THE MODERN

ARIEL

MOTOR CYCLE

1935 - 1936

OWNERS' GUIDE

SQUARE FOUR

4-CYLINDER

Price

ONE SHILLING

ARIEL MOTORS LTD.

SELLY OAK, BIRMINGHAM 29

Grams: "ARIEL, SELLY OAK,
Phone: SELLY OAK 1161

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.*, 4F/6 or 4F/5 and year of manufacture.

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, 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 have become seasoned by constant heating and cooling and have acquired first-class bearing surfaces and well-fitting rings. A throttle stop, preventing the throttle being opened more than half way, is fitted and should be left in position for at least 500/750 miles. This fitment will materially assist the rider in the proper running in of the engine, but it must not be considered an absolute preventative of overdriving.

Fuel, Oil and Grease.

Good oil and petrol are always necessary, but are even more essential during the running-in period. We very strongly recommend the exclusive use of one of the following oils :—

Wakefield Castrol XXL.
Mobiloil D.
Aero Shell.

Do not use Castrol R or similar racing oils; these are unsuited to the Square Four.

Any No. 1 spirit of reputable brand will be entirely satisfactory, and we do not advise the use of benzole mixtures.

The following greases are recommended for general use :—

Castrolease Medium.
Mobilgrease No. 2.
Shell Motor Grease Soft.

Instructions for Starting.

The engine will always start readily if these instructions are followed :—

Set the ignition one-third advanced, slightly open the throttle—about one-eighth of the total movement of the grip—close the air lever and very slightly flood the carburetter by momentarily depressing the "tickler" in the lid of the float chamber. Turn the ignition switch on the panel to "ON." Now depress the kick-starter sharply. If the engine has started,

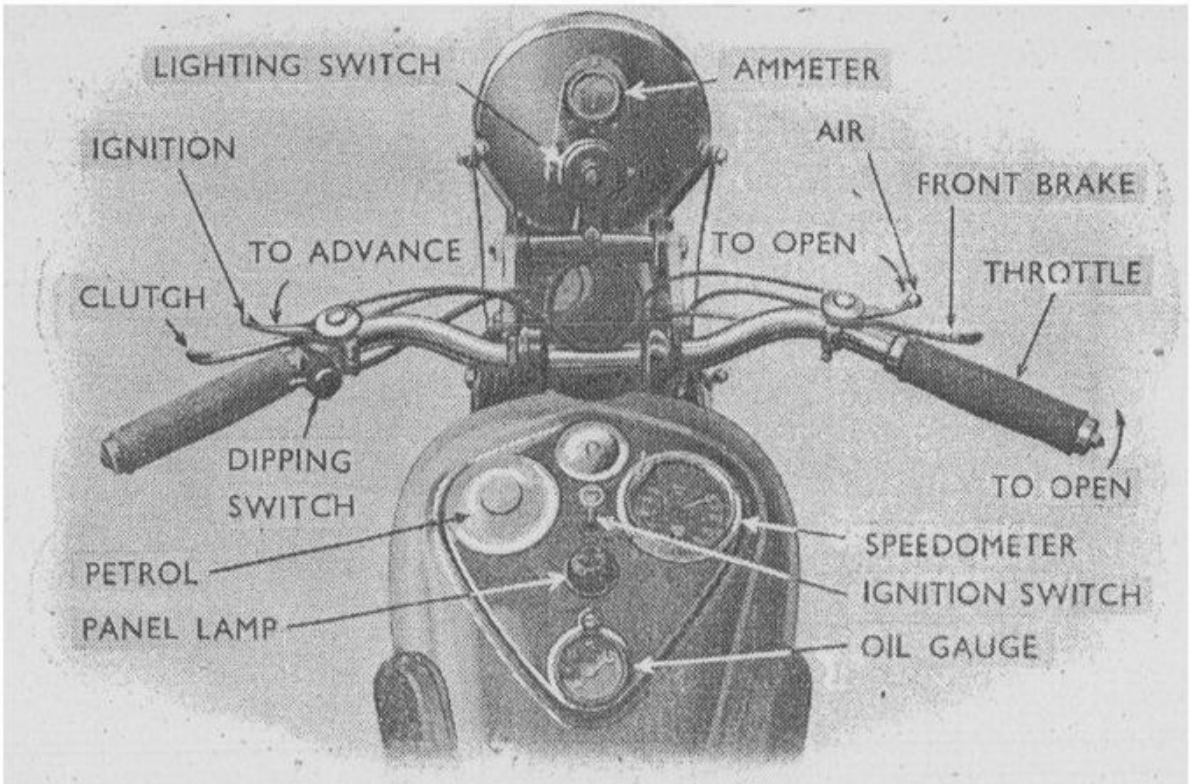

FIG. 1.
THE CONTROLS.

fully advance the ignition and open the air lever about half to three-quarters. As soon as the engine is warm—about half a minute—fully open the air. Note that when the engine is warm it will probably be better to leave the air open when starting.

