THE MODERN

# ARIEL

## MOTOR CYCLE

1939-48

# OWNERS' GUIDE

THE

# SQUARE FOUR

600 c.c.
1,000 c.c. } 4-CYLINDER

*Price* . . 1/6

ARIEL MOTORS LIMITED
Selly Oak :: Birmingham, 29
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# INTRODUCTION.

This book is intended to enable the rider to keep his machine in first-class running order by carrying out running adjustments and minor repairs as required. If any point of difficulty arises, however, we are always pleased to advise. When sending in an enquiry or when writing about a machine at any time, always state clearly:—

Engine number and letter (stamped on drive side crankcase just below cylinder flange).

Frame number and letter (stamped on right side of saddle lug).

Model—*e.g.*, 4G., 4H. or 4F., and year of manufacture.

The 1939 prefix letters are as follows:—

| Model. | Engine. | Rigid Frame. | Spring Frame. |
|---|---|---|---|
| 4F, 600 c.c. | EE..... | P..... | AX..... |
| 4H, 4G, 1,000 c.c. | DE..... | P..... | AX..... |
| 1948 4G, 1,000 c.c. | CJ..... | XP..... | AX..... |

## Running-in.

Proper running-in of the new engine is of the utmost importance, as misuse during the first few hundred miles will lead to poor results and unnecessary expense. Definite running-in speeds cannot be given, as the safe limit of speed depends absolutely upon road conditions, load, etc. Keep the engine turning over easily on small throttle openings, letting it rev. rather than pull slowly on large throttle openings. All motor cycles leaving our factory are in first-class condition, but we have to leave the running-in to you. What your engine ultimately becomes depends upon your care during the first 500-1,000 miles. Give yourself lasting satisfaction by using restraint until the pistons and cylinder bores have become seasoned by frequent heating and cooling and, with the piston rings and plain bearings, etc., have acquired first-class bearing surfaces.

During the first few hundred miles running, check all nuts, bolts and screws, etc., for tightness as parts will bed down during the running-in period, thus causing slack bolts, etc.

A number of proprietary brands of Running-in Compound containing Acheson colloidal graphite are available, and we recommend the use of one of these both for running-in and general use afterwards.

Running-in Compound should be added to the engine oil in the proportion of one pint to each gallon for the first few thousand miles, after which a smaller proportion of a quarter to half-a-pint per gallon oil may be used with advantage.

Upper cylinder lubricant containing colloidal graphite can be added to the fuel and may be used throughout the life of the engine.

It is advisable to change the oil at approximately 200, 500 and 1,000 miles during the running-in period in order to ensure the immediate removal of any metal particles and foreign matter which are specially likely to be found during this time.

## Fuel, Oil and Grease.

Good oil and petrol are always necessary, but are even more essential during the running-in period.

The lubricants shown in the table on page 55 are being used in our Works and the brand of oil with which

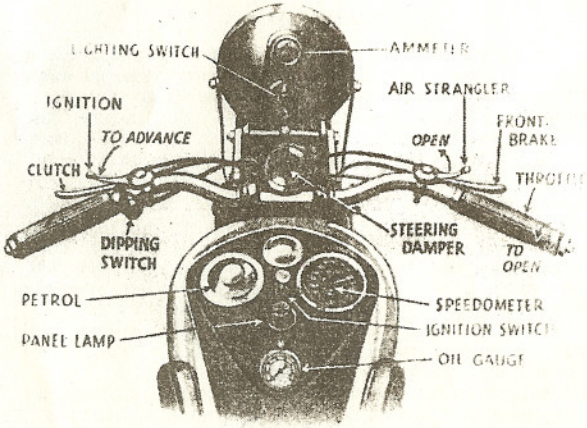



FIG. 1.

THE CONTROLS.



the engine was tested is indicated on the filler cap. We very strongly recommend the exclusive use of one or other of these oils.

Do not use Castrol R or similar racing oils in the Square Four engine; the oils shown in the table are much more suitable.

Any No. 1 Spirit of reputable brand, Ethyl petrol or good Benzole mixture will be entirely satisfactory in the 1,000 c.c. models. In the 600 c.c. engine the use of a first-class anti-pinking fuel such as Ethyl is essential in order to avoid pinking on the relatively high compression ratio employed.

Petrol and oil consumption is very dependent on road and driving conditions and the mechanical condition of the motor cycle in general. The harder the machine is driven and the hillier the road, the more petrol will be used per mile. Under normal touring conditions in average country, petrol consumption should be approximately 70 M.P.G. for the 600 c.c. models, and 60 M.P.G. for the 1,000 c.c. models used solo. Used with sidecar, consumption would be about 55 M.P.G. (600 c.c.) and 45 M.P.G. (1,000 c.c.).

Oil consumption is also dependent to some extent on driving speed, but should average about 1,500/2,000 M.P.G. for either type of engine in good condition.

## Instructions for Starting.

The engine will always start readily if in reasonable condition. Any difficulty in starting indicates that something is out of adjustment and the trouble should be looked for immediately and put right. Under normal conditions, an easy start will always be obtained by proceeding as follows:—

**600 c.c. models fitted with Solex type FH Carburetter with air choke.**

**Engine Hot.**—Switch on, leave air strangler open, advance ignition about half-way and open throttle very slightly. On depressing the kickstarter the engine should start. If the engine does not start immediately, close the strangler about halfway.

**Engine Cold.**—Leave the switch in the "off" position, close the strangler fully and open the throttle liberally about one-third to half open. Kick the engine over compression five or six times so that each cylinder draws

in a charge of gas. Switch on, advance the ignition about halfway, leave the throttle one-third open and slightly open the strangler. Now kick-start, when the engine should fire. After the first few explosions, the engine speed will rise rapidly due to the liberal throttle opening. Close down the throttle gradually until the engine is running at a good fast tickover. Adjust the position of the air strangler as required. It will probably be found necessary to keep the strangler partially closed until the engine begins to warm through; this may take two or three minutes. Open the strangler fully as soon as this can be done without the engine stopping through weak mixture.

**1,000 c.c. models fitted with Solex Bi-Starter Carburetter.**

**Engine Hot.**—Switch on, leave the bi-starter plunger on the carburetter in the normal running position (right in), advance the ignition about halfway and open the throttle very slightly. The engine should start at the first or second depression of the kickstarter. If it does not start immediately, pull out the plunger of the bi-starter to the intermediate position (leaving the throttle slightly open) and use the kickstarter again. Do not keep the bi-starter in action for more than one or two depressions of the kickstarter or the mixture will be too rich. Immediately the engine starts push in the plunger.

**Engine Cold.**—Switch on, pull the bi-starter plunger right out, **close** the throttle and use the kickstarter. The engine will normally start at the first or second depression of the starter lever. As soon as the engine begins to misfire due to rich mixture, push in the plunger to the intermediate position. The machine can now be driven away using the throttle in the normal manner. As soon as the engine has heated up sufficiently to run at low speeds and pick up on the main carburetter, push the bi-starter plunger right in. The distance for which it may be necessary to keep the bi-starter in action will depend upon atmospheric conditions and temperature, but in normal weather a few hundred yards will suffice.

Do not keep the bi-starter in action longer than necessary as it gives a very rich mixture which will tend to soot plugs and will lead to waste of petrol.

*General Notes for either type of carburetter.*

In all cases, as soon as the engine has started, fully



advance the ignition and keep at full advance for all normal running.

If the engine is very stiff to turn by means of the kickstarter, it can be freed by engaging top gear and rocking the machine backwards and forwards a few times. When free, put the gear in neutral and start as already described. If it normally becomes necessary to free the engine in this manner, it suggests that a thinner grade of oil should be used.

As soon as the engine is running check the oil pressure. On first starting from cold this will be about 20lbs. per square inch, gradually increasing as the oil thins and flows more readily. The normal pressure is approximately 40/45 lbs. per square inch, but during the warming up period this pressure may be considerably exceeded. Do not drive hard until the pressure has dropped to normal. Further, do not drive hard if the pressure is appreciably below normal or bearing trouble is likely to be experienced.

**Note that on the 1937-48 type of Square Four engine, as distinct from the earlier models, the lubrication system is a full pressure one and the maintenance of a proper pressure is essential to the correct functioning of the lubrication system.**

## Tracing Troubles.

If the engine does not start readily, check as follows:—

1. See that the petrol tap is turned on, and if the petrol is getting low, see that the reserve tap is also on. Make sure that the vent hole in the petrol filler cap is clear or an air lock will be created.

2. If the strangler is being used make sure that it is closing completely, if required.

3. See that the carburetter is bolted up tightly on to the cylinder head; the flange joint washer is liable to contract after several heatings.

4. Make sure that the throttle valve has actually moved in response to the movement of the control. The wire may have stretched or broken. Further, the slow running adjustment screw just by the flange joint may require resetting. Screw in to weaken, and out to richen, the slow running mixture.

5. See that there is no fault in the high tension leads, particularly in that from the magneto, to the

centre of the distributor cover and that no lead is trapped which might lead to a break in the insulation.

6. See that the contact breaker points are clean and are opening and closing as the engine is turned round. (See Notes on Contact Breaker, page 30).

7. Check over the leads from the distributor to the sparking plugs, seeing that they go to the right cylinders. (See Fig. 12).

8. Test the ignition system. To do this, disconnect one of the H.T. leads from a plug and hold it just above the top of the central electrode so that there is a gap of 1/16in. to ⅛in. Now operate the kickstarter. A good spark shows that there is nothing wrong with the magneto. The trouble may, therefore, be either dirty sparking plugs or carburation.

9. To test the plugs, take out one of them, connect the high tension wire to the plug terminal, and place the plug on some metallic part of the machine. Now operate the kickstarter and see if there is a spark at the plug points. If there is no spark, it indicates a dirty plug and it is probable that all the plugs are in a similar condition. Take them all out and thoroughly clean.

10. If in the previous test a good spark was obtained across the plug points, the plug tested was probably in sound condition. If one plug is firing correctly, it should be enough to set the engine running, even if only irregularly, assuming that the other three plugs are dirty. It might be, however, that the plug was dirty internally and would not spark when in the engine. If the plug looks dirty, take it to pieces, clean it, and also the other plugs; then try kickstarting again. If the engine still fails to start, it is probably not due to ignition trouble.

11. If in Test No. 8 no spark is obtained from the high tension lead, it indicates that there is some fault in the ignition system. Take off the contact breaker cover and try kickstarting again. If the engine fires, it indicates a short on the earth wire leading to the cut-out switch. Bind the broken part with insulating tape, or, as a temporary measure, disconnect the wire at the contact breaker.

12. Check for a stoppage in the fuel supply. Disconnect the petrol pipe at the float chamber, turn on the petrol tap and see that there is a good flow of petrol through the tap and pipe. Clean the gauze filter on the



float chamber connecting union whilst it is removed.

13. Take off the carburetter and detach the float chamber by undoing the two square head screws above the chamber. The float chamber complete with float and jets then comes away. See that the jets are clear, particularly the auxiliary jet which screws into the top edge of the float chamber. This jet governs the idling and slow running mixture.

14. Take off the distributor cover and make sure that this has not been damaged or cracked. See that the rotor is not damaged and that it is firmly keyed to the shaft; also note that the carbon brush is making contact with the metal tongue in the distributor cover. If a start is still impossible, the trouble would appear to be due to some internal defect of the magneto.

## Erratic Running.

If the engine starts but runs erratically, check the following:—

1. Let the engine warm up thoroughly. This will take at least 10 minutes normal running on the road; a cold engine will not give of its best.

2. Make sure the strangler has opened. See that there are no air leaks in the induction system as at carburetter joints and the connecting flange joint. See that there is a free flow of petrol and that none of the jets are partly obstructed.

3. Check the sparking plugs; test each one in turn by shorting the plug terminal to the engine with the engine running. Listen to the exhaust note of the engine whilst doing this. If the exhaust note changes, i.e., the engine slows down when the terminal is shorted, it shows that this plug was previously firing and has now been "cut out," so that it is not now firing. The plug is, therefore, probably sparking efficiently. Carry out this test with each plug. If when "cutting out" any particular plug there is no change in the exhaust note and the engine continues to run at the same speed it shows that the plug is not firing. It should be taken out and cleaned or, if necessary, replaced with a new one.

4. See that none of the valves are sticking. A sticking valve is most probably due to shortage of (or unsuitable) oil. Clean out the oil feed pipe to the rocker box and check the oil pressure on the gauge.

5. Check valve clearance adjustment (see page 30). Insufficient clearance will cause misfiring.

Remember that it is not easy to maintain perfectly regular firing of all four cylinders when the engine is idling. A slight amount of "hunting" under no-load conditions should be ignored provided the engine fires regularly under load.

## Hints on Driving.

Always start in bottom gear, changing up one gear at a time as the engine gathers speed. Always declutch to change gear, either up or down.

