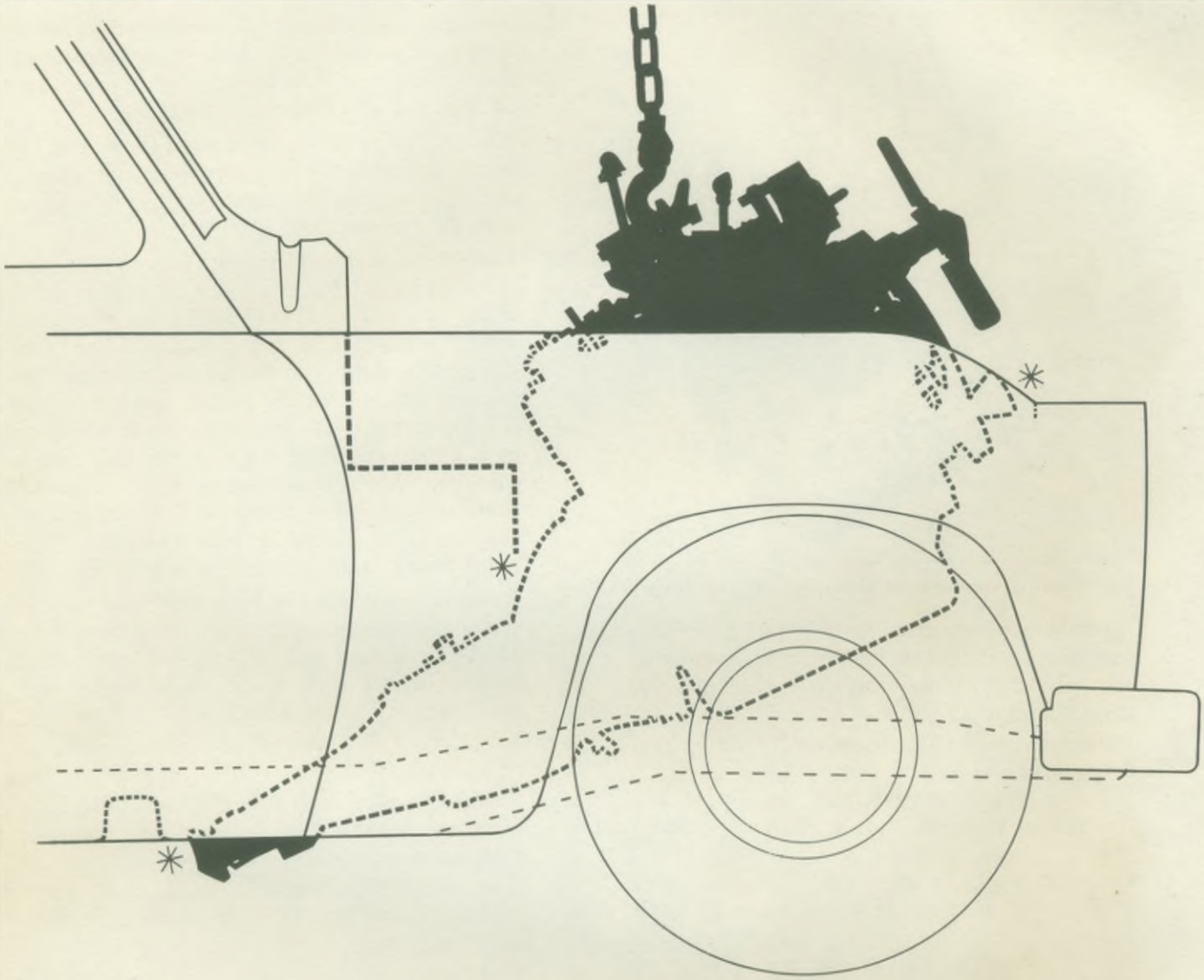


Fig. 40. Removing engine unit with special lifting hook. The asterisks show the points which necessitate the angle of tilt for withdrawal.

32. Withdraw pistons and connecting rod assemblies with cylinder sleeves after removing the big end bearing cap securing setscrews employing a $\frac{7}{16}$" A/F spanner. The eight bushings for the connecting rod bolts should be put aside for reassembly into the rods with the caps when the sleeves have been withdrawn from the engine to avoid their being mislaid.
33. Remove top halves of main bearings and crankshaft. Note relation of numbers on bearing caps with those punched on the cylinder block face.

ASSEMBLY OF ENGINE

The following procedure should be adopted :—

1. Having ensured that the aluminium core plugs at each end of the oil gallery are in position and in good order, and the welch plug at the rear end of the camshaft is similarly fitted, fit the upper halves of the main bearing shells.
2. Shellac face for top half of oil seal and install.
3. Drop the crankshaft into position on the bearings, threading the two bottom halves of the thrust washers into position on each side of the centre main bearing housing. Note location of bearing cap numbers in relation to those on cylinder block flange as shown in Fig. 42.
4. Shellac bottom half of rear oil seal and install with rear bearing cap. (See also Page 51.)

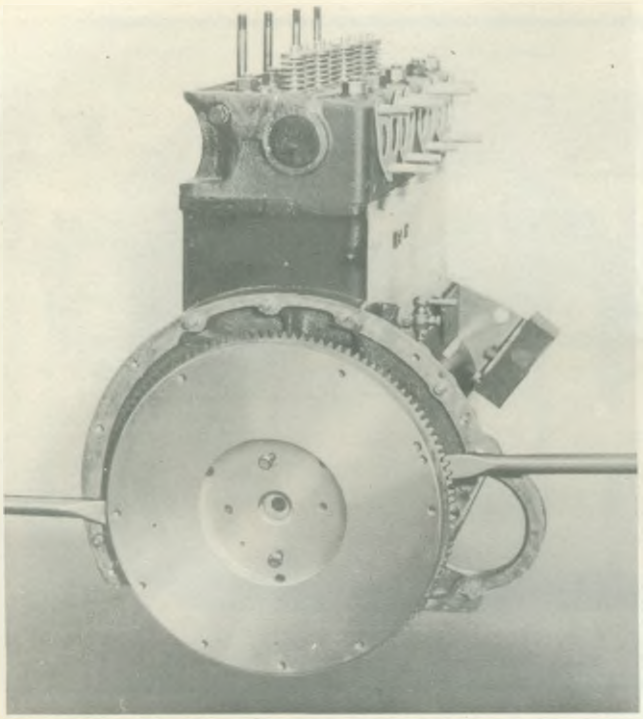


Fig. 41. Method for removal of flywheel

5. Ensure that the two halves of the seal make a proper joint at each extremity, and fit flush with the cylinder block face. (Nut torque 8-10 lbs./ft.)
6. Fit the other two bearing caps with the bottom halves of the thrust washers located on each side of the centre cap.
7. Secure the three bearing caps with $\frac{1}{2}$" setscrews and spring washers ($\frac{11}{16}$" A/F spanner required). Nut torque 90-100 lbs./ft.)
8. Check end float in crankshaft and ensure that this is .004" to .006", selecting thrust washers where necessary to ensure the requisite float, or alternatively rubbing the steel back down on a piece of emery cloth placed on a surface plate to provide the necessary end clearance.
9. Fit front main bearing sealing block and filling pieces, using jointing compound liberally to ensure oil tightness. Tighten up the two round-headed $\frac{5}{16}$" setscrews utilizing a substantial screwdriver, or better still, the proper tool prepared by Messrs. V. L. Churchill & Co. and illustrated elsewhere in this manual. Ensure flush relation of sealing block with cylinder face.
10. Force felt strips into the recess on either side of rear main bearing housing and apply jointing compound to these annular recesses. A special punch, with a blunt nose and about $\frac{3}{16}$" square in section, can be conveniently used for the driving these felts into position. It will be found that about eight pieces of $\frac{3}{4}$" length × $\frac{5}{16}$" section felt will be required to fill each recess. (See also Page 51.)
11. Assemble pistons on to connecting rods in such a way that the split portion of the piston skirt faces towards the cap side of the rod (see Fig. 3). The connecting rod and piston assembly should then be fitted into the respective cylinder sleeves, utilizing a piston slipper for the purpose. The centre line of the connecting rod cap should be in diametrical relation to an opposed pair of flats on each cylinder sleeve upper flange.
12. All roughness should be removed from the cylinder liner spigot faces and after wiping these clean they should be lightly coated with jointing compound for the spectacle packings. Position the two packings in the cylinder block.
13. Having fitted the figure of eight packings, the cylinder sleeves with the piston and con rod assemblies in position should be fitted into the cylinder block so that the con rods line up with the caps towards the camshaft side of the engine, thus placing the split away from the point of maximum thrust. It will be seen that there are two positions in which the sleeves can be fitted, pairs of flats being provided at 90°, thus, after a period of service, an alternative position of a liner may be provided to deal with piston slap, caused by light wear.
14. It is particularly important that after fitting the sleeves into the cylinder block, the engine should not be turned until some method has been employed to prevent the sleeves moving in relation to the cylinder when the engine is turned. This can be done by employing two special retainers manufactured for this purpose by Messrs. V. L. Churchill & Co. (see Fig. 20). If this precaution is not taken and the engine rotated, the liners will rise from their contact with the figure of eight packings and in most cases damage these joints. A worthwhile precaution is the application of jointing compound to the underside of the figure of eight packing.
15. Fit bearing caps with the bottom half of the shells to the respective rods (the bearing caps, if previous instructions have been regarded, will face to the right of the engine, viewed from the front end of this unit.) Fit