Keep the ignition fully advanced for all normal running. Retard for starting and for very slow running, as in town traffic, etc. Occasionally it may be beneficial to retard for hill climbing, particularly with sidecar.

Although you have a four-cylinder engine, you have also a close-ratio four-speed gearbox, and nothing is to be gained by hanging on to too high a gear. Change to the next lower gear immediately the engine shows signs of labouring or if there is any snatch in the transmission.

Don't open the throttle suddenly when the engine is running slowly; this causes pinking.

Don't stand in gear with the clutch held out, or the cork inserts will overheat and require replacement; drop into neutral.

Make necessary adjustments periodically. Don't wait until they must be made.

If you hear a slight metallic knock when the engine is pulling at low revs. especially with the engine hot, it is almost certainly due to the slight initial clearance allowed between the teeth of the crankshaft coupling gears.

The knock arises from the alterations of power impulses on each crankshaft. This noise is perfectly harmless and can be ignored. If, however, you wish to eliminate, retard the ignition somewhat and/or drop to a lower gear.



## How to Change Gear Silently.

Due to the fairly considerable inertia of the large diameter clutch now used, some little care is required in changing gear if a dead silent change is to be obtained. No noise should, however, be made if, when changing from a lower to a higher gear, a slight pause is made in the neutral position between the gears. The length of the pause will depend upon the engine revs., but a little experience will soon indicate the length of pause required. When changing from a higher to a lower gear, leave the throttle partly open so that the engine speeds up as soon as the clutch is released, and then move the gear quickly, allowing the clutch to slip during the change.

To engage low gear when at a standstill, it may be best to depress the kickstart once or twice with the cluteh held out before the engine is started; this frees the plates. After starting the engine, set it to **tick over as slowly as possible,** then release the clutch and hold it out for two or three seconds before endeavouring to engage the gear. This gives the plates time to stop spinning, and it should then be easy to get into gear with practically no noise at all. Many riders rev the engine excessively when engaging bottom gear. This is fatal to a quiet engagement.

# THE ENGINE.

## Useful Notes.

| *Model.* | *Bore.* | *Stroke.* | *Capacity.* | *B.H.P.* | *Peak Revs.* | *Compr. Ratio.* |
|---|---|---|---|---|---|---|
| 4F. | 50.4mm. | 75mm. | 599c.c. | 23 | 5,600 | 6.9 |
| 4G, 4H. | 65mm. | 75mm. | 997c.c. | 36 | 5,800 | 5.8 |

## Construction.

The Square Four engine has four vertical cylinders in a monoblock casting, the arrangement being to form a square. The pistons in the front and rear pairs of cylinders work on normal 2-throw crankshafts lying parallel to one another and geared together by gears running in an oilbath housing. Each crankshaft carries a heavy centrally disposed flywheel and is also bob-weighted opposite the two crank throws to give perfect balance. The crankshafts are carried on roller bearings

on the drive side and white metal lined bronze bearings on the timing side. The rear shaft, which carries the transmission sprocket, is supported by an additional roller bearing outside the main coupling gear.

Aluminium alloy pistons are carried on light alloy connecting rods by full floating gudgeon pins, the small ends of the rod being bushed. The plain big ends are split and lined with white metal.

The camshaft and magdyno are driven from the rear crankshaft through the medium of a roller chain which makes a conventional triangular drive. Chain tension is maintained by a Weller Spring Tensioner.

The overhead rockers are carried on two hollow spindles through which oil is forced under pressure, and operate the two rows of vertical valves. The rockers are operated by light alloy push rods from a camshaft mounted high up in the crankcase between the two crankshafts.

Lubrication is of the full pressure forced feed type to the two timing side main bearings, the four big ends and the overhead rockers, the remainder of the engine being lubricated by mist and the oil thrown out from the main and big end bearings.

The cylinders are numbered 1, 2, 3, 4 going round clockwise looking down on the engine, No. 1 being the right hand front.

## The Lubrication System.

The lubrication system is of the full pressure type, the two white metalled bronze main bearings on the timing side, the four white metalled big-end bearings and the eight overhead rockers being fed direct with oil at full pressure. The roller bearings on the drive end of the mainshafts and the ball bearing on the drive end of the camshaft are lubricated by oil mist. The plain bearing on the other end of the camshaft is fed from an oil well formed in the crankcase above the bearing.

The oil circulation, which is shown diagrammatically in Fig. 2, is as follows. Oil is drawn from the tank by the pump housed in the timing case, and is forced into an annular groove formed round the outside of the rear timing side main bearing; this groove is within the bearing housing so that the oil can only escape via the oilways provided. The main oilway is through a pipe



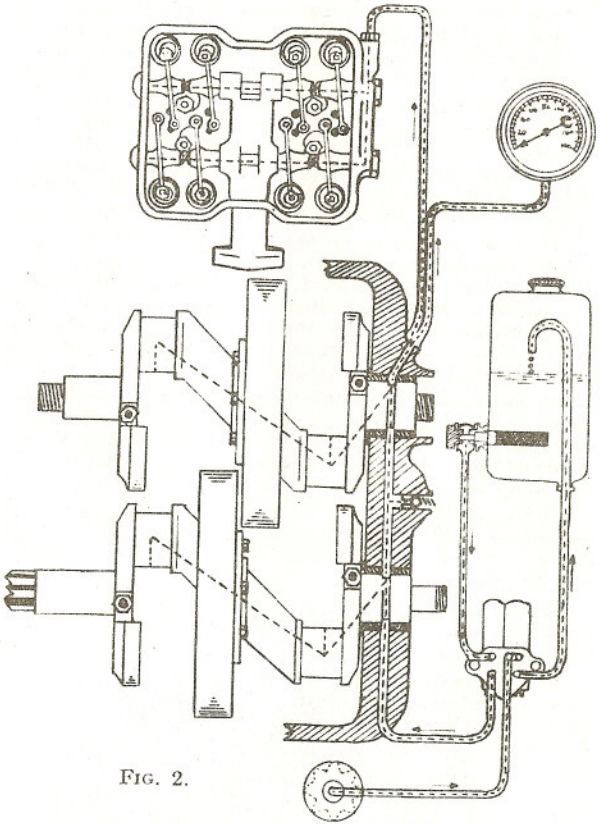


FIG. 2.

DIAGRAM OF LUBRICATION SYSTEM.

Oil is drawn from the tank and passes through an oilway in the crankcase wall to the two main bearings and thence through the drilled crankshafts to the big ends. A separate feed is taken to the Rocker Box and a connection made to the Oil Gauge. The oil drains down into the star-shaped filter in the sump and is then pumped back into the tank for further circulation.

cast in the wall of the crankcase to a similar groove formed round the front bearing. In each bush two oil holes are drilled through into the groove so that oil is forced into the bearing.

Each crankshaft is drilled with oilways from the timing end so that the oil is forced through direct to the white metalled big end bearings. Oil is fed into the crankshafts through the two main bearings, the shafts being grooved circumferentially and drilled radially to collect the oil forced into the bearing.

From the oilway round the front bearing, pipes are led to the rocker spindles and oil pressure gauge. A pressure relief valve, consisting of a spring loaded ball, is provided in the oil duct between the two main bearings. The pressure on the relief valve spring should be maintained at maximum by keeping the loading screw turned in as far as it will go.

Oil passing through the relief valve together with a certain amount which escapes from the rear bearing into the timing case, lubricates the chain drive to the camshaft and magdyno; the surplus drains back into the sump via overflow holes in the wall of the case.

Oil escaping from the rocker shafts lubricates the valve gear and then drains down the push rod enclosing tubes, past the tappets, on to the cams, and so down into the sump.

The return oil pump draws the oil through a filter situated in a well in the sump and returns it to the tank.

The delivery and return pumps are of the plunger type located side by side in the common pump body and operated through the medium of a sliding block from a crank formed on the camshaft sprocket securing nut.

## Oil Tank and Filters.

The oil tank holds ¾ gall. and should normally be kept as full as possible. In any event, do not allow the level to fall below the mark indicated on the tank.

It is recommended that the tank and sump should be drained about every 1,000/1,500 miles, when the gauze filter on the inner end of the delivery pipe connection in the oil tank together with the filter in



the sump should be withdrawn and cleaned in petrol.

Swill out the tank with petrol to remove all traces of sludge and dirt and refill with fresh oil. See table on page 55 for recommended lubricants.

## Notes on the Oil Supply.

As stated previously, the normal oil pressure is approximately 40/45 lbs. per square inch and the machine should not be driven hard until the pressure has steadied to about this figure.

Maintain the maximum oil pressure. Do not reduce the normal pressure by slackening the relief valve screw. This screw is not intended to be used for the purpose of adjustment, but only for dismantling for cleaning, etc.

If it is desired to test the oil flow at any time, this is most easily done by removing the oil tank filler cap and observing the return. It is clear that if the oil is returning to the tank, it must be going into the engine as the system is a circulating one. A direct method of checking the oil delivery is to slacken the connection to the oil gauge and rocker box, by the front bearing. If oil exudes freely with the engine running it shows that the delivery pump is passing the oil.

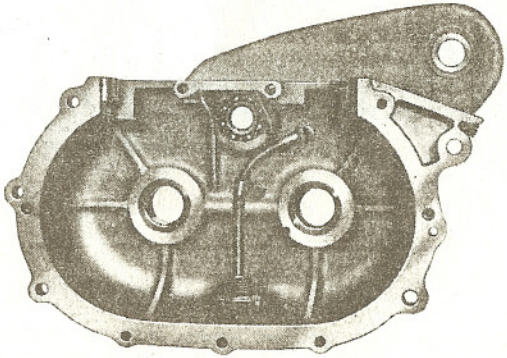


FIG. 3.

INSIDE VIEW OF TIMING SIDE CRANKCASE SHOWING OIL FILTER IN SUMP AND RETURN OIL PIPE.

When the engine is first started the oil will return to the tank in a continuous stream for half a minute or so until the sump has been drained, after which it will return in bubbles. If this test is made with the engine cold there may be a pause of several minutes between the end of the continuous stream and the beginning of the bubbles as the new oil which is being forced into the engine will take time to drain down into the sump.

Note that whilst these two tests may be regarded as useful in checking the circulation they are not conclusive proof that oil is reaching *all* bearings as there might be a choked oilway.

When first starting up the engine after draining the tank; or if the engine has been standing for a long time, it may be necessary to slack off the relief valve before the oil will commence to circulate. If, therefore, the oil gauge does not speedily show a pressure when the engine is started, slack the valve for 10 or 15 seconds, then retighten and observe the gauge. If this is still not showing any pressure, again slack the valve and test. The object is to remove any air which may have got into the system.

It is practically impossible for the lubrication system to go wrong, and any slight irregularity in oil pressure or supply will almost certainly be traced to dirty oil or poor joints. To remedy:—

1. Remove oil relief valve, clean ball and seating in petrol and replace.

2. Clean oil filters in sump and tank, and if the oil has been in use for some time, drain off, flush out the tank, sump and oil pipes, etc., and refill with clean oil.

3. Clean the ball valves and springs, carried in the cupped plugs below the pump body. To do this it is necessary to remove the timing cover.

4. Make sure that all oil pipe connections are tight and that the pump is securely bolted against the face of the timing case.

## Decarbonisation.

The period for which an engine will run efficiently without being decarbonised depends to a considerable extent upon driving conditions. To obtain the best results the "Square Four" should be decarbonised about every 5,000/8,000 miles under average conditions



of use. For the first time, however, it is recommended that decarbonisation and valve grinding should be done after about 2,500 miles as the engine will carbon up more quickly whilst being run light during the running-in period before pistons and rings have bedded into the cylinder bores and made a good oil and gas seal.

Decarbonisation is quite simple and straightforward and is carried out as follows:—

1. Remove the exhaust pipes, manifolds, sparking plugs, carburetter and rocker box lid.

2. Disconnect the oil pipe to the rocker box.

3. Remove the 12 head securing bolts. It is most convenient to take these out in the following order:— 1—The four rocker box bolts. These pass through the rocker box near the push rods; the nuts holding the rocker box lid screw on to their upper ends. 2—The four centre bolts; there are two by the induction pipe (one on either side) and two corresponding ones in front of the rocker box. 3—The four corner bolts; these are through the head by the corners of the rocker box.

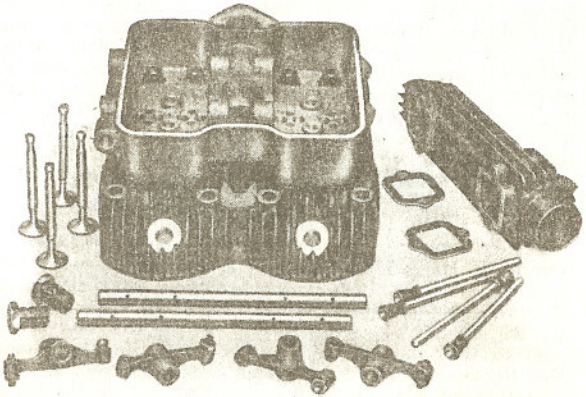


FIG. 4.