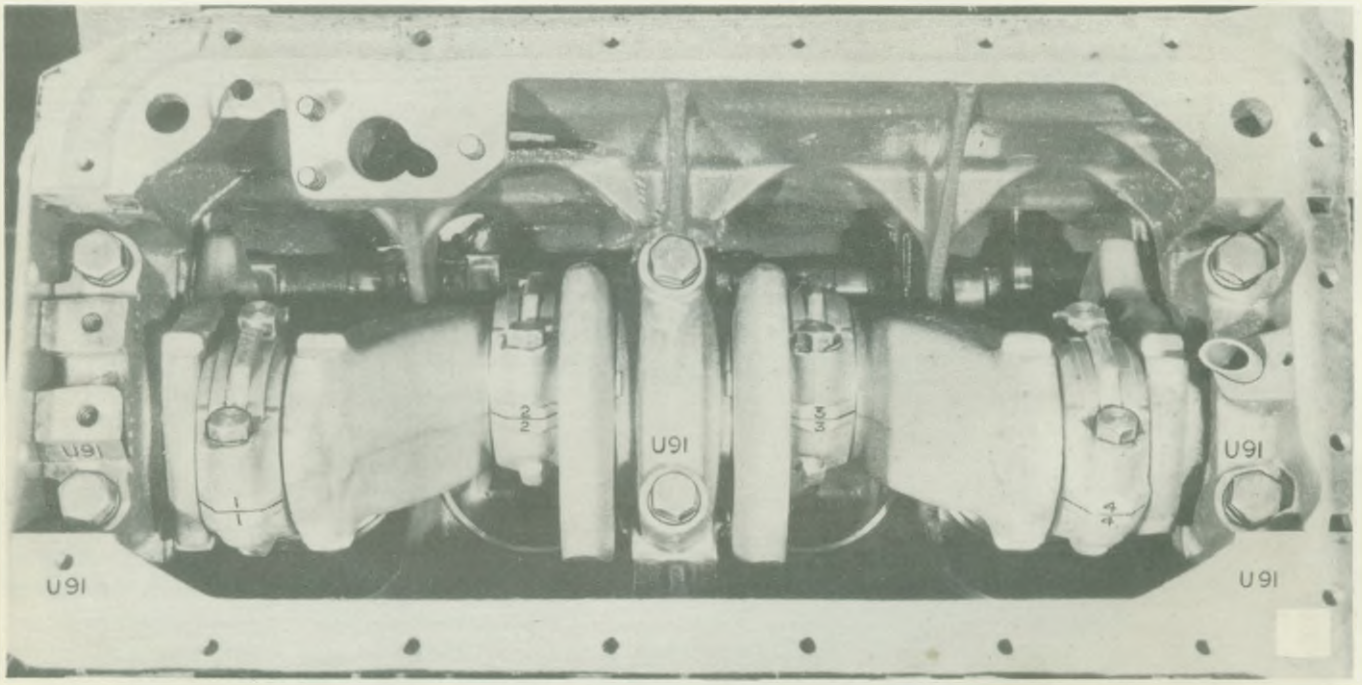


Fig. 42. Showing bearing cap and cylinder block markings

locking plates to setscrews ($\frac{9}{16}$" A/F spanner) Nut torques 42-46 lbs./ft.

16. Fit front engine plate packing, utilizing jointing compound. The plate is located by two $\frac{5}{16}$" dowels and secured by four $\frac{5}{16}$" setscrews and spring washers ($\frac{1}{2}$" A/F spanner).
17. Fit oil pump assembly, securing wih three studs and nuts, locked by spring washers ($\frac{1}{2}$" A/F spanner).
18. Fit two oil seal retainers on the rear of the cylinder block with the eight $\frac{1}{4}$" setscrews and spring washers ($\frac{7}{16}$" A/F spanner).
19. Fit dowel in crankshaft having regard to the markings on the flywheel.
20. Fit flywheel on to crankshaft spigot so that the arrow marking on its periphery lines up with the centre of the cylinder block at 12 o'clock above the assembly when Nos. 1 and 4 pistons are T.D.C. In production, another marking 180° from the arrow is made, and indicates naturally the "top dead" position of the other two cylinders. The flywheel should be secured, utilizing the four $\frac{3}{8}$" setscrews and spring washers for the purpose ($\frac{9}{16}$" A/F spanner).
21. Fit camshaft and flanged front bearing into cylinder block.
22. Fit engine sump and packing, securing with 17—$\frac{5}{16}$" bolts ($\frac{1}{2}$" A/F spanner). The short bolt should be fitted into front sealing block.
23. Install the eight hollow tappets.
24. Fit the 10 combustion head studs which are $\frac{7}{16}$" N.F. at one end and N.C. at the other (the coarse threaded end is screwed into the cylinder block). Take care not to apply too great a leverage to studs when driving these into cylinder block, in particular the second pair of tapped holes from the rear are rather susceptible to damage if this precaution is not regarded.
25. Fit crankshaft timing wheel with necessary shims to align.
26. Fit camshaft wheel temporarily in position, partially tightening the two $\frac{5}{16}$" setscrews which are provided ($\frac{1}{2}$" A/F spanner).
27. Fit combustion head, having ground the valves in and replacing any damaged valves or springs. Tighten up cylinder head nuts symmetrically ($\frac{11}{16}$" A/F spanner) as indicated in Fig. 24.
28. Fit push rods and rocker shaft, taking care not to damage rocker shaft when fitting or to bend push rods by misplacement of outer or rocker spring caps as shown in Fig. 22.
29. Set tappet clearance to .010" on inlet and .012" on exhaust.
30. Where timing wheel markings are present, in order to set the valve timing it is only necessary to align the radially scribed lines on the faces of the two chain wheels and to turn camshaft until centre punch marks are in correct relation. In the absence of such

markings, the procedure suggested in the next two operations should be adopted.

31. Set both rockers to .014″ on No. 1 and 4 cylinders, with the outer springs removed, turn camshaft round with the chain removed until the inlet and exhaust valves on No. 1 cylinder are at the point of balance or, in other words, the inlet valve is just opening and the exhaust closing. Next turn engine to T.D.C. on No. 1 cylinder, judging this position by the relation of the arrow on the flywheel periphery with the mark on the cylinder block at 12 o'clock. (Where the engine is in chassis frame, use the hole in the crank shaft pulley and the pointer on the timing cover to find T.D.C.) Fit the timing chain around the crankshaft and camshaft chain wheels in such a manner to allow a pair of setscrew holes in the camshaft wheel to line up with a corresponding pair in the camshaft keeping the driving side of the chain tight. It will be necessary to experiment with the two pairs of setscrew holes provided in the camshaft wheel. The second pair of holes, providing a half tooth adjustment whilst turning the wheel back to front, will allow a $\frac{1}{4}$″ tooth range of variation. Fit camshaft timing wheel, securing two setscrews with $\frac{1}{2}$″ A/F spanner (see Valve Timing on Page 21). Tightening torque 24-26 lbs./ft.
32. Having set the timing as detailed in the previous operation, place engine on T.D.C. on No. 1 cylinder (nearest water pump) with both valves closed, *i.e.*, firing point. Take straight edge and lay this across faces of the two timing sprockets and scribe a line radially across faces of these two gears, thus providing the necessary timing marks for future repairs. To ensure correct positioning of the camshaft for future timing operations, make a centre punch mark on the end of the camshaft through a setscrew hole and similarly mark the face of the camshaft wheel adjacently. Having set the valve timing and marked the gears, the outer valve springs should be re-installed, taking suitable steps to avoid push rod damage. DO NOT FORGET TO RESET ROCKER CLEARANCES TO WORKING CLEARANCE OF .010″ FOR INLET AND .012″ FOR EXHAUST. PROVIDE FOR INITIAL LUBRICATION OF VALVE CAPS BY USE OF OIL CAN.
33. Fit the Woodruffe key for the fan pulley. Centralization of timing cover is ensured by two dowel pegs. Ensure the condition of the oil seal which is fitted with leather lip inwards towards the centre of engine.
34. Fit timing chain tensioner, distance washer and split pin, lock tabwasher on camshaft timing wheel. Fit timing cover joint washer, timing cover and bolt in position.
35. Fit tabwasher and starter dog, secure with dog lock tabwasher. Fit shims between tabwasher and dog nut to provide relation to cylinder compressions.
36. Fit dynamo bracket and dynamo.
37. Fit fuel pump washer and fuel pump.
38. Fit oil filter washer, filter unit and oil pressure pipe. Bolt oil pressure gauge pipe in position.
39. Fit inlet and exhaust manifold washers. Fit manifolds. Tighten up.
40. Fit paper washer and water pump.
41. Fit thermostat washer, body and hose pipe.
42. Fit distributor drive shaft and clamps and time ignition regarding the offset on the distributor dogs (see Fig. 10).
43. Set timing as detailed previously, placing engine on T.D.C. No. 1 cylinder both valves closed. Check distributor points gap which should be .010″ to .12″ fully opened. Having ensured the correct gap, which is important to give correct timing, rotate distributor in opposite direction until points just begin to separate with rotor arm opposite No. 1 segment on distributor cover. With the timing correctly set at T.D.C. and the oil pump spiral gear properly meshed with the camshaft, the rotor arm should be pointing to No. 1 sparking plug (the plug nearest the radiator). Tighten up clamp bolt and test car on road, advancing ignition as far as possible consistent with freedom from pinking. (See Electrical Section for High Lift Cam.)
44. Fit sparking plugs and connect leads from distributor.
45. Fit coil and H.T. lead to distributor.
46. Fit crankcase ventilator adaptor in rocker cover.
47. Fit rocker cover, washer and cover.
48. Couple ventilator pipe and rocker cover to adaptor in manifold.
49. Fit carburettor and return spring and bracket.
50. Fit clutch assembly.
51. Fit air cleaner clips and air cleaner brackets and air cleaner. Do not finally tighten cleaner

bracket and nuts until cleaner has been mounted on carburettor to avoid damage to this component due to slight misalignment.