CYLINDER HEAD, ROCKER BOX AND PARTS OF THE VALVE GEAR.

Now lift up the head sufficiently for the push rods to clear the cylinder block, and draw the head away to the side. The push rods cannot drop out as their cupped tops will not pass through the base of the rocker box.

4. Remove the head gaskets, taking care not to damage them. Scrape clean and put on one side ready for replacement.

5. It is not necessary to remove the block and this is best left in position unless it is required to examine the pistons or rings; the piston tops can be scraped clean in position. Removing the block upsets the fit of the piston rings and will probably result in an increase in oil consumption. Therefore, leave the block in position and also take care not to remove the carbon which has formed round the top of each cylinder bore above the pistons. This carbon forms a very effective oil seal.

If it is necessary to remove the block to inspect piston rings or anything similar, first remove the magdyno. This is held by a clamping strap and a bolt and dowel in the base. Loosen the former by means of the nut near the top and take out the base bolt. The driving sprocket should be removed before the magdyno is loosened. Now undo the eight cylinder base nuts and lift the block straight up clear of the pistons. Take care that the pistons are not damaged as they fall clear of the block. Mark the pistons before removing them from the rods so that they may be replaced correctly. (See note under "Pistons.").

6. To grind in valves, the rockers must first be removed. To do this undo the two hexagon spindle bearing plugs at the oil feed end of the rocker box. To withdraw the spindles screw into their ends a 5/16in. by 26 T.P.I. bolt (one of the rocker box bolts) and pull straight out through the end of the box. Collect the Rockers, Shims and Spring Spacing Washers, etc., as the spindles are withdrawn and lay out on the bench in order. Whilst all these parts are quite interchangeable it is best practice to refit each part in its original position. Note that no shim is used next the bearing plug. Remove the valve stem end caps, draw out the push rods and put with the other parts.



Note the sequence of numbering the valves. With head upside down and the front towards operator, the front row are 1, 2, 3, 4 **right to left,** and the back row 5, 6, 7, 8 **left to right.**

The valve springs can be compressed with a valve spring compressing tool, when the split cotters can be removed and the valves taken out. A suitable valve spring compressor is obtainable from Ariel Stockists or the Ariel Service Department. Note that the large coil of the inner spring fits next the taper hole collar.

Grind in the valves in the usual manner, using a fine grinding paste and lifting the valve off its seat frequently, to prevent the formation of rings.

7. Scrape all carbon from the piston tops, combustion chambers and exhaust manifolds. Leave the carbon at the top of each bore, as explained in item 5.

8. To re-assemble, proceed in the reverse manner. Everything is perfectly straightforward, but special note should be made of the following:—

(a) If the cylinder block has been removed, refit the pistons to the connecting rods (see notes, page 19 on Pistons, Rings and Gudgeon Pins), and when placing the cylinder block into position, be particularly careful not to damage or distort the pistons and see that the piston rings are carefully worked into the cylinder bores. A little temporary carelessness will easily damage a piston or break a piston ring. The simplest way to replace the block single handed is as follows:—

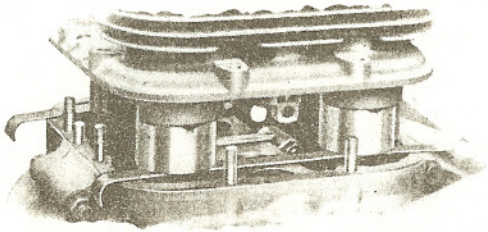


FIG. 5.

METHOD OF REPLACING CYLINDER BLOCK, 600 c.c. MODELS.

**600 c.c. Models.**—Obtain two steel strips approximately 9in. long by 1in. wide by 3/32in. thick. Now rotate the engine until all four pistons stand at the same level above the top of the crankcase. It will be found that there is just room to place the strips along the top of the crankcase and under the pistons so that the piston skirts rest on the strips and hold the pistons steady and perfectly square, thus enabling the cylinder block to be lowered into position. The method is illustrated in Fig. 5.

**1,000 c.c. Models.**—Obtain two wood or metal strips approximately 9in. long by 7/16in. deep by ¼in. wide. Rotate the cranks until all the pistons stand level with one another just above the top of the crankcase. Take a strip and slip this along the top of the case between the cylinder base studs and the two pistons on one side. The cut away side of the skirt just gives the necessary clearance. Repeat with the other strip on the two remaining pistons and it will be found that the four pistons just rest on the two strips and are held upright so that the block can be lowered into position and the rings eased into the bores.

(b) See that the joint faces of the head and block are perfectly clean and that the gaskets are sound. If the gaskets are in any way damaged fit a new pair.

(c) The gaskets must be placed so that the bolt holes match up with those in the block. A light smear of jointing compound may be used on each side of the gasket if desired.

(d) When replacing the push rods in the rocker box take care not to displace the guide cups which position the lower ends of the rods for ease of reassembly.

(e) It is most convenient to fit the head bolts in the following order. 1. Four rocker box bolts, these should be reassembled into the rocker box before the head is replaced, unless the tank is off; do not omit the washers. Screw each bolt down just a few threads in order to locate the head and gaskets. 2. The four centre bolts; screw down a few threads. 3. The four corner bolts; screw these home until the head is firmly down on the gasket. Now take up the slack in the other eight bolts and then work from one bolt to another, tightening each one a little at a time until every bolt is quite firm.



When the engine has been run a short time repeat the tightening as the gasket will probably give a little with the heat.

(f) **IMPORTANT.—Do not forget to replace the hardened steel end caps on the valve stems or considerable damage may be done.**

(g) Adjust valve clearance as described on page 30.

## Pistons, Rings and Gudgeon Pins.

**Pistons.**—These are of a special hard, wear-resisting aluminium alloy. Whilst adequately strong for proper conditions of use, they are somewhat brittle and are liable to crack or break if given a sharp blow; therefore, handle with care when out of the engine, and be particularly careful not to cause damage when removing the cylinder block. Mark each Piston before removing from the connecting rod so that it shall be refitted in the same cylinder and the same way round.

**Rings.**—Piston rings must be free in their grooves and have approximately .003in. side clearance when new. The gap between the ends of the rings (new) when tried in the cylinder bore is .010–.012in.

**Gudgeon Pins.**—These are fully floating and are retained in the piston by spring circlips. The circlips must be perfectly round and flat when removed, and must expand into the grooves and fit firmly. Do not refit circlips too often; they are cheap enough to replace.

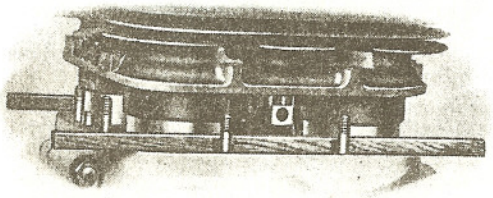


FIG. 6.

METHOD OF REPLACING CYLINDER BLOCK, 1,000 c.c. MODELS.

## Engine Dismantling.

Owners are advised not to dismantle the engine needlessly, and not at all unless having considerable mechanical ability. The general procedure is, however, as follows:—

1. Remove exhaust pipes, carburetter and control wires, etc.

2. Remove primary chain case, including necessary dismantling of clutch.

3. Take engine from frame.

4. The head, block and pistons, etc., can be dealt with as when decarbonising.

5. **The Rocker Box.**—To remove the rocker box from the head, first remove the rockers with spindles and take out the valves. Turn the head over and remove the two nuts on the studs in the middle of the head. These ensure a tight joint in the induction system between the rocker box and head. Next press out the valve guides. The box is now free.

When replacing the box make quite certain that all joint faces are perfectly clean and smooth. Fit a new set of graphited washers or a good joint will not be obtained. As these washers are inclined to stick together, make sure that only one washer is on each joint face or the unequal thickness of the various joints will cause trouble. Drop the box into position and tighten the two nuts on the induction joint studs; this will hold the box. Now smear the valve guides just below the shoulders with jointing compound and replace the guides, pressing them firmly into position. Wipe away any surplus compound which has squeezed out. The valves and rocket gear can then be reassembled as after decarbonising.

**Timing Gear.**—Take out the oil relief valve and the eleven cheese head screws which hold the cover. The removal of this exposes the timing gear and oil pump.

To remove the pump undo the two nuts and pull the pump body complete with plungers and sliding block off the two studs. Now undo the nuts securing the magdyno, camshaft and timing sprockets and pull these sprockets off their respective shafts. The camshaft nut has a left-hand thread. The magdyno sprocket fits on a plain taper whilst the other two are parallel and



keyed. It will facilitate the work here if the spring tensioner blade is tied down to take the pull off the chain whilst the sprockets are being taken off. Note the oil seal washer at the back of the mainshaft sprocket.

**Mainshaft Coupling Gears.**—Remove the engine sprocket and shock absorber assembly and undo the nuts holding the cover. Now draw off the cover, taking care not to damage the joint faces. If the inner race with rollers and cage of the rear mainshaft bearing have remained behind on the shaft pull them out. It may be noted here that the bore of the inner race of this bearing in the gear cover is .001in. less than those in the crankcase. Take care, therefore, to refit this race to the cover and not in the crankcase. Now unscrew the nut and remove both gears with an extractor. Remove the two keys and put by safely.

It must be noted that the coupling gears are a tight fit on their shafts, and to avoid damage, it is essential that they are drawn off with a properly constructed screw extractor. A screw thread is formed on the boss on each gear to carry the extractor sleeve. Similarly, when refitting, force the gears on to the shafts with a proper screw arrangement. Do not attempt to hammer them on or to use a press or anything similar. It is also essentail to see that the keys locate properly with

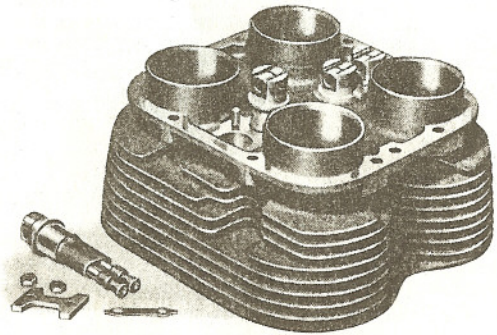


FIG. 7.

CYLINDER BLOCK SHOWING TAPPET ARRANGEMENT.

the keyways in the gears. If they are slightly out of register, the corner of the keyway in the gear will form a cutting edge and slice a thin shaving of metal off the side of the key. Apart from the possibility of backlash developing between the gear and the shaft, due to the loose fitting key, the metal will get between the back of the gear and the inner race of the roller bearing and prevent the gear pulling home properly.

Teeth on each gear are centre dotted for correct crankshaft coupling when replacing. The marked tooth on one gear fits between the two marked teeth on the other gear. The marking is duplicated and either combination may be used.

**The Crankcase.**—Undo the cap over the front timing side main bearing and remove the locknut and oil seal washer. Remove the several bolts holding together the two halves of the case, not forgetting the two connecting the bridge inside the crankcase mouth, and draw apart the two halves. The crankshafts, with connecting rods and camshaft, can now be withdrawn.

The lipped Roller Bearing outer races on the drive side can be pressed out after removing the spring circlips outside the races; the housing is bored parallel right through and the races can therefore be removed in either direction. Note that the lip of the outer race is next the circlip. It may again be noted that the bore of the inner race of the bearing in the gear cover is .001in. less than those in the crankcase. Take care, therefore, to refit the smaller race to the cover and not to the crankcase.

The plain bearings on the timing side are pressed into the case and are positioned so that the oil holes through the bushes are horizontal. This brings one hole in each bush in line with the main oil duct in the crankcase wall. The bearings are held positively in position by set screws passing through the bearing housings from underneath and locating in shallow holes formed in the bushes. Before removing the bushes these set pins must be removed. Press the bushes out into the crankcase.

Note that the set pin locating holes in the bushes are drilled after the bushes have been inserted. Use a 13/64in. dia. drill and do not allow the point to go deeper than ⅛in. into the bush or it will break through the white metal lining.



**Connecting Rods and Big End Bearings.**—The connecting rods are light alloy, the big ends being split and lined with white metal. When excessive clearance develops in the big end have the bearing remetalled. Do not attempt to take up the clearance by filing the faces and scraping the bearing. Original connecting rods in good condition can be exchanged for service rods at the cost of remetalling, thus preventing loss of time. Rods which have been faced will not be exchanged or remetalled.

Mark each rod before removal to ensure replacement on the same crank and the same way round. When refitting rods see that the big end cap is the same way on the rod as previously. Also make sure that the big end bolt heads are home in the recesses in the rod, and do up the nuts evenly and firmly, getting on plenty of tension to keep the two parts of the bearing rigid. Note that the heads of the big end bolts are out of centre with the stems; as the recess in the rod for the bolt head also is out of centre, the bolt is prevented from turning when the nut is tightened. **Do not omit to split cotter the nuts after assembly.**

The small end bushes are pressed into the rods and can be renewed in the event of wear.