52. Fit ventilator pipe from sump to rear of air cleaner.
53. Fit gearbox.

GENERAL MAINTENANCE HINTS

If a car is to give a good performance and the maximum efficiency and economy is to be obtained, there are certain points with regard to the engine and its ancillaries which should be watched and these are set out below. These attentions should be dealt with in accordance with the day-by-day mileage. For average motoring six monthly inspections are recommended.

Engine compression.

An engine which lacks compression cannot develop its proper power and a periodic test of compression should therefore be carried out by either employing a proper compression gauge, or alternatively judging this by manual means with the starting handle. Cylinder compressions should be equal and if there is an appreciable difference in these, steps to investigate—such causes as poorly seated valves, broken or weak valve springs, sticking valves, improper rocker adjustment (these should be .010" exhaust and .012" inlet cold), worn pistons, rings and/or cylinder sleeves, etc.—should be taken.

Ignition system.

Notes on Sparking Plugs

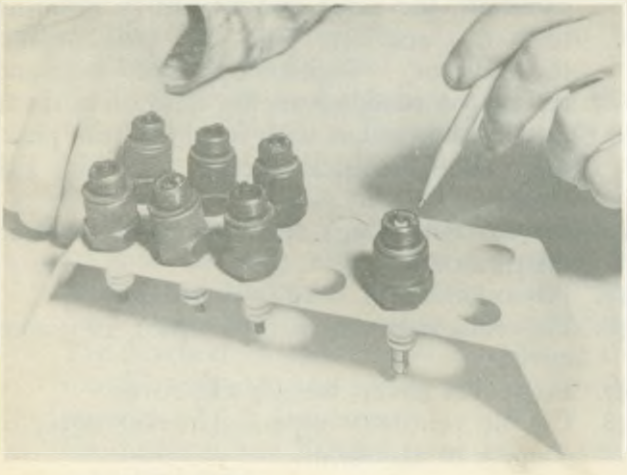


Fig. 43

1. **When sparking plugs are removed from the engine, remove their gaskets with them.** Place the plugs and gaskets in a suitable holder identifying each plug with the cylinder number. The tray shown above is a simple construction with holes drilled to admit the upper end of the plugs. Place a new plug of the proper type beside the others to afford a comparison of relative condition of the plugs in use, to the new plug.

Fig. 44

Fig. 45

2. **Look for signs of oil fouling, indicated by wet, shiny, black deposit on the insulator.** Oil pumping is caused by worn cylinders and pistons or gummed-up rings. On the suction stroke of the piston, oil vapour from the crankcase is forced up past the worn rings, where it fouls the plugs and causes sticking valves, with resultant waste of petrol. On the compression stroke, the mixture of oil and petrol vapour is forced past the rings into the crankcase again, contaminating the oil and turning it black with carbon. Carbon deposits in the combustion chamber are formed from burning oil vapour and cause " pinking."
3. **Next, look for petrol fouling indicated by a dry fluffy, black deposit.** This is caused by many things—faulty carburation, ignition system, defect in battery, distributor, coil or condenser, broken or worn-out cable. The important thing is for the petrol consumption to be improved and the customer satisfied. If plugs show suitability for further use, proceed to clean and test.
4. **In preparing for cleaning, remove plug gaskets, and in doing so ascertain their condition.** Note the gaskets illustrated. Upper left shows a gasket not properly compressed. A large proportion of the heat from the insulator is dissipated to the

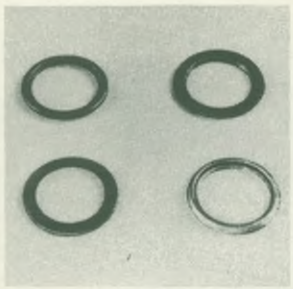


Fig. 46

Fig. 47

cylinder head by means of the copper gasket between the plug and the cylinder head. Plugs not down t ght can be easily overheated, throwing them out of the proper heat range, causing pre-ignition, short plug life and bringing about so-called " pinking." Don't tighten plugs too much—but be reasonably sure a good seal is made between plug and cylinder head. Lower left shows a gasket on which the plug was pulled down too tight, or had been too long in service. Note the distorted condition. Note evidence of blow-by, also a cause of plug over heating and resulting dangers. Upper right shows a reasonably compressed gasket giving the plug adequate seal and a good path for heat dissipation. All may be compared with the new gasket, at lower right. If gaskets are at all questionable they should be replaced by new gaskets.

5. **Occasionally a blistered insulator or badly burned electrode may be noted when examining plugs.** If the plug is the type normally recommended for the engine and was correctly installed, i.e., down tight on the gasket—the condition may have been brought about by a very " lean " mixture, or overheated engine. It is well to remember that plugs operating in the condition described above are often the cause of poor engine performance and extravagant petrol consumption. It may be, however, that a plug of a " colder " type is required.
6. **After cleaning, examine plugs for cracked insulators or insulator-nose worn away through continued previous cleaning.** In this case we should recommend that the plugs have passed their point of useful life and new plugs should be installed. Look for a deposit on the insulator, under side electrode, which may accumulate heat and act as a " hot spot " in service.
7. **After cleaning and blowing surplus abrasive out of shell recesses** and off plug threads by means of " blow out " nipple—examine threads for carbon accumulation. Use a wire brush to remove carbon and clean the threads. A wire buffing wheel may also be utilised ; however, use reasonable care in both operations in order not to injure electrodes or insulator tip. The threaded section of plug shell is often neglected in plug cleaning, even though, like the gaskets, these threads form a means of heat dissipation. When threads are coated with carbon, it retards the even flow of heat to the cooling medium, thereby causing overheating. (When installing plugs, this simple procedure will ensure no binding of threads and avoid unnecessary use of plug spanner.) Screw the plug down by hand as fas as possible, then use spanner for tightening only. Always use a box spanner to avoid possible fracture of the insulator.

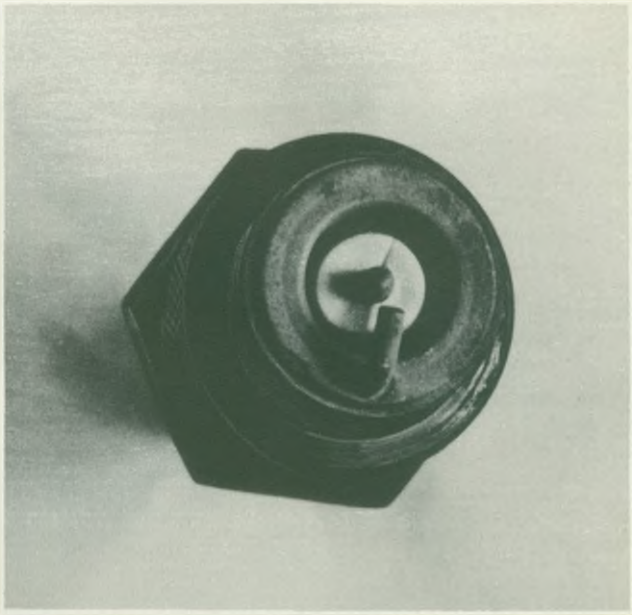


Fig. 48

8. **Next, we are ready for resetting the electrodes.** Remember that electrode corrosion and oxides at gap area vitally affect spark efficiency. The cleaner can remove the oxides and deposits from the insulator, but because of gap location, the cleaner stream cannot always reach this area with full effect, also, the tenacious adhesion of corrosion, etc., would require too much subjection to cleaner blast for removal. Therefore, when plugs are worthy of further use, it is sometimes good practice to dress

the gap area, on both centre and side electrodes, with a small file before resetting to correct gap.

Resetting of electrodes should be part of service during useful life of the plugs. However, the strains of intense heat, pressure mechanical shock, electrical and chemical action, during miles of service, wreak such havoc on the electrodes that molecular construction is affected. Plugs reach a worn-out condition and resetting can serve a good purpose only for a time. When gaps are burned badly, it is indicative the plug is worn to such an extent that further use in unwarranted and wasteful. When resetting, bend the Side Wire only, never bend centre electrode as this may split the insulator tip.