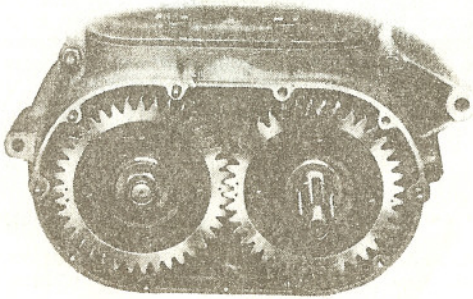


FIG 8.

CRANKSHAFT COUPLING GEARS, SHOWING TEETH MARKED FOR CORRECT MESHING.

**Crankshaft Assembly.**—The flywheels are bolted to the centre of each shaft and it is only necessary to see that the bolts are tight; do not remove the flywheels unnecessarily.

The balance weights are dovetailed and pressed on to the shafts and are locked in position by bolts. Under normal use they should never require moving and it is strongly recommended that no dismantling of the general crank assembly should be attempted, apart from big end replacement.

When the shafts are out of the crankcase give the oilways a thorough clean out. To do this effectively it is necessary to remove the plug screws and force paraffin (kerosene) through each oil passage. It may be found that at the ends of oil passages where the oil is not actually circulating, the hole is choked solid with foreign matter. Clear this with a stout piece of wire and then force paraffin through. Make sure that the plug screws are refitted securely.

## Engine Re-assembly.

The general re-assembly is quite straightforward, but the following extra notes may be helpful.

1. If the original connecting rods are replaced, fit each rod to the same crank as before and the same way round. Get bolts tight and use split pins on the nuts. If remetalled or new rods are fitted make sure that the bearing is not too tight. In general, it should not be necessary to scrape a new bearing. Note, however, that the light alloy rods will expand appreciably as the engine warms up and a big end which appears too tight on assembly will probably be perfectly free when the engine is warm. If there is any doubt as to whether a bearing is tight, pour a little hot oil over the big end of the rod after assembly. The bearing must then be perfectly free.

2. See that the crankcase joint faces are perfectly smooth and clean, and smear with jointing compound before final re-assembly.

3. Assemble the crankshafts into one half of the crankcase first, and then slip the other half case into position and bolt up.

4. Be careful to refit the oil retaining washers to the crankshafts outside the two plain main bearings.

5. Do not forget the two bolts through the crankcase bridge above the camshaft.



## Timing Gear.

A triangular drive is formed by a roller chain running over the driving sprocket on the rear mainshaft, the camshaft sprocket and the magdyno sprocket, the chain being kept in tension by a Weller spring tensioner.

The camshaft sprocket, which fits with the boss inwards, has one keyway and is a light push fit on the camshaft. This fixes the position of this sprocket relative to the camshaft.

The crankshaft sprocket has three keyways in order that a slight variation in timing may be obtained if necessary. To obtain the standard timing fit the camshaft sprocket and rotate until the two holes drilled in this point downwards to the centre of the rear crankshaft. Rotate the crankshaft until No. 1 piston (front timing side) is at top dead centre. Now fit the crankshaft sprocket so that the line scribed on it points up in line with the two holes in the camshaft sprocket. In this position it will be found that the key on the shaft engages with the bottom keyway in the sprocket. Now mesh the chain, keeping the timing marks in line.

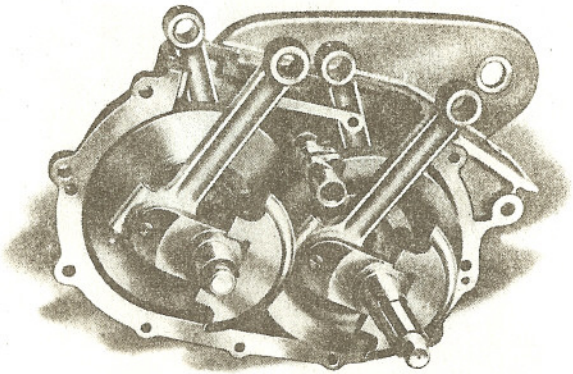


FIG. 9.

CRANKSHAFT ASSEMBLIES IN TIMING SIDE CRANKCASE.

In actual practice it is necessary to pull the sprockets from their shafts, mesh them with the chain and refit. The correct meshing may entail one or two attempts before the timing marks come in line, but must come right if No. 1 piston is kept at top dead centre and the marks are in line.

Do not forget the main bearing oil seal washer at the back of the crankshaft sprocket.

The correct valve timing is:—

Inlet valve opens 3/16in. or 25° before T.D.C.

Inlet valve closes ½in. or 55° after B.D.C.

Exhaust valve opens 19/32in. or 60° before B.D.C.

Exhaust valve closes ⅛in. or 20° after T.D.C.

As soon as the chain is correctly meshed, couple up the magdyno sprocket in order to keep tension on the chain and prevent it jumping the teeth. The magdyno can be timed now or later.

Note that oil leakage past the magdyno sprocket is prevented by the reverse oil thread cut on the outside of the sprocket boss. To make an efficient oil seal,

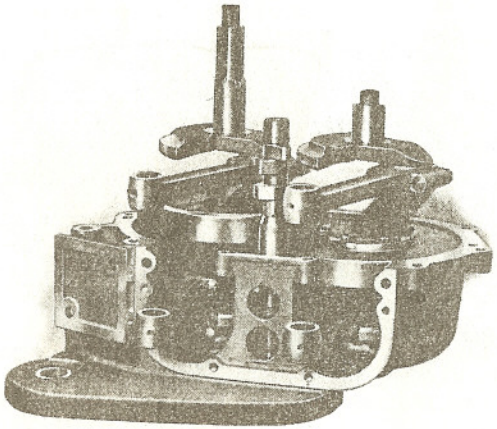


Fig. 10.

Another View of the Crankshaft Assembly.



the top of the thread must just not touch the hole in the case. It is therefore important not to damage the thread or the hole.

See that the pump drive nut on the camshaft and the locknut on the mainshaft are done up securely. Fit the pump and set the ignition timing in accordance with instructions relating to these items. Fit timing cover and do up cheese head screws securely.

## Oil Pump.

The pump is housed in the timing case, the two plungers being operated through the medium of a sliding block worked off a crank formed on the camshaft sprocket securing nut.

It is essential to keep the pump bolted up tightly against the joint face and so use a correct paper joint washer which must be in good condition. Do not use jointing compound on this washer.

When fitting the Duralumin block which operates the plungers, fit with the chamfered end of the hole *inwards* against the face of the nut.

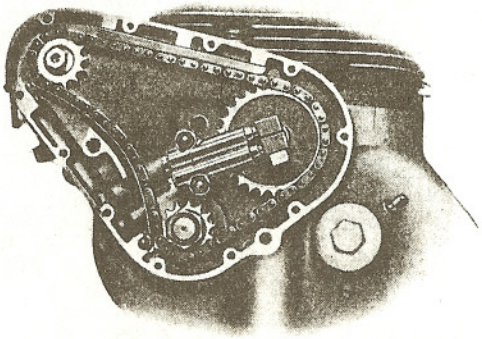
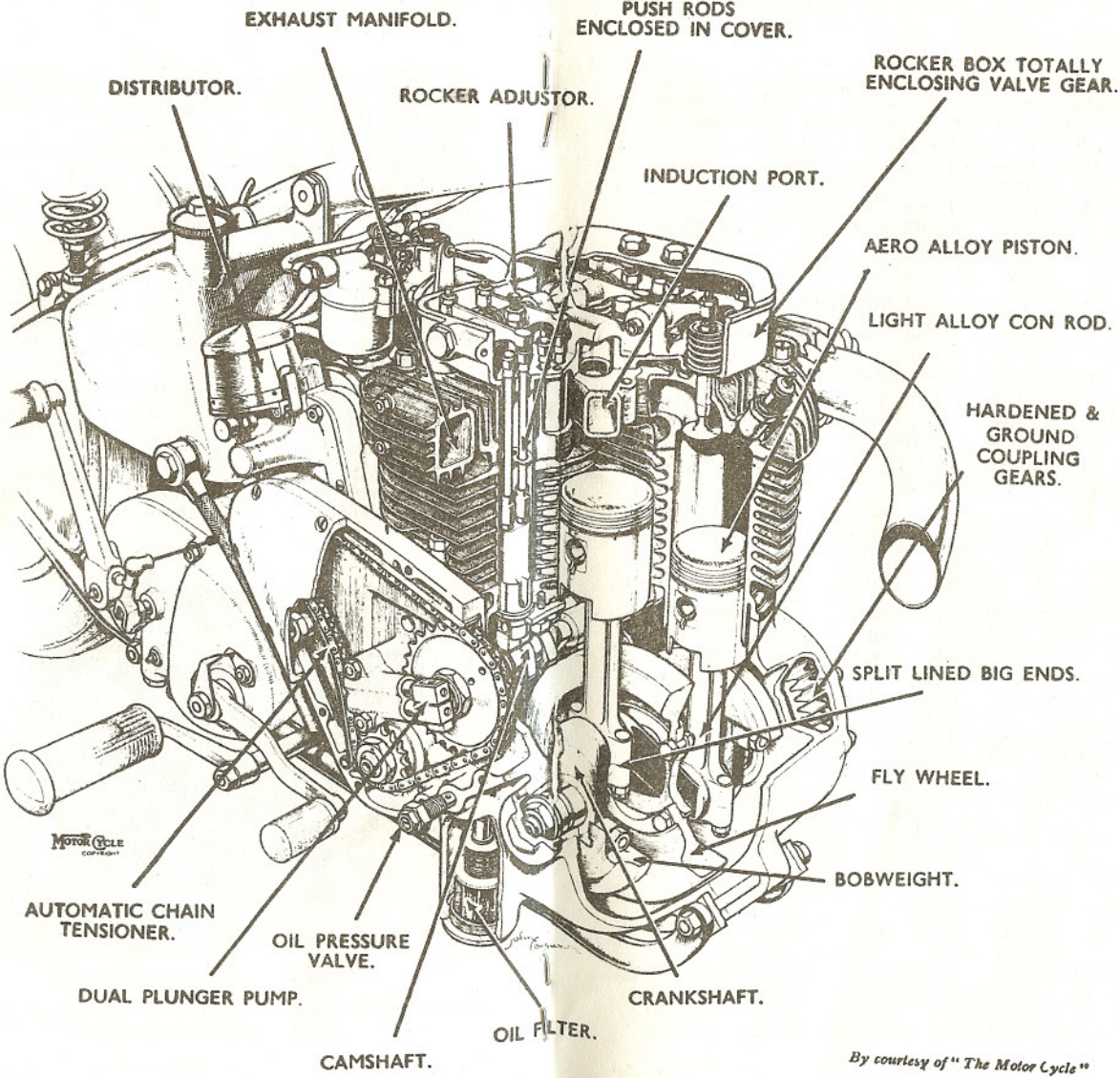


Fig. 11.

Timing Gear and Oil Pump.

(Note timing mark on crankshaft sprocket in line with holes in camshaft sprocket.)




*By courtesy of "The Motor Cycle"*

The pump will rarely require any attention so long as the lubrication system is kept clean. Failure, either through shortage of oil or a flooded crankcase, is generally due to dirt on the pump ball valves, to clean which the plugs below the pump body must be removed and the balls, springs and plugs washed in petrol. The ball seatings in the pump body should be washed out by squirting in petrol. When refitting see that the plugs are done up securely.

## Valve Clearance Adjustment.

Adjust clearance with engine cold. Correct clearances are:—

Inlet .006in. Exhaust .008in.

To ensure that each valve is on its seat, rotate the engine until any inlet valve closes; turn the engine just past compression and then set the clearance for the inlet and exhaust valve on this cylinder. Repeat for each of the other cylinders.

# IGNITION SYSTEM.

## Distribution.

The ignition system is quite simple, an ordinary 180° magdyno being used. The magdyno runs at engine speed and therefore provides two sparks per revolution. There is a single high tension lead from the magneto pick-up to the centre of the distributor cover. The current is carried across from this centre lead to each of the four contacts on the distributor cover by means of the rotating centre piece. This rotor is a push fit on the end of the shaft and is located by means of a key, moulded inside, which engages with a keyway cut in the shaft. The rotor can, therefore, only be pushed home in the one position. See also note under Ignition Timing. The connections between the distributor and the different sparking plugs are clearly shown in Fig. 12.

The firing order is 1, 2, 3, 4.

Keep the contact breaker points clean and correctly adjusted. Attention should only be required every 2,500 miles or more. To adjust the points, remove the cover and turn the engine round slowly until the points are seen to be fully open. Now, using the magneto spanner, slacken the locknut and rotate the fixed contact



screw by the hexagon head until the gap is set to the thickness (.012in.) of the gauge (rivetted to the spanner). Tighten the locknut, seeing that this operation does not move the fixed contact screw.

It is particularly important to keep the contact breaker free from oil and petrol or rapid burning of the points will occur. If they become blackened they may be cleaned with very fine emery cloth and afterwards with a cloth moistened with petrol; clear away all traces of metal dust and let the petrol dry off before replacing the contact breaker.

To remove the contact breaker from its housing for cleaning, undo the central hexagonal headed screw and gently prise up the contact breaker; it fits on a tapered and keyed shaft. The points are most easily cleaned if the contact arm is lifted off its pivot after swinging aside the flat locating spring. When replacing the contact breaker make sure that the projecting key on the tapered boss is engaged properly with the keyway in the shaft. Also see that the securing screw is tight, but do not use undue force or the threads will be damaged.

The two spiral gears for the distributor drive are lubricated by a screw down greaser just under the distributor base. One turn every 250 miles is adequate.

It may be noted that the inner end of the body of the greaser locates in a groove in the vertical drive shaft and positions this in the housing. If it is desired to remove this shaft, it is therefore only necessary to undo the greaser body when the shaft can be screwed out of engagement with the horizontal gear.

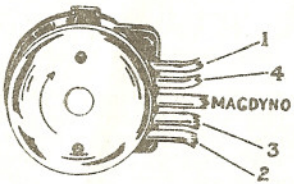



Fig. 12.

Distributor Connections.

## Ignition Timing.

To set the timing, release the magneto sprocket from the taper on the armature shaft, remove No. 1 sparking plug and rotate the engine until the piston is 5/16in. for 1,000 c.c. models or 3/16in. for 600 c.c. models before top dead centre on the compression stroke. Set the ignition control to full advance. (Note.—Be sure the contact breaker cam ring is responding to the movement of the lever.) Move the contact breaker in the direction of rotation until the points are just separating and tighten up the chain sprocket, taking care that this operation does not alter the setting. It is advisable to check this setting because of its importance. It is also advisable to check the position of the rotor arm relative to the contacts in the distributor body. When the rotor is pushed backwards (anti-clockwise) so as to take up all backlash in the drive, the marks on the rotor and on the base should be in line. If they are not, pull off the rotor, slacken the screw in the centre of the shaft and tap the top of the shaft sideways to free the taper fixing. Rotate sleeve at top so that marks will come into line when the rotor is fitted and tighten screw. Refit rotor and check timing.

Note that a fair amount of backlash exists in the distributor drive. This is quite normal and does not affect the running in any way.

## The Sparking Plug.

The sparking plug has considerable influence on the performance of the engine and only the best quality plugs of suitable type for the particular conditions of use should be nsed.

The following types of plug are recommended:—Lodge C.14 or H.14 for running-in and average use. If a more heat-resisting plug is required, as for sidecar work and hard solo driving, the K.L.G. LKS.5 and 831 or the Lodge R.14 may be used. The choice of the most suitable plug for the particular conditions of use is most important, and it should be understood that a plug which will stand a considerable amount of oil, as during the running-in period and under traffic conditions, cannot be expected to withstand continued hard driving at high speeds. Similarly, the plug most suited to hard driving will be very prone to oil



up if much slow running is done. The sparking plug which we fit to new machines is of the type found to give the best average results during running-in and normal use afterwards, combining good oil resisting properties with reasonable heat resistance. Fast soloists and sidecar owners should bear these points in mind, as it may often be that better results would be obtained by fitting more heat resisting plugs after the first 2/3,000 miles.

It is occasionally necessary to dismantle the plug and thoroughly cleanse the inside. This is most easily done by holding the gland nut (small hexagon) in a vice and unscrewing the plug body (large hexagon). Do not lock up the vice too tightly or the gland nut will be distorted and difficulty will be experienced in detaching the plug. Do not scrape the mica on the central electrode, or this will be liable to flake off and cause pre-ignition. Use only a clean rag moistened with petrol. Clean the carbon from the inside of the body with an old penknife. When re-assembling, do not forget the copper washer. Screw up tightly and re-set the points to the correct gap 0.5in. to .018in.

When an Ethyl petrol is used regularly it is very desirable to clean the internal insulation of the sparking plugs every 1,000 miles.

## THE CARBURETTER.

Riders are strongly advised not to alter needlessly the carburetter setting. Keep the carburetter clean and periodically empty sediment and moisture from the float chamber and clean the filter in the connecting plug securing the petrol pipe to the carburetter.

To dismantle the carburetter for cleaning and to gain access to the jets, disconnect the petrol pipe at both ends, unhook the throttle cable and detach the complete instrument by undoing the two flange joint nuts. Now undo the two square-headed screws in the top of the float chamber and drop the float chamber and jet assembly away from the main body of the instrument. The auxiliary jet is in the top edge of the float chamber. On the standard carburetter with air choke (fitted to the 600 c.c. models) the main jet is held in position by the brass jet cap at the end of the float chamber arm.

On the Bi-starter carburetter (fitted to the 1,000 c.c. models) the main jet is carried in the inner end of the brass plug which is screwed obliquely into the base of the float chamber.

The standard setting is as follows:—

| | 600 c.c. | 1,000 c.c. |
|---|---|---|
| Choke tube ... ... | 20 | 23 |
| Main jet ... ... ... | 100 × 58 | 120 |
| Auxiliary jet ... ... | 55 | 70 |
| Jet cap ... ... ... | 19 × 2 × 140 | — |
| Air Correction jet ... | — | 150 |
| Starter jet } Bi-starter { | — | 100 |
| Air jet } device { | — | 30 |

Riders are recommended not to alter needlessly these settings.

For further details concerning the carburetter see the Solex Instruction Book.

# THE TRANSMISSION.

## The Gearbox.

It may be said in general terms that the amount of power developed by a motor cycle engine depends upon (1) The amount of gas burned at each power stroke; (2) The number of power strokes obtained per minute. The first condition is controlled by the position of the throttle lever and the second by the speed at which the machine is being driven, and the gear ratio employed.

Even though you have a four cylinder engine, recollect that the best results are obtained when the engine is turning over easily and without snatch, and nothing is to be gained by remaining in too high a gear at low road speeds. Whilst the four cylinder engine is obviously superior to the single in its ability to pull at low speed, it is generally far better to take advantage of its ability to rev without vibration.

**Recollect, a gearbox is provided for use.**

*Lubrication:*—The gearbox should be topped up every 1,000 miles with 2-3 ozs. of one of the recommended greases. A grease nipple is provided in the top of the box just behind the kick-start mechanism.

Do not forget to lubricate all the joints and pivots in the hand control gear-operating mechanism or to grease the enclosed foot control mechanism via the



grease nipple on the top of the cover. Greasers are also provided for the K.S. lever bearing, and for the spiral gears for the speedometer drive.

## Standard Gear Ratios.

| | Engine Sprocket | Top | Third | Second | First |
|---|---|---|---|---|---|
| 600 c.c. | | | | | |
| Solo | 24 | 5.4 | 6.9 | 9.5 | 14.4 |
| *Optional* | 23 | 5.6 | 7.2 | 9.9 | 15.0 |
| Sidecar | 22 | 5.9 | 7.5 | 10.3 | 15.7 |
| 1,000 c.c. | | | | | |
| *Optional* | 25 | 4.3 | 5.5 | 7.4 | 11.6 |
| Solo | 24 | 4.5 | 5.7 | 7.7 | 12.1 |
| *Optional* | 23 | 4.7 | 6.0 | 8.0 | 12.6 |
| Sidecar | 22 | 4.9 | 6.2 | 8.4 | 13.2 |

It may be noted that the difference in top gear ratios with the same engine sprocket is due to a difference in the size of the gearbox driving sprocket. Standard sprocket sizes are as follows:—

| | 600 c.c. | 1,000 c.c. |
|---|---|---|
| Clutch Sprocket ... ... ... | 44 | 44 |
| Gearbox Driving Sprocket ... | 16 | 19 |
| Rear Wheel Sprocket ... ... | 47 | 47 |

The 600 c.c. model also has a gearbox giving slightly wider ratios.

## Clutch Adjustment.

Adjustment to the clutch plates and springs is rarely necessary, and the spring plate tension is correct when the spring nuts stand level with the face of the spring plate. After adjusting the clutch, see that the spring plate lifts equally; if not, the nuts should be eased off on the low side or tightened on the high side until it does.

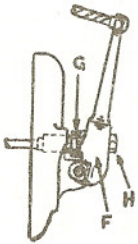



FIG. 13.

CLUTCH WIRE ADJUSTMENT.

The cable adjuster on the gearbox should be set to keep the operating lever in such a position that the Bowden cable is subjected to the minimum of bending; then adjust the plunger screw (H) through the operating lever (F) to give 1/64in. clearance between the two thrust points on the lever and the face of the plunger (G) which slides through the gear box cover. To vary the clearance, push in the top end of the operating lever (thus withdrawing the clutch), and slip off the Bowden wire. Let the lever fall down and rotate the screw (H) through the plunger (G) clockwise to decrease clearance and vice-versa. Replace the cable and check the clearance. The adjustment cannot unscrew in operation as the head of the screw and flats formed on the plunger will only slide through, and not rotate in, the slotted operating lever.

To remove the rubber protecting cover, pull the top end down along the operating lever, after which the lever can be pushed in and the cable freed.

A clutch which sticks when the machine has been standing can be freed by depressing the kickstarter with the clutch held "out" before the engine is started.

## To Dismantle the Clutch.

Remove the clutch dome held by four screws, and then undo the five spring retaining nuts projecting through the spring plate, when the clutch plates can be withdrawn. Care should be taken to re-assemble them in the correct order. The first plate to be put in is the thick plain plate, then a cork insert plate, and a plain plate alternately, finishing with a plain plate.

## Clutch and Sprocket Removal.

Remove the clutch plates, undo the securing nut on the end of the mainshaft, and pull off the clutch centre, which is splined on the mainshaft. This leaves the clutch sprocket and outer clutch housing (carried on a needle roller bearing) in position on the shaft. To remove these parts, knock back the edges of the ring tab washer locking the six set bolts in the centre of



the housing and take out the bolts; the outer housing is now free. To remove the sprocket, it is only necessary to take off the outer half of the oilbath case when the sprocket, sleeve and needle roller bearing can be slipped off the shaft. The rollers are not held in the cage and will therefore drop out when the sleeve is removed. To replace the parts the rollers can be stuck in the cage with a little grease. Note that the plain thrust washer fits behind the roller race with the tongued washer between the race and the clutch centre.

When reassembling these parts, be absolutely sure that the six set bolts are screwed right home and that they are locked in position by the circular tab washer.

## Gear Control Rod. (Hand Change only.)

Engage second gear and see that the gear lever is centrally placed in the second gear gate through the quadrant. If not central, adjust by removing the joint pin in the fork end at the lower end of the control rod and rotating the fork end. Slip the joint pin into position and check the gear lever in each of the other gears: in top and bottom it should not be hard against the end of the quadrant.

## Engine Shaft Shock Absorber.

The shock absorber spring is not adjustable, and the two lock nuts must be kept tight against the shoulder on the shaft. If they are removed, do not forget to replace the tab washer **between** them, turning one tab over on to each nut. Also, do not omit the **hardened** steel washer between the spring plate and inner lock nut.

The correct order of assembly for the shock absorber is as follows:—Sprocket, slider, spring retaining collar, spring, spring plate, hardened washer, locknut, tab washer, locknut.

It is most important to see that the splines on the spring plate register with those on the shaft so that the plate is actually on the splined part of the shaft and not trapped between the hardened washer and shoulder on the shaft. The action is lubricated by the oil in the chain case.

## Primary Chain Adjustment.

Chain adjustment is effected by swinging the gearbox, which is pivot-mounted, back or forward as required. Slack off the pivot bolt which is below the gearbox and which passes through the two lugs on the cradle tubes; similarly, slack off the clamp bolt passing through the engine plates above the gearbox. At the top rear extremity of the offside engine plate, will be found the draw bolt adjuster; rotating the nut on the draw bolt swings the box about the pivot bolt, varying the chain tension. Adjust until the primary chain has approximately ⅜in. up and down movement midway between the sprockets, at the tightest point. Re-tighten clamp bolt and pivot bolt. See that the clamp bolt is pulled up as hard as possible or the box will slip backwards under heavy load. Check hand gear control adjustment.

If the draw bolt nut does not turn easily, do not force it or the draw lug on the gearbox may be broken. Ascertain why the box is not moving; probably the bolts are not properly free or the chain may already be too tight.

## Rear Chain Adjustment.

### (Rigid Frame).

(For Spring Frame Models see page 44).