Fig. 49

Fig. 50

9. **Inspect for leakage after testing,** by applying oil around the terminal. Leakage is indicated by the presence of air bubbles, the intensity of which will serve to show degree of leakage. Leakage throws the plug out of its proper heat range, as the hot gas escaping has a " blow torch " effect on the plug, causing compression loss, pre-ignition, rapid electrode destruction and overheating of the insulator tip.

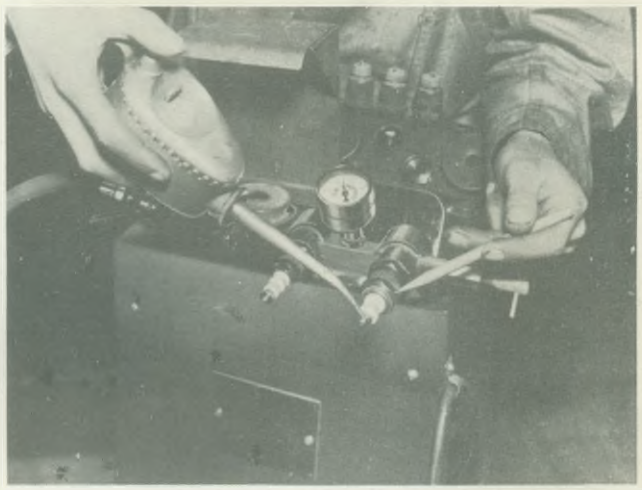


Fig. 51

10. **New gaskets have been fitted to the plugs** and the general improvement in appearance is apparent now that the plugs are ready to be installed in the engine. It requires no imagination to know that improved engine performance, better petrol consumption and satisfaction will result. The use of the stand (as illustrated) is evidence of your careful handling of the plugs.

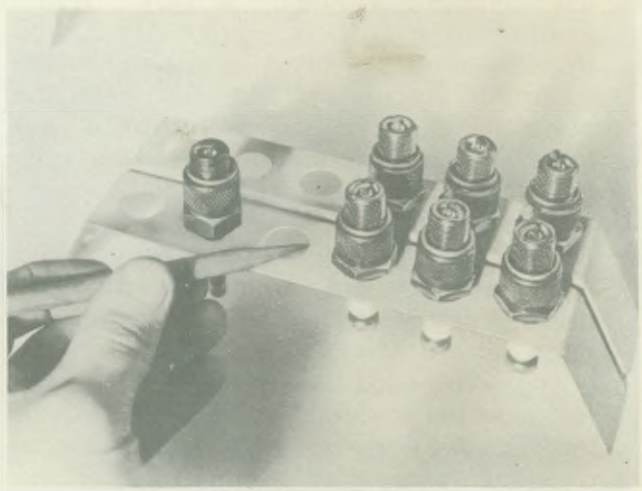


Fig. 52

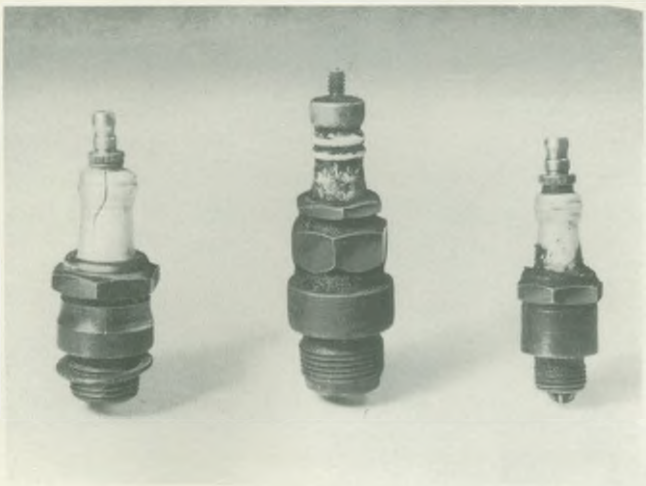
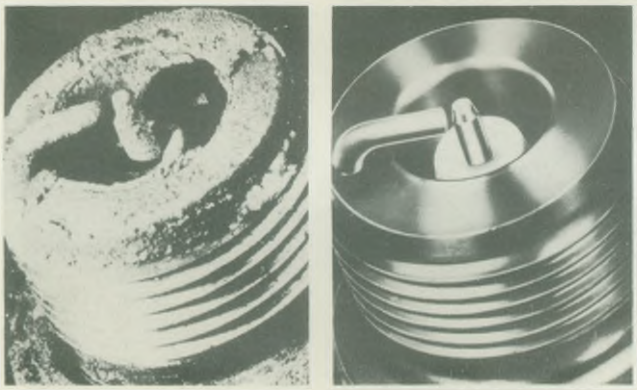


Fig. 53

11. **The top half of the insulator is often responsible for causes of poor plug performance,** namely, paint splashes, accumulation of grime and dust : cracked insulators caused by slipping spanner, or overtightening of terminals. Examine for cracked insulators at shoulder and terminal post. Remove grime and dust. Recommend inspection, cleaning and testing every 3,000 miles.



An unretouched photograph of a CHAMPION Sparking Plug after 25000 miles of service, compared with a new plug. The weak spark given by the former can readily be imagined and amply justifies our recommendation that to save petrol, plugs should be changed before such a stage of wear, as that shown in the photograph is reached

Fig. 54

Clean and replace sparking plugs periodically as necessary. The correct gap for the " Vanguard " plugs should provide a gap of .030" to .032", the Champion L 10 ½" reach plug being specified. The normal efficient life of a sparking plug is 10,000 miles, after which, if full efficiency and economy is desired, the plugs should be replaced by new ones of the type specified.

The distributor cap and rotor should be periodically examined for cracks which will allow electrical leakages.

The contact breaker points should be examined each 5,000 miles, when normal lubrication of this part of the car is recommended, and where these have become burnt or pitted they should, if possible, be squared up with a piece of carborundum stone, so that when the points are closed they fit flush against each other. If the points have become seriously worn they should be replaced by new items. The points should be properly set to provide a gap of .010" to .012" when fully open. (High lift cam .014" to .016".) this is in excess of .010" the assistance of the local

The condenser wiring and the low and high tension circuits should be ensured, as should the automatic advance and retard mechanism. Similarly the coil should be ensured.

The ignition timing should be checked and if necessary reset. The normal setting should allow the pointer on the scale shown in Fig. 28 to be in a central position, but in many cases it will be found that a more advanced position can be used without " pinking " and, indeed, the most advanced position consistent with freedom from knocking is recommended. To alter the ignition, it is merely necessary to slacken off the two nuts and to make small arcuate movements of the distributor head towards the marking " A " on plate to advance or vice versa. After an alteration to the ignition timing, the car should always be tested on the road.

Where it is necessary for any reason to fit a new distributor head this can be done as follows :—

Turn the engine round by the starting handle until No. 1 piston is at the top of its stroke (this position may be found by the employment of the hole in the fan pulley flange) and both valves are closed in this position, the slot in the helical gear boss which engages with the dog on the distributor shaft should be inclined at approximately 53° from the vertical position as shown in Fig. 10 with the slot offset towards the rear of the engine.

Accumulators.

The condition and state of charge should be checked at reasonable intervals of time as is recommended in the Electrical Section. Attention should be paid to the possibility of loose connections and corroded terminals. Terminals should be cleaned off and coated with vaseline.

Electrical wiring, dynamo and starter.

The condition of the wiring and the electrical connections under the bonnet should be inspected each six months, as should the operation and condition of the starter motor and dynamo.

Cooling system.

The water circulation and operation of the water impellor and thermostat should be investigated every six months.

Manifold system.

Quite apart from the scheduled first servicing operations, which are carried out free for the retail customers by the vendor, it is important that a six monthly check of the tightness of manifold nuts should be made. The tightening up of these nuts should be carried out with the engine cold in a symmetrical manner.