Slack off the two rear wheel spindle nuts E (Fig. 15) and loosen the nut securing the brake anchor bar to the brake plate. Adjust the chain by rotating the screw adjusters K; turn each adjuster by an equal amount. After making the adjustment tighten up the spindle nuts, the locknuts on the adjusting screws and the brake anchor bar nut. The rear chain should have approximately ⅝in. movement at the tightest point midway between the sprockets. Adjust the rear brake if necessary; see brake adjustment, page 42.

## Chain Lubrication.

The primary chain is lubricated by dipping into the oil in the case. Maintain the oil level up to the "Oil Level Plug," but do not overfill or the oil may be thrown out of the case where the gearbox mainshaft enters. The oil level is not maintained from the engine lubrication system.



Rear chain lubrication is carried out by means of a needle valve in the primary chaincase, just behind the clutch dome. The valve controls an overflow to the rear chain; this overflow only works when the engine is running. Obtain the correct setting by trial on the road; turn clockwise to decrease the supply and vice-versa.

# WHEELS AND BRAKES.

## Front Wheel.

**Removal.**—Before removing the front wheel, place the machine on the rear stand and then lift up the front wheel and swing the stand round under the wheel. Let the stand swing just forward of the vertical position but take care not to let it touch the brake cam bearing or this may be damaged. Remove the bolt from the top end of the brake anchor bar, disconnect the speedometer cable at the lower end if a front wheel driven speedometer is fitted, slack the two spindle nuts and slip the washers out of the recesses in the fork ends, when the wheel will drop out.

**Brake.**—To remove the brake plate, undo the brake plate locknut and slip the plate, complete with shoes, etc., off the spindle. The brake cam is carried in a floating bearing which ensures concentricity of the brake linings with the drum and also gives a semi-servo action. Keep the plate clean so that the bearing can move freely within the limits allowed.

Occasionally lightly grease the brake cam, cam spindle, bearing plate and brake shoe stop peg.

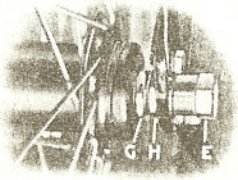



Fig. 14.

Front Wheel Bearing Adjustment.

Adjustment is by means of the milled screw on the lower end of the brake rod.

**Bearings.**—These are taper roller; the outer race is pressed into the hub whilst the inner race is a light sliding fit upon the spindle.

*To adjust:*—Slacken outer spindle nut E (Fig. 14) on side opposite brake drum; hold inner cone adjusting nut G and loosen outer locknut H. Adjust inner nut, and then, still holding this inner nut, tighten the locknut and the outer spindle nut. When the bearing is correctly adjusted **there must be just the slightest slack as measured at the rim.**

*To remove bearings:*—Remove wheel from frame. Take off brake plate (see under Brake). Screw off the two thin locknuts, and tap wheel spindle out towards the brake drum side. Now prise off the dirt excluding disc. The inner bearing with rollers and cage will then come out complete; each side is the same. Do not attempt to remove the outer race—unless damaged—as this is pressed into the hub.

*Lubrication:*—The hubs should be greased every 1,000 miles, using a medium bodied grease. As soon as grease begins to leak past the dirt excluding washer it indicates that the hub is full and no more grease should be inserted or it will be forced into the brake drum, with a serious reduction in brake efficiency.

## Fixed Rear Wheel.

### (Rigid Frame)

The fixed rear wheel follows the same principles of construction, etc., as the front wheel. The following notes cover the main differences.

**Removal.**—Put the machine on the rear stand and disconnect the brake rod, chain and brake plate anchor bar. Undo the spindle nuts, swing up the hinged portion of the guard and draw the wheel back clear of the fork ends.

**Brake.**—As for the front wheel, except for adjustment. The rear brake has a fulcrum adjustment and *all normal brake adjustment must be made by rotating the square-ended fulcrum spindle, in the brake plate.* See full notes on page 42 under Detachable Rear Wheel.

**Bearings.**—See all notes under Front Wheel.



## Detachable Rear Wheel.

### (Rigid Frame, 1937-9 only).

(For Spring Frame Models, see pages 44-46).

**Removal.**—To remove the detachable wheel, put the machine on the rear stand. Undo the three wheel nuts holding the hub to the brake drum, slacken the two plated stay nuts and unscrew and withdraw the spindle bolt on the offside. Tap out the distance piece between the hollow wheel spindle and the fork end, if it has not already fallen out, pull the wheel to the side, clear of the driving pegs and studs, lift up the hinged guard and pull the wheel out.

The wheel is replaced by reversing the procedure.

**Brake.**—To remove the brake, it is generally most convenient first to take out the detachable wheel, although the wheel and brake assembly can be removed as a complete unit if desired.

After taking out the wheel, loosen the brake plate locknut by inserting a thin spanner between the fork end and the brake plate. Disconnect the brake rod, brake anchor bar and chain. Now undo the spindle nut and withdraw the brake drum and sprocket assembly.

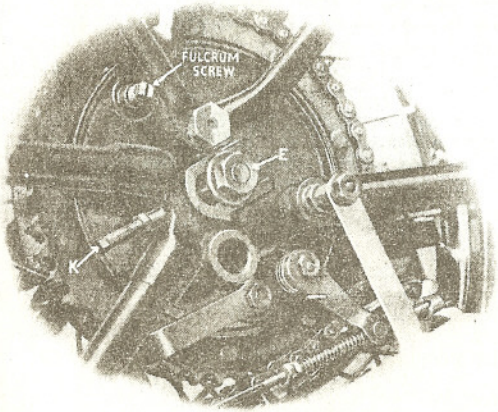



FIG. 15.

REAR BRAKE FULCRUM AND CHAIN ADJUSTMENT.

The brake plate complete with shoes can be removed as soon as the locknut has been fully unscrewed.

Lightly grease the brake cam and fulcrum adjustment device, also brake cam spindle and joints.

To reassemble, reverse the order given and see that:—Spindle nuts are dead tight, brake anchor bar is securely fixed, brake rod connected and adjusted and chain fitted.

*Adjustment:*—The rear brake is fitted with a fulcrum adjuster (Fig. 15) and **all normal brake adjustment must be made by rotating the square-ended fulcrum spindle** situated in the brake plate diametrically opposite the brake lever bearing. Turn clockwise to compensate for wear. The hand adjuster on the rear end of the brake rod must be slacked off whilst the fulcrum adjustment is made. When the fulcrum spindle will turn no further, re-tighten the hand adjusting nut until the brake pedal has only a trace of idle movement.

**Always adjust the rear brake by means of the fulcrum adjuster or the best results will not be obtained.** The thumb screw on the brake rod should only be used to compensate for rear chain adjustment.

**Bearings.**—The wheel itself is carried on a hollow spindle by two journal ball bearings. The brake drum and sprocket are carried on a fixed spindle clamped in the nearside fork end through the medium of a third journal ball bearing.

To remove the hub bearings take out the round circlip and grease retainer in the hub at the flange end and undo the two bearing locknuts at the drive end. The outer nut locks the outer race to the hub whilst the inner nut locks the inner race to the hollow spindle; remove the outer nut first. Now drive out the hollow spindle (and with it the drive end bearing) from the flange end. Note that a collar is pressed on to the hollow spindle outside the flange end bearing; therefore take care to dive on the spindle as the collar will be left behind. The flange end bearing can then be knocked out by means of a drift placed through the hub.

To remove the brake drum bearing, take out the circlip and grease retainer from the hub side. Remove the brake plate locknut, brake plate and distance collar and knock out the fixed spindle and bearing from the brake plate side.



*Lubrication:*—As for the front hub except that slight overfilling is less likely to force grease on to the brake.

## Brake Pedal.

The brake pedal is carried on a pin fixed to the frame stay immediately behind the gearbox fixing. Maintain brake adjustment so that there is no undue lost motion when the pedal is depressed. Grease the bearing periodically.

## THE SPRING FRAME.

**Construction.**—The design of the sprung rear wheel is such that rear chain tension is maintained constant and the brake can be operated direct by the usual rod without the interposition of any link mechanism or flexible cable. This perfect geometric pivoting of the wheel about the gearbox mainshaft ensures maximum life and smooth braking.

The actual construction is as follows:—

Each rear fork lug has cylindrical extensions at the top and bottom. Fitted through the centre is a hardened guide tube A which is clamped to the lug by a substantial bolt K. On this tube is mounted the slider B with bushes C at each end. The spring abutment collar D is forged integral with the slider and extended rearwards to form a horizontal pivot boss E fitted with bush F. The pin G passing through this pivot supports each side of the stirrup H which surrounds the fork lug. The closed end of the stirrup is anchored to the chain stays by short links I, and one arm is extended to carry the wheel spindle. Renewable bushes are fitted to all bearings and the slider mechanism is completely enclosed against mud and dust by tubes L and M. Grease nipples are fitted at the top of the slider tube bolt which is drilled down its centre to carry grease direct to the two slider bushes C, and the slider boss for lubrication of the bush F. The link bearings are fitted with oil impregnated bushes which require no further lubrication.

This combination of the straight line movement given by the slider B, and the small radius are obtained by pivoting the stirrup just forward of the fork lug, gives a flat arc with centre at the gearbox driving sprocket, thus ensuring constant chain tension.

**Assembly.**—The dust excluding tube L is fitted into the cylindrical fork lug from the top, the cut away part facing backwards. Next drop in the thick packing washer and the short recoil spring. Place the slider B in position (short extension below Collar D at bottom) and above the collar fit the dust tube M and the compression spring. Thread the aluminium collar N on to the bolt K and follow with the guide tube A. Now run this assembly down through the slider and thick packing washer until the end of the bolt projects through the bottom of the fork lug; screw on the domed nut and lock up solid. Check this nut periodically for tightness.

The fitting of the stirrup is quite straightforward. Note that the pivot pin G is fitted from the wheel side of the stirrup and screws into the short arm. Tighten the pin until the stirrup has no side float then do up the locknut. The square end of the pin facilitates subsequent adjustment when the head is masked by other fittings. Fit the two links and bolts from the closed end of the stirrup to the frame lug.

**Lubrication.**—Apply the grease gun to the nipples on the head of the clamp bolt K and the pivot boss E every 250 miles.

**Chain Adjustment.**—The wheel slides in the fork ends in the conventional manner but a cam adjustment is employed instead of the screwed adjusters used on the standard models. The two cams carry integral hexagons in order that they may be turned by a spanner, but note that the cams do not screw on to any part. They merely rotate on the plain portion of the wheel spindle or sleeve as the case may be. Further, the cams are not interconnected and each side of the wheel must therefore be adjusted an equal amount to maintain wheel alignment.

*Fixed Wheel.*—Slacken the two outer wheel spindle nuts rotate the cams as required and **relock the spindle nuts.**

*Detachable Wheel.*—Slacken the spindle nut on the brake side. At the other side loosen the sleeve nut. This is the centre one of the three hexagons; the inner one is the cam hexagon and the outer is the main wheel spindle bolt. Rotate the cams as required and **relock securely the spindle nut and sleeve nut.**



**Rear Wheel Removal.**—This is carried out in exactly the same manner as on the rigid frame models. Note however, that with the fixed wheel the chain adjustment and wheel alignment is upset as the two cam adjusters come away with the wheel.

With the detachable wheel, adjustment and alignment are not interfered with as the detachable spindle bolt is carried in a sleeve in the fork end. This sleeve carries the cam adjustment.

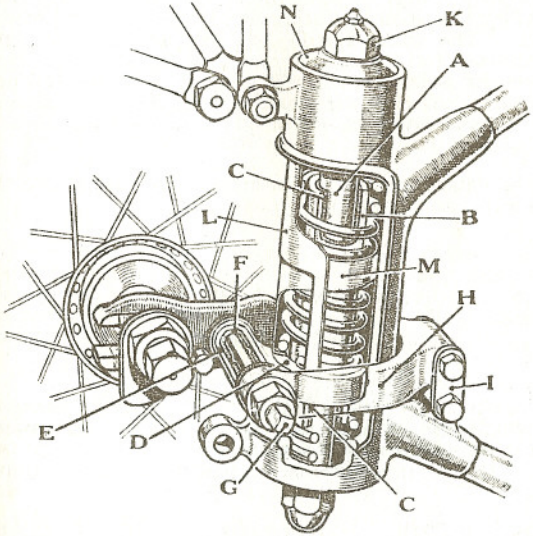



FIG. 16.

SECTION OF SPRING WHEEL ARRANGEMENT.

**Brake.**—The actual brake construction and adjustment is again the same as on the standard models. **Adjust the brake by means of the fulcrum adjustment.** The brake plate however, is not secured to the spindle by means of a locknut. It is located endways by collars inside and outside the plate and is gripped and held securely when the wheel spindle nuts are

tightened. The plate is prevented from rotating when the brake is applied by a peg on the stirrup engaging with a slot in the brake plate. When refitting the wheel, be sure that the peg and slot are in engagement.