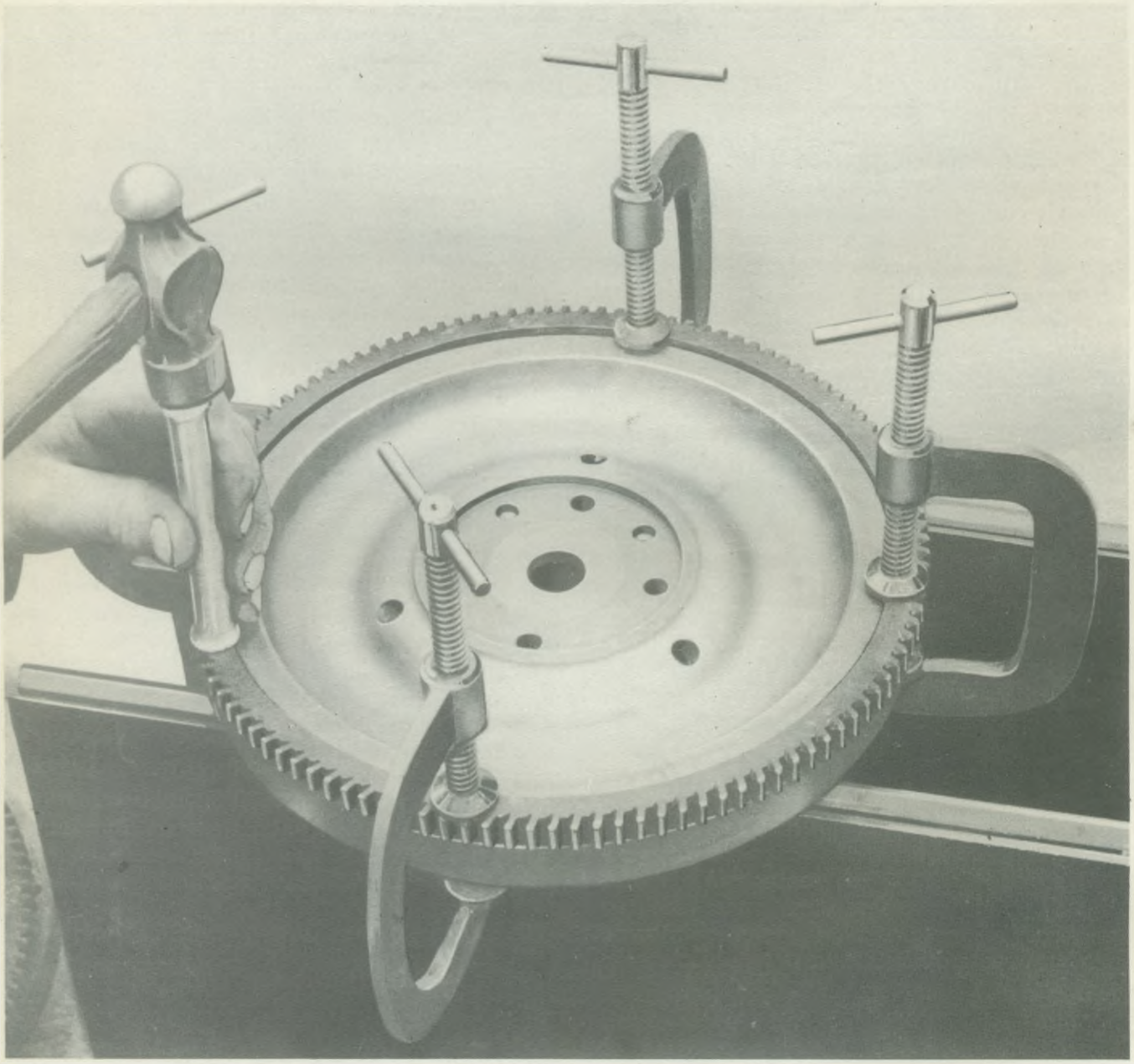


Fig. 55. Indicates the use of " G " Clamps when fitting new starter ring

Petrol system.

Clean out the petrol pump replacing the cork gasket if suspicion as to is condition exists. Ensure that the pump pressure is adequate if facilities exist for testing the pump against a pressure gauge, a figure of 1¼ to 2½ lbs. should be registered.

The accelerator controls and linkage should be checked periodically with a view to ensuring that a full range of throttle movements is obtained.

The carburettor should be cleaned out thoroughly and the various jets blown out with compressed air, the use of pieces of wire to clean these out should be avoided.

The carburettor float should be examined for possible leaks and if such exist a replacement should be fitted as soon as possible in the interests of economy and performance.

The carburettor flange joints should be checked and, where necessary, such as where the carburettor is dismantled, new flange joints should be fitted. Having dealt with the possibility of air leaks to the induction system as recommended above, the carburettor volume control and throttle stop should be reset as described for the carburettor in " Fuel System."

Fitting replacement starter rings.

Where it is necessary to fit a replacement starter ring, certain precautions are required if its future life and hardness characteristics are to be ensured.

The method for fitting these ring gears without any danger of destroying the heat treatment is described below and its adoption will assist in ensuring the future life of the ring gear.

The engines fitted to the early Standard and Triumph Roadster Models were equipped with a starter ring ⅜" in width. The ½" wide starter ring, at present fitted, was introduced at Engine No. V.9881E with the Standard Models and at TRA.616E with the Triumph Roadster. All the 2-Litre Triumph Saloon Cars are fitted with the wider ring.

Where it is found necessary to replace one of the ⅜" rings it will become necessary to increase the depth of the flywheel spigot to ½" to accommodate the new gear. A flywheel and starter ring assembly may be obtained under our Service Exchange Scheme, where a repairer is not equipped to carry out the necessary machining of the flywheel to accommodate the wider ring.

The method of fitting the replacement ring gear involves the employment of four " G " clamps as indicated in Fig. 55. The installation of the ring can be quite easily carried out whilst cold, but the immersion of the ring in boiling water or the raising by other means to that temperature will assist somewhat in the operation, but greater heating than this is not recommended.

Before refitting the starter motor, the armature should be checked for end float. Where this is in excess of .010", the assistance of the local Lucas Agent should be sought with a view to having the existing starter motor adjusted, or in supplying a reconditioned unit.

The flywheel should be placed on a solid base and the ring gear offered up squarely and the most favourable position for its entry on the spigot selected and then the four " G " clamps should be fitted equally spaced around the circumference of the ring as shown in illustration The ring gear should then be tapped lightly on to the spigot with a soft metal drift, taking care to keep it square and to follow its progress on to the spigot by tightening up the " G " clamps.

Having thoroughly started the ring on the spigot, the " G " clamps can be dispensed with and the gear driven fully home against its flange on the flywheel.

Pressure oil filter assembly.

Early models of the Vanguard employed the Tecalemit Oil Filter Assembly, which is a full flow type of filter. A change over to the Fram Filter was made at Eng. No. V.312E, this type being of the by-pass variety, it being described in detail earlier in this Section. Yet another change in filter was made at Eng. No. V.89332E on standard models, when the Purolator was introduced, this also being of the by-pass type. The change to a Purolator filter was made on the Triumph Renown at Eng. No. TDB.2725E. The Purolator type of filter is still in use with Series II models and current Triumph Renown cars.

Oil filter elements.

It is most important that only the element designed for the filter which is fitted is used when fitting a replacement. Failure to regard this instruction may lead to serious engine damage.

Attachment of oil filter assembly.

Four bolts were used for the attachment of this assembly to the cylinder block up to Engine No. V.179369 and Engine No. TDC.1567, for the Standard and Triumph models. With this arrangement spring washers are fitted to three of these bolts and on the bolt which secures the

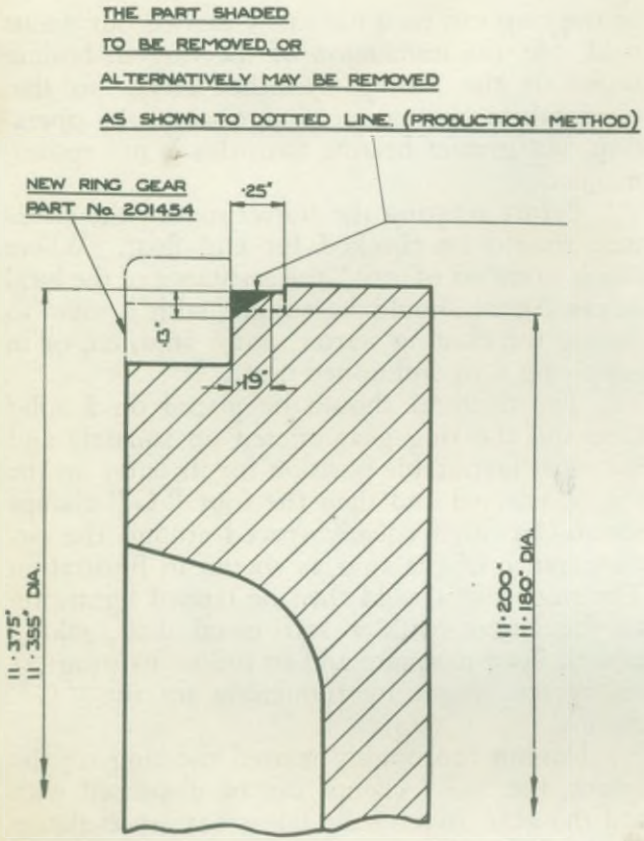


Fig. 56. Showing modifications required to flywheel to accommodate 8/10 pitch starter gear

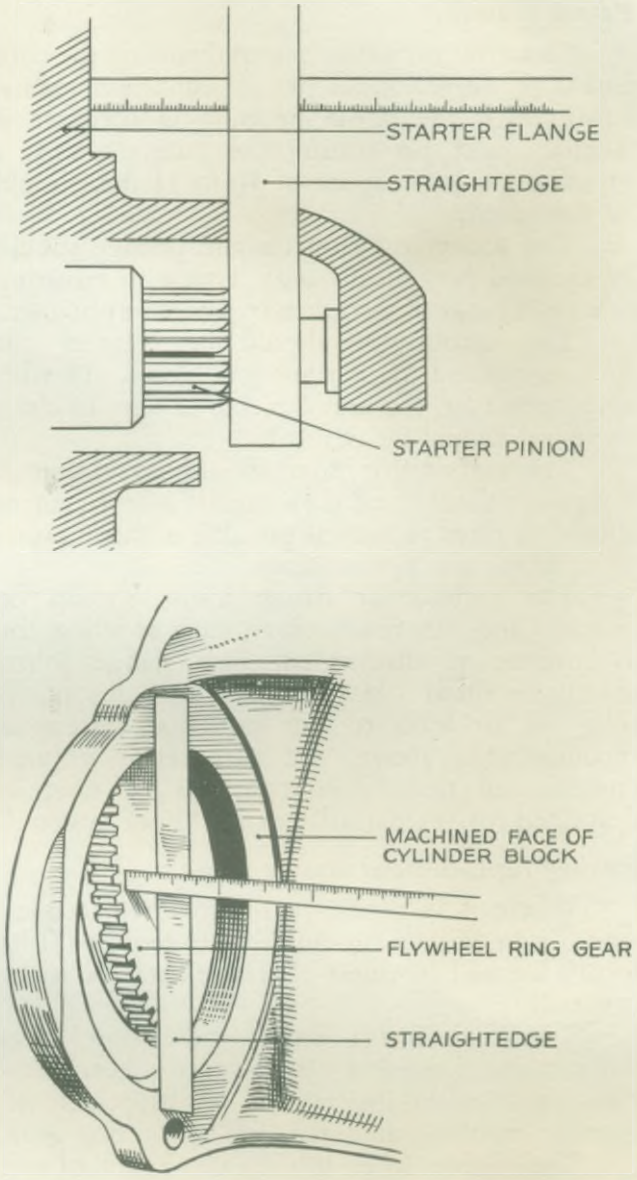


Fig. 57. Upper illustration shows dimension "B" being measured, the lower sketch shows the measurement of dimension "A"

pressure pipe banjo two copper washers only are used, one on either side of the adaptor. The two forward attachment bolts are wired, to prevent the one which secures the banjo adaptor working loose.

The tightness of the four holding bolts is of considerable importance if oil leakages are to be avoided. Periodic checks should be carried out as to the tightness of these bolts; this particularly applies to the Pre-delivery Check and during initial maintenance checks. A nut tightening torque of 18-20 lbs./ft. is specified for these bolts. To carry out these checks necessitates cutting the wire on the two forward bolts and refitting as shown in the inset in Fig. 59.

In units from the number quoted above, the bolt for the pressure pipe adaptor was replaced by a stud and self-locking nut, the wiring having been dispensed with as no longer necessary.

Tightening checks are still necessary with the new arrangement and the torque figures given above still apply.

To fit 8/10 pitch starter motor pinion and ring gear in place of 10/12 gears.

An alteration to the pitch of the starter motor pinion and gear ring was introduced at Engine No. V.178766E, on the Standard Two Litre models and at Engine No. TDC.1603E on the Triumph "Renown". This alteration entails the replacement of the former 10 tooth pinion and 117 tooth ring gear by gears having 9 and 91 teeth respectively.

In order to accommodate the larger 9-tooth pinion, an additional machining operation on the flywheel was introduced, which consists in a

suitable reduction of the flywheel, as shown in Fig. 56. This machining operation requires the use of a lathe with sufficient capacity to conform with the method employed in this factory. The alternative method of providing the clearance which is shaded in the illustration, can be done without the aid of a lathe and, if carefully carried out, with little appreciable effect upon flywheel balance.

Starter motor pinion " out of mesh " dimension.

It is of considerable importance when fitting a new starter motor, or fitting a new pinion to an existing Starter Motor, or fitting a new pinion to an existing Motor, to ensure when assembling the unit on to the engine that the correct " out of mesh " dimension is obtained. It is also necessary when fitting a new pinion to an existing motor to ensure that the armature float is not excessive. The maximum float specified by Messrs. Lucas for armatures on Service Exchange Units is .010".

The correct " out of mesh " dimension for the starter pinion should lie between $\frac{3}{32}$" and $\frac{5}{32}$" and can be calculated, after making the measurements shown in Fig. 57, by subtracting dimension " B " from dimension " A ".

Where the " out of mesh " dimension is inadequate, this can be easily increased by fitting one or more shims, Part No. 102014, between the starter motor and engine mounting flange.

Where the pinion " out of mesh " dimension is excessive, the assistance of a Lucas agent may be necessary to obtain a Service Exchange Unit which will provide a " B " dimension suitable to allow the required pinion position.

Method of making oil seal for rear crankshaft main bearing.

When fitting a rear main bearing cap it is important that the following procedure be adopted :—

1. Apply sealing compound to flange of top half seal, then slide this half seal round the crankshaft into position. Fit the four seal setscrews, tightening these until they are only just binding.
2. Insert a 12" length of .003" feeler strip between the crankshaft seal and rear journal.
3. Tap top seal on to feeler gauge so that this is lightly nipped, then lock the four setscrews. Remove feeler strip.
4. Apply sealing compound to joint face of bottom half seal and sparingly to joint faces. Fit seal to cap with four setscrews just nipping.
5. Before fitting cap, tap bottom seal outwards, towards joint face as far as the clearance in the setscrews will allow, then position cap and tighten holding bolts.
6. Finally tighten the setscrews for the lower seal.
7. (a) Cut packing felt into $\frac{3}{4}$" lengths and soak these in a suitable jointing compound.
   (b) Use a brass punch shaped to fit the felt grooves to drive the felt strips into the two grooves. Having completely filled the grooves, they should be cut off with a sharp knife so as to leave the felts to stand $\frac{1}{64}$" proud, as shown in the illustration (Fig. 58).

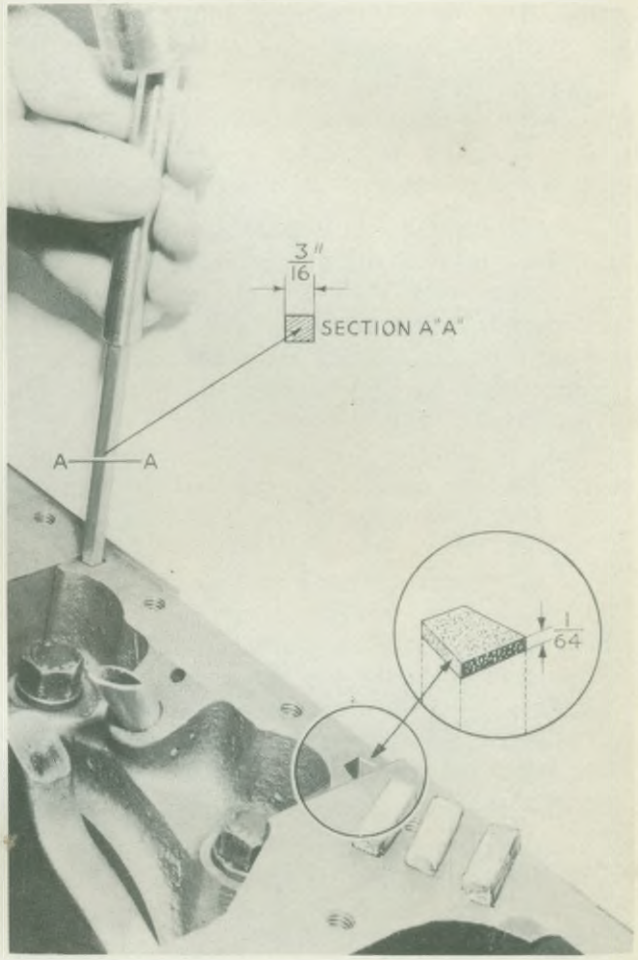


Fig. 58. Fitting rear main bearing cap

Excessive engine oil consumption.

As a result of complaints of heavy oil consumption with small batches of new cars, certain

modifications were introduced with the Standard and " Renown " models.

Where difficulties of this description are experienced, where the condition of the engine in other respects is satisfactory, the following points should be investigated in the order given :

1. The oil levels in the engine sump were found to be unnecessarily high and it was decided to lower this with a view to preventing wastage. In order to lower the level, the length of the dipstick from the underside of the collar to the bottom of the rod was increased to 7" in the case of the " Vanguard" and 6½" for the " Renown ". This modification was made at Engine No. V.165790E on the " Vanguard " and at Engine No. TDC.713E on the " Renown," decreasing the oil capacity to 11½ and 12 pints respectively for the models mentioned. The oil capacities quoted are those required to bring the level up to the top mark on the dipstick with a perfectly dry engine. The detail numbers for these two dipsticks are 102012 and 102139 for the Standard and " Renown " respectively.
2. The breather valve was originally fitted in the Manifold, but its design and position were altered on Eng. No. V.152890E and Future on Standard models, and at Eng. No. TDC.6469E and Future with " Renown " engines. From tests made an appreciable improvement in oil consumption followed this alteration. To make this change it is merely necessary to remove the split pin from the old valve and to open out its hole to $\frac{9}{32}$", retaining the modified adaptor in the manifold. The new breather valve, Part No. 103816, should be fitted to the banjo end of the connecting pipe in the rocker cover in place of the existing screw.
3. The valve guides fitted, until quite recently, were provided with an internal chamfer on their upper faces and a sharp edge at the lower end. This chamber round the valve stem allowed oil to collect and pass into the combustion head. To deal with this difficulty, the guides should be reversed in the cylinder head and to facilitate their installation an external chamfer should be made on each guide, similar to the one originally supplied for this purpose.
4. A chromium-plated top compression ring was fitted on pistons up to Eng. No. V.178768E on the Standard models and Eng. No. TDC.1603E on " Renown " cars. Owing to the time these rings took to " bed in " it was decided to fit normal cast iron ones, thus eliminating initial complaints of heavy oil consumption, which were experienced when there were any initial slight ring irregularities.
5. Quite apart from the change in position of the breather valve mentioned in (2), a periodic examination of the breather valve should be carried out to provide against the possibility of a restricted valve. A restricted breather valve, by allowing a build up of crankcase pressure, will cause oil seal leakage, which, when it occurs at the rear end, can not only lead to heavy consumption, but also cause damage to the clutch friction faces.