**Bearings.**—On the fixed wheel the bearings are non-adjustable, being ordinary ball journal bearings. To remove or inspect the bearings, take out the wheel and remove spindle nuts, cam adjusters, collars and brake plate, etc., being careful to lay these down in correct order so that no mistake shall be made in reassembly. Prise off the dust cover at the brake end of the hub and unscrew the bearing locating ring in the other end of the hub. The wheel spindle has two shoulders forming abutments for each inner race. If the spindle is now driven or pressed out it will carry with it one bearing; the other bearing can then be removed by utilising the spindle again after taking off the bearing already removed.

The detachable wheel bearing arrangement is exactly the same as on the rigid frame models.

# FRAME PARTS.

## Front Forks.

*Adjustment and Lubrication.*

To adjust the fork spindles, slacken the two hexagon locknuts—one at each end of the spindle—and rotate the spindle by means of a spanner placed on the squared end. Rotate anti-clockwise to tighten and clockwise to loosen.

*Note carefully* that retightening the locknut at the end of the spindle which is not squared, will tighten up the adjustment. Therefore adjust a little at a time, tighten locknut and test. When the final adjustment has been made, secure the locknut at the squared end.

The reason that tightening the locknut affects the adjustment is that the spindle at this end is stepped, the shoulder bearing up against a corresponding shoulder in the hole through the link. When the locknut is loosened, the link moves away from the shoulder on to the spindle and *extra* clearance therefore develops.



For correct fork spindle adjustment, the knurled washers next the side links should just rotate easily.

The fork dampers are adjusted by means of the hand nut on the offside lower front spindle only. Keep the spindle screwed right home in the nearside link and the locknut tight.

For the best results, the forks should have a free action, with just sufficient damping to prevent excessive fork bounce on bad roads.

Grease the fork spindles and lower joint pins of the auxiliary damper springs every 250 miles. Also put a spot of oil where the top anchorages of the auxiliary springs pivot on the fork spindle.

When the fork spindles develop excessive backward and forward play, the oil impregnated spindle bushes should be replaced. The spindles are hardened and are unlikely to require replacement each time the bushes are renewed.

## Front Stand.

Never use the front stand by itself. Always first place the machine on the rear stand and then swing the front down under the wheel until the stand is vertical. Do not let it touch the brake cam bearing or damage may be done to either the stand or the brake.

## Steering Head Adjustment.

The head bearings are of the cup and cone ball type and should be adjusted after the first few hundred miles running, after which they will require only infrequent attention.

When adjusting the head bearings it is advisable to take the weight off the front wheel by putting a block under the crankcase; also slacken the steering damper right out. Now loosen the bolt through the ball head clip. Above the clip are two thin nuts; slacken off the top one—a locknut—and adjust by means of the lower one. The steering should be quite free, but there should be no shake in the handlebars. Carefully re-lock.

*Lubrication.*

Two grease gun nipples are provided for the two head bearings. Grease here every 1,000 miles.

## Resilient Handlebar Mounting.

### 1939 Models.

The handlebar is carried in a bracket in which it is fixed through the medium of compressed rubber rings. The two large compression nuts must always be kept screwed up *hard* in order that the resilient mounting may work effectively.

## Steering Damper.

The action of the steering damper is to make the steering much stiffer. It is extremely useful for combination work and high speed solo work, particularly on rough roads. Do not tighten up the damper more than is necessary, and remember to slacken it off whilst reducing speed, as stiff steering at low speeds is very unpleasant and, on occasion, very dangerous. The damper is controlled by the rotation of the black hand knob projecting above the centre of the handlebars; turning clockwise increases the damping.

To dismantle the damper, support the front wheel off the ground by means of a box under the engine. Unscrew the damper knob and remove the anchor plate bolt and star washer fixing nut. To take out the tie rod which passes through the column, remove the lower rear fork spindle.

When re-assembling, note that the nut securing the star washer screws up to a small shoulder, leaving the star washer free to rotate; take care not to trap the washer.

The fixed anchor plate is in the centre of the assembly, the lipped plate, which rotates with the crown, coming next the star washer.

## Petrol Tank.

The petrol tank is secured by four set-bolts, each having two rubber washers and one plain steel washer and locked with a wire. The thick rubber washer goes next to the tank. The set-bolts should not be screwed up too tightly.



If the tank has to be taken off, the cross pipe connecting the two sides must be removed and the tank should, therefore, be emptied. *Note.*—As this pipe comes below the tank, it is liable to choke with sediment, etc. If, therefore, the petrol capacity of the tank appears to diminish take off this pipe and clean, so that there is a free petrol flow between the two sides of the tank.

*To remove filler tank.*—Slacken centre screw, rotate filler cap a quarter turn anti-clockwise, and lift up.

*To replace cap:*—Drop into position, turn cap clockwise as far as possible and tighten centre screw.

*Reserve Petrol:*—A two-level petrol tap is provided. Always run on the main supply, then, when this is exhausted, the tap can be turned to the reserve position and the tank replenished at the next opportunity. Find out how far the machine will travel after turning the tap to reserve and you will then know for future use that petrol must be procured within this distance.

Do not forget to close the reserve tap after filling up.

*To open main supply* pull out knob "Pull on."

*To open reserve supply* pull out knob "Pull reserve." The knob "Pull on" *must* also be left open.

*To close tap* push in both knobs.

*To lock tap open* give quarter turn to plunger after pulling out.

### 1939 Models Only.

*Adjustment of corks:*—As the corks wear with use, adjustment can be effected as follows:—Undo the small hexagon locknut outside the knurled knob marked "Pull on" or "Pull reserve" as required. Then with a small screwdriver, give the adjusting spindle—projecting through the centre of the knob—a half or full turn in an anti-clockwise direction and re-tighten the locknut.

*To renew the corks:*—Take out the small grub screw at the side of the tap and pull out the plunger complete. Fit new cork, replace plunger and adjust. Put back grub screw.

## Instrument Panel.

To remove the instrument panel, proceed as follows:—

If a panel-mounted speedometer is fitted, detach the driving cable from the gearbox by undoing the small fixing screw in the face of the gearbox just below where the cable enters the box. Pull the cable up out of the box. Disconnect the oil gauge pipe at the junction immediately beneath the tank. Remove the petrol filler cap. Take out the two panel fixing screws in the face of the panel.

The panel can now be raised sufficiently to remove any instrument, etc. If the panel is to be taken right away, the two panel lamp leads and the switch leads must be disconnected. These are easily traced as they come down the tunnel with the speedometer flex. Mark them to ensure correct replacement.

When refitting the speedometer flex into the gearbox, it will probably be necessary to rotate the back wheel so that the flat metal tongue on the end of the inner cable can slip into mesh with the corresponding slot on the driving spindle.

## Adjustable Footrests.

These consist of six parts. Two adjustable rests (with rubbers), two footrest supports, a footrest rod, passing through the engine plates, and a distance tube between the plates. The rests are held on to the supports by a taper, the supports being held in position by the rod, and prevented from turning by two pegs on the engine plates which engage with recesses in the supports.

*To remove or adjust the rests:*—Slack off one nut on the end of the footrest rod until the spring washer is just free. With a heavy hammer or mallet give the inner end of the footrest a smart blow to release the taper; the direction of the blow must be such as to rotate the rest about the support. Strike the other rest in the same manner.

It is unnecessary to slacken the other nut and if the nut which is slackened is undone too far the support will disengage with the peg and rotate, so preventing the taper joint being broken.

After setting the rests in the required position see that the securing nut is really tight.



## Rim and Tyre Sizes.

The 3.00 × 20 front tyre is fitted to a 2¼ 20 rim. The most suitable oversize is 3.25 × 20.

The 3.25 × 19 tyres are fitted to 2½—19 rims and oversizes are 3.50 × 19 and 4.00 × 19, although the latter is better mounted on a 3—19 rim. The 4.00 × 18 tyre is fitted to a 3—18 rim and this is the largest available tyre.

## Tyre Pressures.

Actual tyre pressures are dependent upon several factors such as load carried, normal running speed and road conditions, etc. For average use the following are the recommended **minimum inflation pressures** for Dunlop Cord Tyres, given in lbs. per square inch:—

| | Tyre Size. | | Front. | Rear. | Sidecar. |
|---|---|---|---|---|---|
| **Solo** | 3.00—20 | ... | 26 | — | — |
| | 3.25—19 | ... | 20 | 26 | — |
| | 3.50—19 | ... | 16 | 22 | — |
| | 4.00—18 | ... | 16 | 18 | — |
| **Sidecar.** | 3.00—20 | ... | 30 | — | — |
| | 3.25—19 | ... | 22 | 32 | 16 |
| | 3.50—19 | ... | 18 | 26 | 16 |
| | 4.00—18 | ... | 16 | 20 | 16 |

If a pillion rider is carried, the rear tyre pressure should be increased to carry the extra load.

# WHEEL ALIGNMENT.

## Solo Machine.

Procure a plain board about 6ft. long, 3in. wide and ¾in. thick. One edge must be planed perfectly straight and square. With the machine on the stand place the straight edge of the board alongside the two wheels so that the board touches the rear tyre at two points. Turn the handlebars if necessary so that the front wheel lies parallel to the edge of the board. Unless the front and rear tyres are of the same size the board will not touch the front tyre. Measure the clearance from the tyre to the edge of the board then place the board in a similar position on the opposite side of the wheels and measure again. When the wheels are in track the clearance will be the same on each side. Alter the alignment of the rear wheel by means of the adjusters K., Fig. 15, until this occurs. If the tyres are of the same size the board will, of course, just touch the front tyre on each side.

## Sidecar.

Stand the combination on a smooth level floor and see that the motor cycle wheels are in line as described. Take the board and place it against the sidecar wheel as illustrated. Measure the distance from the inner edge of the board opposite each wheel spindle to the near edge of the front and rear wheel rims. In practice it is generally desirable to have the front measurement "B" about ¼in. less than the rear measurement "A"; this is called "toe-in." Adjust the sidecar connections until this alignment is obtained.

*Note.*—If the rims are of different widths allowance for this must be made. Assuming the rear rim to be the wider, add half the difference in rim width to measurement "B" before comparing with "A" e.g., assuming a 3in. rear rim and a 2½in. front rim, add ¼in. to measurement "B."

An incorrectly aligned sidecar can seriously affect tyre life. Hence, check over connections occasionally and test the wheels for alignment. Also see that the motor cycle is upright.

## Sidecar Connections and Vertical Alignment 1939.

The 1939 Ariel Sidecar Chassis was a special design of triangular construction with 3-point connection; due to this design a fourth point connection is entirely unnecessary. The front and rear connections are ball jointed and should be kept locked up quite tight, so that the ball has no apparent freedom inside its housing. (Make quite certain that the locking ring is secure.) This connection easily adjusts itself to slight movement and occasional graphite greasing will prevent any tendency to squeak.

Wheel alignment is obtained by sliding the drop arm, from the rear ball joint, along the sidecar frame tube.

Vertical alignment of the motor cycle is obtained by means of the screwed yoke end at the top of the seat pillar connection tube. Further adjustment is available by sliding the chassis clamp lug, to which the tube is attached, along the frame; keep the ball headed pinch bolt at right angles to the connecting tube. Grease periodically the sliding joint at the bottom of this tube. The motor cycle should be perfectly upright, or even leaning very slightly outwards; on no account allow it to lean in towards the sidecar. The Ariel 1939 Sidecar Chassis can be fitted to 1948 models, but is now no longer manufactured.



# CLEANING.

## Chromium Plating.

Chromium plating must never be cleaned with metal polishes and similar abrasives, or the surface deposit will be destroyed and rusting of the metal underneath will take place. Always clean with a wet sponge and polish with a soft cloth.

The attention of riders who live in industrial and manufacturing districts may be called to the fact that there is generally a certain amount of chemical matter on the roads. In wet weather, these chemicals get splashed on to the chromium-plated parts and may often lead to the chromium deposit being attacked. Similarly, where salt is used on the roads to remove snow, the chrome will be attacked more readily. It is therefore a sound plan where these conditions of use are encountered, to swill down the chrome parts with clean water, after the machine has been used.

## Enamelled Parts.

The enamelled parts should never be dry cleaned or the surface will be scratched. This may lead ultimately to moisture penetrating to the metal with resulting corrosion and flaking off of the enamel.

To remove mud and dirt use a sponge and plenty of water, soaking the mud off. Oil and mud can be removed by soaking with paraffin. When all dirt has been removed, dry off the machine with a chamois leather and then polish, if desired, with one of the proprietary polishes.