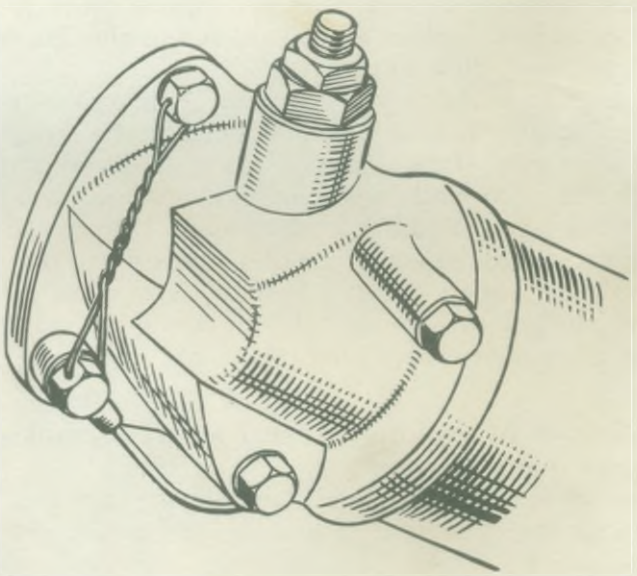


Fig. 59. Showing correct method of wiring filter bracket holding bolts. (Engines up to V179369 and TDC1567.)

"VANGUARD"—SERIES II

ENGINE

SUPPLEMENT

For the " crankcase ventilation " description given on Page 11 for Series I models read :—

" Crankcase ventilation is arranged on all but a few early cars, by means of air entering through two slots in the oil filler cap. The filler cap is located by a bayonet fixing to position the slots to face in a forward direction.

The oil filler cap contains a wire gauze filter through which the incoming air must enter before passing, by way of the rocker cover and push rod tubes, to the engine sump. The filtered air replaces the gases ejected from the sump through the inverted " U "-shaped exhauster pipe, which fits into an adaptor on the left-hand side of the crankcase. The gases are ejected by the combined effects of normal sump pulsations and the slipstream operating on the specially shaped lower end of the exhauster pipe."

On Page 24, to information given for setting ignition timing on Series I models, add the following :—

" With this model a vernier adjuster screw is provided on the distributor for fine adjustment of the ignition. This adjuster screw must be turned anti-clockwise to advance and vice versa to retard. One division on the adjuster screw scale represents 2 degrees movement of the distributor itself and this corresponds to 4 degrees of flywheel movement.

For reference purposes in these Works, the adjuster screw is set on the fourth mark (from the diaphragm) with the contact points just breaking at T.D.C. of No. 1 cylinder's firing stroke. This initial setting should, of course, be treated as a reference point only, as subsequent adjustments may be made after engine build."

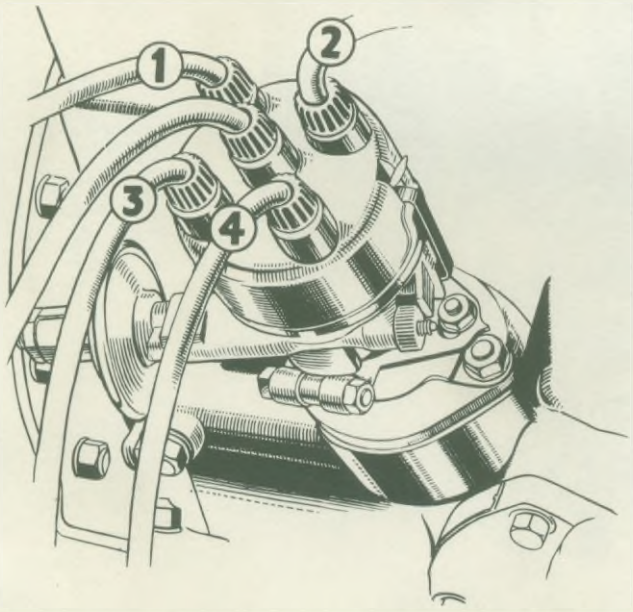


Fig. 1. Showing ignition timing adjuster and wiring of distributor

CRANKCASE VENTILATION

(Fig. 4.)

Description.

The crankcase ventilation system used on these models is somewhat different from that used on the Series I model.

The new arrangement has the virtue of simplicity and requires no maintenance attention, which was necessary with the previous system if this was to function properly.

To enable the ejection of the crankcase gases there is a large bore pipe in the form of an inverted " U " (see Fig. 4), which is fitted into an adaptor in the left-hand side of the crankcase. The adaptor is fitted into a boss which was previously used to accommodate the tapped hole for the breather pipe union used with Series I models. (The adaptor used with this later arrangement may be replaced by one to take the breather pipe union, if it is desired to use the later cylinder block for a Series I engine).

One end of the " U "-shaped outlet pipe fits into the crankcase adaptor and is located therein by a strap from the other branch of the " U " to one of the sump attachment bolts. The exposed end of this outlet pipe is cut off at an angle to provide a large area opening into the slipstream underneath the car.

Air enters the rocker cover through two slots cut in the special rocker cover oil filler cap. This cap has a built-in filter gauze, through which the air passes, and is located on the rocker cover filler pipe by a bayonet fixing to ensure that the two slots face forwards. The filter cap is held down in the rocker cover by a spring clip which grips on the inside of the filler pipe.

The filtered air passes into the sump by way of the push rod sealing tubes.

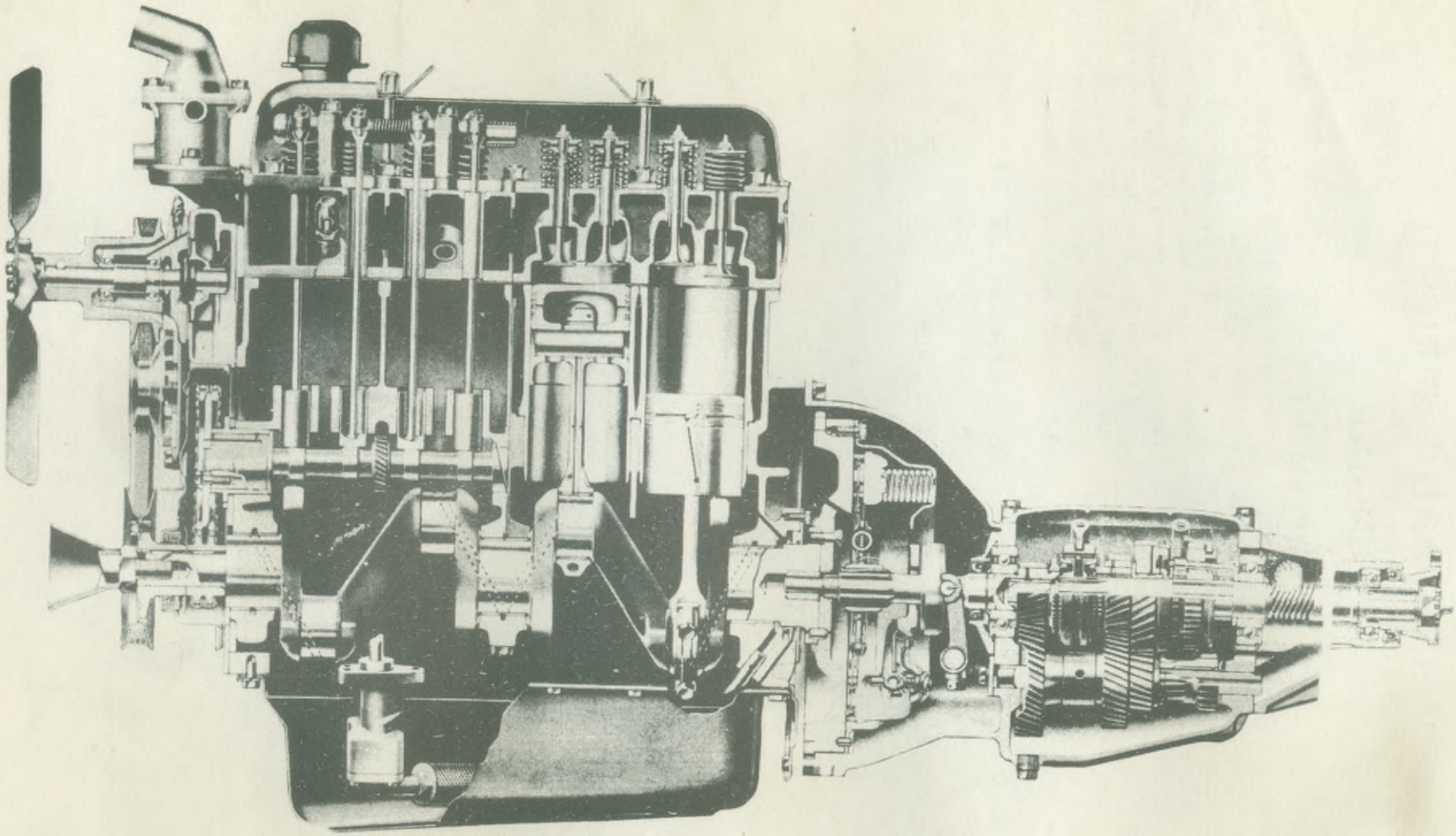


Fig. 2. Longitudinal section of engine and gearbox.

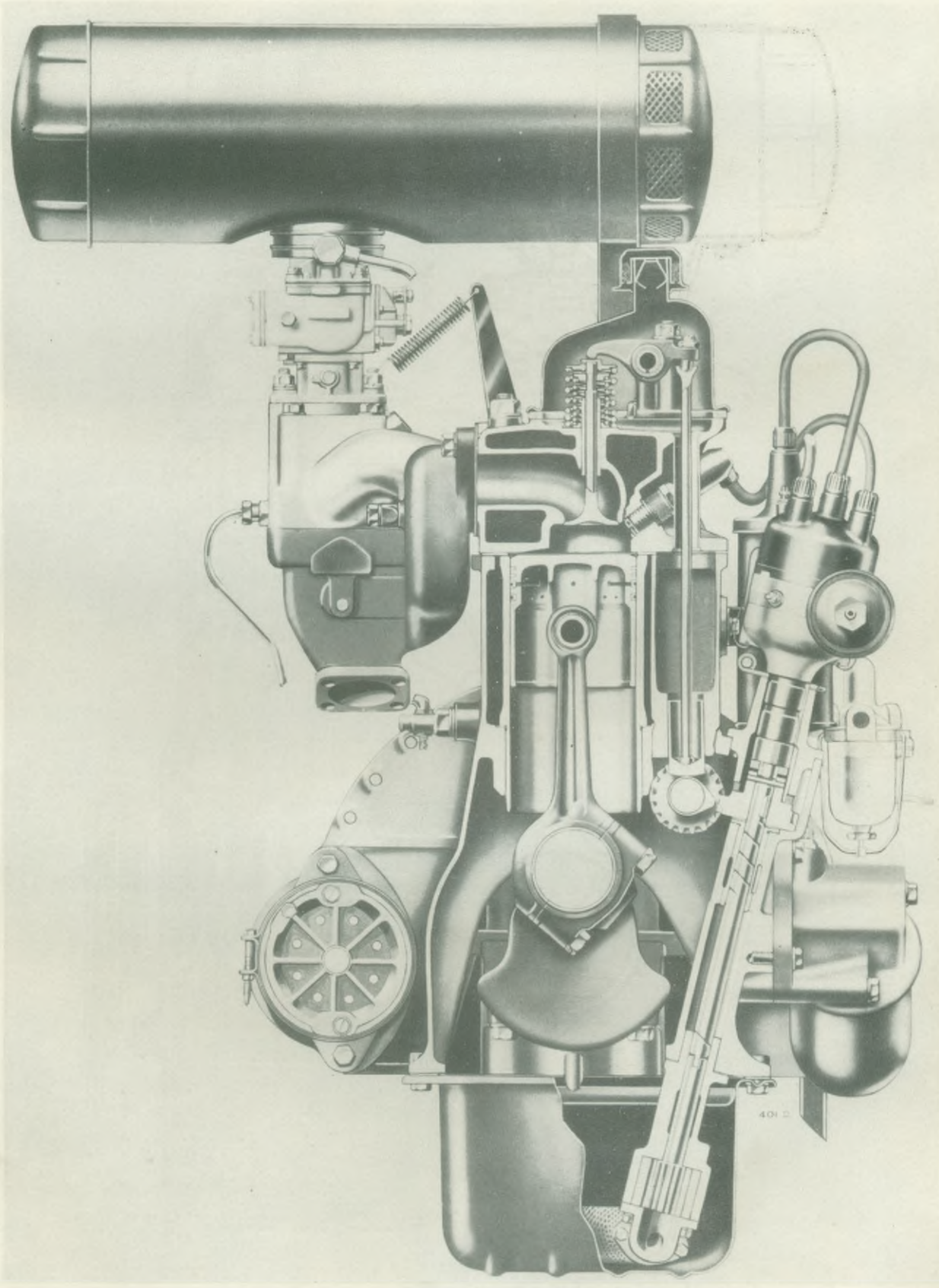


Fig. 3. Cross-section of engine

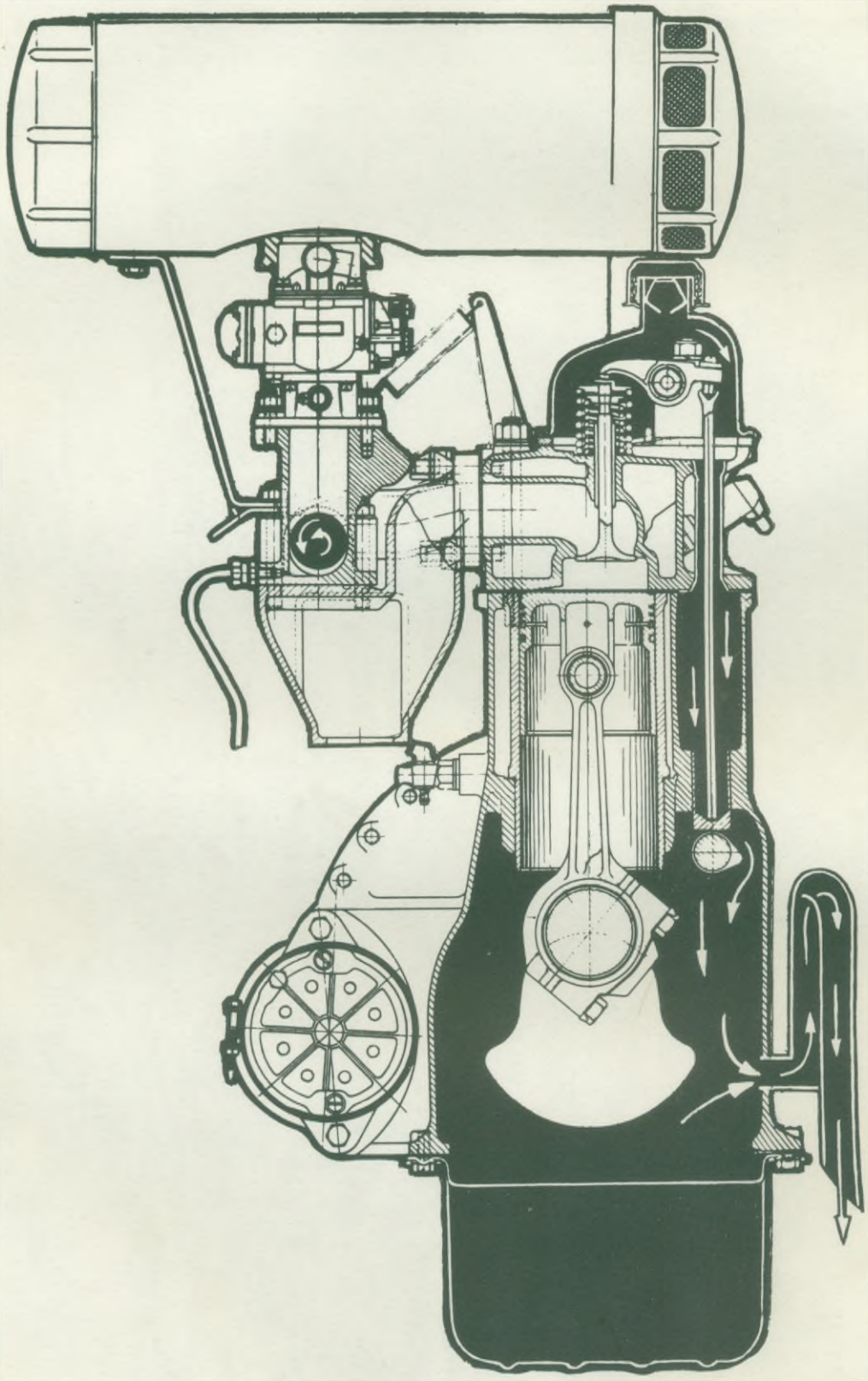


Fig. 4. Series II. Crankshaft ventilation system