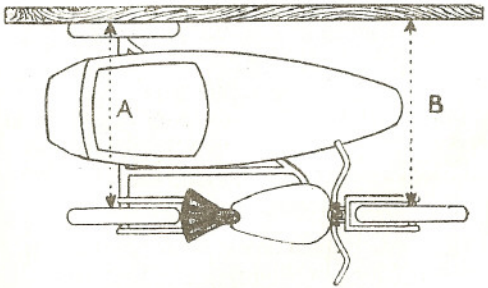



Fig. 17.

Method of Testing Wheel Alignment.

## WHEN AND WHERE TO LUBRICATE.

### Every 250 Miles.

| | | |
|---|---|---|
| **Oil.** | Check level in tank and top up if required. | |
| | Clutch operating lever pivot ... | 1 point. |
| | Clutch operating plunger ... ... | 1 „ |
| | Thrust points between lever and plunger ... ... ... ... | 2 „ |
| **Grease.** | Front Forks ... ... ... | 5 „ |
| | Auxiliary Damper Springs (and oil top pivots) ... ... ... | 2 „ |
| | Spring Frame ... ... ... | 4 „ |
| | Distributor Gears ... ... ... | 1 turn of greaser. |

### Every 500 Miles.

| | | |
|---|---|---|
| **Oil.** | Replenish Primary Chain Case to "oil level" plug. | |
| | Check supply to rear chain ... | 1 point. |
| | All handlebar controls and cables. Front and rear brake operation | Pivots & cable. |
| | Outer end brake cam bearings in each wheel ... ... ... | 2 points. |
| **Grease.** | Rear brake pedal pivot ... ... | 1 „ |
| | Foot Gear Change ... ... | 1 „ |
| | Kickstart Crank ... ... ... | 1 „ |
| | Speedometer Spindle ... ... | 1 „ |

### Every 1,000 Miles.

| | | |
|---|---|---|
| **Grease.** | Steering Head Bearings ... ... | 2 „ |
| | Front and Rear Wheel Bearings . | 2 „ |
| | 2-3 ozs. in Gearbox. | |

### Every 1,500 Miles.

Drain oil tank and sump, flush out and refill.

| | | |
|---|---|---|
| **Grease.** | Front Wheel Speedometer Gearbox | 1 „ |

### Every 2,500 Miles.

| | | |
|---|---|---|
| **Oil.** | Plain Dynamo Bearing by Commutator ... ... ... ... | 1 „ |
| | Wick on Contact Breaker Cam Ring | 1 „ |
| **Grease.** | Withdraw Clutch Push Rod and grease lightly including Ball in Plunger ... ... ... ... | 2 „ |



ENGINE OILS AND GREASES RECOMMENDED FOR USE WITH THE SQUARE FOUR.

See also Notes on Pages 2 and 3.

## LUBRICATION RECOMMENDATIONS

| | WAKEFIELD | ANGLO | PRICES | SHELL | VACUUM |
|---|---|---|---|---|---|
| **Engine 4 cyl.** Summer | Castrol XXL | Essolube 50 | Motorine B de Luxe | Triple Shell | Mobiloil BB |
| Winter | Castrol XL | Essolube 30 | Motorine E | Single Shell | Mobiloil A |
| **Engine Single cyl.** Summer | Castrol Grand Prix | Essolube 50 | Motorine B de Luxe | Triple Shell | Mobiloil D |
| Winter | Castrol XXL | Essolube 40 | Motorine C | Double Shell | Mobiloil BB |
| **Gearbox** | Castrolease Medium | Esso Grease | Belmoline C | Shell Retinax CD | Mobilgrease No. 2 |
| **Oil Bath, Chain Case & Rear Chain** | Engine Oil | Engine Oil | Engine Oil | Engine Oil | Engine Oil |
| **Wheel Hubs** | Castrolease Heavy | Esso Grease | Belmoline C | Shell Retinax RB | Mobil Hub Grease |
| **General Greasing** | Castrolease CL | Esso Grease | Belmoline C | Shell Retinax CD | Mobilgrease No. 2 |
| **Telescopic Forks** Normal Conditions | Castrol XL | Essolube 30 | Motorine C | Double Shell | Mobiloil A |
| Arctic Conditions | Castrolite | Essolube 20 | Motorine E | Single Shell | Mobiloil Arctic |

**Table showing relation between Engine Revolutions per minute and speed in miles per hour for different gear ratios with 26in. wheels.**

| Gear Ratios. | MILES PER HOUR. | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
| 4.3 | 558 | 835 | 1115 | 1390 | 1670 | 1950 | 2230 | 2505 | 2785 | 3060 | 3335 | 3615 | 3900 | 4180 | 4460 | 4735 | 5010 | 5285 | 5570 |
| 4.5 | 583 | 874 | 1168 | 1457 | 1749 | 2040 | 2332 | 2623 | 2915 | 3206 | 3495 | 3789 | 4081 | 4372 | 4664 | 4955 | 5247 | 5538 | 5830 |
| 4.7 | 608 | 912 | 1216 | 1520 | 1824 | 2128 | 2432 | 2736 | 3040 | 3344 | 3648 | 3952 | 4256 | 4560 | 4864 | 5168 | 5472 | 5776 | |
| 4.9 | 634 | 951 | 1268 | 1585 | 1902 | 2219 | 2536 | 2853 | 3170 | 3487 | 3804 | 4121 | 4438 | 4755 | 5072 | 5389 | 5706 | | |
| 5.4 | 700 | 1050 | 1395 | 1750 | 2095 | 2450 | 2795 | 3145 | 3495 | 3860 | 4195 | 4545 | 4890 | 5240 | 5600 | 5940 | | | |
| 5.6 | 725 | 1085 | 1450 | 1810 | 2175 | 2540 | 2900 | 3260 | 3625 | 3985 | 4350 | 4720 | 5070 | 5440 | 5800 | | | | |
| 5.7 | 738 | 1107 | 1476 | 1845 | 2214 | 2583 | 2952 | 3321 | 3690 | 4059 | 4428 | 4797 | 5166 | 5535 | 5904 | | | | |
| 5.9 | 763 | 1145 | 1527 | 1910 | 2295 | 2675 | 3055 | 3435 | 3820 | 4200 | 4580 | 4960 | 5340 | 5725 | | | | | |
| 6.2 | 803 | 1205 | 1606 | 2008 | 2409 | 2810 | 3212 | 3614 | 4015 | 4417 | 4818 | 5219 | 5621 | | | | | | |
| 6.9 | 894 | 1340 | 1785 | 2235 | 2680 | 3125 | 3535 | 4020 | 4470 | 4920 | 5365 | 5805 | | | | | | | |
| 7.5 | 972 | 1455 | 1945 | 2430 | 2915 | 3400 | 3895 | 4370 | 4850 | 5340 | 5830 | | | | | | | | |
| 7.7 | 997 | 1495 | 1994 | 2492 | 2991 | 3489 | 3988 | 4486 | 4985 | 5483 | 5982 | | | | | | | | |
| 8.4 | 1088 | 1632 | 2176 | 2720 | 3264 | 3808 | 4352 | 4896 | 5440 | 5984 | | | | | | | | | |
| 9.5 | 1230 | 1845 | 2460 | 3080 | 3695 | 4315 | 4925 | 5540 | | | | | | | | | | | |
| 10.3 | 1335 | 2005 | 2665 | 3340 | 4010 | 4675 | 5390 | | | | | | | | | | | | |
| 12.1 | 1568 | 2352 | 3136 | 3920 | 4704 | 5488 | | | | | | | | | | | | | |
| 13.2 | 1710 | 2565 | 3420 | 4275 | 5130 | 5985 | | | | | | | | | | | | | |
| 14.4 | 1865 | 2800 | 3730 | 4670 | 5600 | | | | | | | | | | | | | | |
| 15.7 | 2035 | 3050 | 4070 | 5080 | 6100 | | | | | | | | | | | | | | |

## Table showing relation between Engine Revolutions per minute and speed in miles per hour for different gear ratios with 26in. wheels.

| Gear Ratios. | MILES PER HOUR. | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
| 4.3 | 558 | 835 | 1115 | 1390 | 1670 | 1950 | 2230 | 2505 | 2785 | 3060 | 3335 | 3615 | 3900 | 4180 | 4460 | 4735 | 5010 | 5285 | 5570 |
| 4.5 | 583 | 874 | 1166 | 1457 | 1749 | 2040 | 2332 | 2623 | 2915 | 3206 | 3495 | 3789 | 4081 | 4372 | 4664 | 4955 | 5247 | 5538 | 5830 |
| 4.7 | 608 | 912 | 1216 | 1520 | 1824 | 2128 | 2432 | 2736 | 3040 | 3344 | 3648 | 3952 | 4256 | 4560 | 4864 | 5168 | 5472 | 5776 | |
| 4.9 | 634 | 951 | 1268 | 1585 | 1902 | 2219 | 2536 | 2853 | 3170 | 3487 | 3804 | 4121 | 4438 | 4755 | 5072 | 5389 | 5706 | | |
| 5.4 | 700 | 1050 | 1395 | 1750 | 2095 | 2450 | 2795 | 3145 | 3495 | 3860 | 4195 | 4545 | 4890 | 5240 | 5600 | 5940 | | | |
| 5.6 | 725 | 1085 | 1450 | 1810 | 2175 | 2540 | 2900 | 3260 | 3625 | 3985 | 4350 | 4720 | 5070 | 5440 | 5800 | | | | |
| 5.7 | 738 | 1107 | 1476 | 1845 | 2214 | 2583 | 2952 | 3321 | 3690 | 4059 | 4428 | 4797 | 5166 | 5535 | 5904 | | | | |
| 5.9 | 763 | 1145 | 1527 | 1910 | 2295 | 2675 | 3055 | 3435 | 3820 | 4200 | 4580 | 4960 | 5340 | 5725 | | | | | |
| 6.2 | 803 | 1205 | 1606 | 2008 | 2409 | 2810 | 3212 | 3614 | 4015 | 4417 | 4818 | 5219 | 5621 | | | | | | |
| 6.9 | 894 | 1340 | 1785 | 2235 | 2680 | 3125 | 3535 | 4020 | 4470 | 4920 | 5365 | 5805 | | | | | | | |
| 7.5 | 972 | 1455 | 1945 | 2430 | 2915 | 3400 | 3895 | 4370 | 4850 | 5340 | 5830 | | | | | | | | |
| 7.7 | 997 | 1495 | 1994 | 2492 | 2991 | 3489 | 3988 | 4486 | 4985 | 5483 | 5982 | | | | | | | | |
| 8.4 | 1088 | 1632 | 2176 | 2720 | 3264 | 3808 | 4352 | 4896 | 5440 | 5984 | | | | | | | | | |
| 9.5 | 1230 | 1845 | 2460 | 3080 | 3695 | 4315 | 4925 | 5540 | | | | | | | | | | | |
| 10.3 | 1335 | 2005 | 2665 | 3340 | 4010 | 4675 | 5390 | | | | | | | | | | | | |
| 12.1 | 1568 | 2352 | 3136 | 3920 | 4704 | 5488 | | | | | | | | | | | | | |
| 13.2 | 1710 | 2565 | 3420 | 4275 | 5130 | 5985 | | | | | | | | | | | | | |
| 14.4 | 1865 | 2800 | 3730 | 4670 | 5600 | | | | | | | | | | | | | | |
| 15.7 | 2035 | 3050 | 4070 | 5080 | 6100 | | | | | | | | | | | | | | |

# THE MODERN ARIEL MOTOR CYCLE

## MODEL 4G

## 1948 SUPPLEMENT to the 1946-7 OWNERS' GUIDE

### Ref. Pages 23-24

During the 1948 Season a modified type of Big End Bearing was introduced and fitted to certain series of Engines. The bearing consists of two separate loose liners, white metalled, which are located in the connecting rod by means of a small protruding lip. The liners are supplied in pairs by our Service Department when replacements are needed and as they are all finished to a determined standard size no special instructions are necessary relative to fitting other than to ascertain that the location is correct when the connecting rod is fitted to the crank journal.

In place of the original slotted type securing nuts, big end bearing bolts are fitted with a special Simmonds Pinnacle lock nut which does not require a cotter pin. These nuts can be used again after being removed, although many riders do prefer to replace the set for security purposes.

On no account must any attempt be made to fit the loose liners to the early type white metalled connecting rod. Loose liners can only be used with the modified rods. It is permissible however to fit the modified connecting rod assembly complete to early type crankshafts, but owing to the rods having a thicker end cap, it will always be necessary to grind deeper chamfers on the inside edges of all balance weights to allow the Big End of the rods to clear whilst in motion with both shafts in position in the crankcases. Engines fitted with the modified connecting rods have the Simmonds locknuts uppermost and it is a comparatively simple operation to remove the nuts, big end bolts and bottom cap from each rod with the engine still in position in the frame of the machine. After removing the cylinder block etc. and before attempting to dismantle the rods, it is advisable to place a piece of clean cloth around the crankshaft assembly in order to catch any of the nuts, bolts etc. which may accidentally be dropped into the crankcase.