See that the oil gauge mounted in the tank is registering a pressure. Under normal running conditions this will be about 10-15 lbs.

The Ariel lubrication system is entirely automatic in action, and so long as the oil sump is kept replenished it is practically impossible for any trouble to occur. Hence occasionally verifying the supply by seeing that a pressure is maintained is all that is required.

If the engine has not started, have two or three more attempts, but do not flood the carburetter any more. Trouble in starting a new machine is more likely to be due to inexperience on the part of the rider than to there being any fault present.

If this is your first machine persevere for a few minutes before starting to look for faults. If, however, the engine still fails to start, check over the following points in the order given.

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. See that the knurled ring holding the top of the mixing chamber in position is firmly screwed down and see that the carburetter is bolted up tightly on to the cylinder head ; the flange joint washer will contract after several heatings.

3. Test the ignition system. To do this, take off one of the plug connections and hold it just above the top of the central electrode so that there is a gap of $\frac{1}{16}$in. to $\frac{1}{8}$in. Now operate the kick-starter. A good spark shows that there is nothing wrong with the magneto. The trouble may, therefore, be either dirty sparking plug or carburation.

4. 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 kick-starter 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.

5. If in the fourth 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 kick-starting again. If the engine still fails to start, it is probably not due to ignition trouble, and so check as follows :—

6. Make sure that the throttle slide has actually moved in response to the movement of the control. The wire may have stretched, or may even be broken. Further possibilities are that the slow-running mixture adjusting screw may require resetting, or the throttle stop screw may require adjusting slightly. See details in carburetter booklet.

7. The Carburetter may require cleaning; dismantle and thoroughly clean, paying particular attention to the slow-running jet in the jet block. To remove the block, disconnect the float chamber and undo the large hexagon gland nut immediately below the mixing chamber body. Take hold of the needle jet (the projecting hexagon centre) and pull down. The slow-running jet passages are in that part of the jet body nearest to the engine. Clean out the passages but do not poke through them wires or other cleaning " instruments " which are likely to damage or enlarge the holes. When replacing this jet body, see that the locating peg is fitting into the small slot at the base of the mixing chamber. Do up the gland nut dead tight, carefully replacing the fibre washer.

8. Check over the leads from the distributor to the sparking plugs, seeing that they go to the right cylinders (See Fig. 3.)

9. If in test No. 4 above, no spark is obtained from the high tension lead it indicates that there is some fault in the ignition system; check as follows :— Take off the contact breaker cover and try kick-starting again. If the engine fires, it indicates broken insulation on the wire leading to the cut-out switch. Bind with insulating tape or, as a temporary measure, disconnect the wire at the contact breaker.

10. See that there is no fault in the high tension leads, particularly in that from the magneto to the centre of the distributor cover on the end of the camshaft.

11. See that the contact breaker points are clean and are opening and closing as the engine is turned round. (See Contact Breaker, page 21.)

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

It is to be assumed that the engine will have started long before the above list of possible causes of trouble has been exhausted, but it may have started and be misfiring when running under load. In this case :—

(*a*) Let the engine warm up thoroughly. This will take several minutes; a cold engine will not give of its best.

(*b*) Possibly one of the plugs is defective; 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 as before "cutting out," it shows that the plug was not firing before being "cut out," and it is, therefore, faulty. It should be taken out and cleaned or, if necessary, replaced with a new one.

(*c*) Sometimes a plug will fire up inside the body instead of across the points. Test as in No. 4. In this case the test can be carried out with the engine running. Should the interior plug insulation be slightly moist with petrol, it makes the test more severe, but the spark should jump the plug points as soon as the petrol vapour has cleared away.

(*d*) Make sure that the carburetter is quite clean. A little water or dirt may be partially obstructing one of the petrol passages, or completely obstructing one of the passages at intervals.

(*e*) See that the taper needle attached to the throttle slide has not slipped ; see page 23.

(*f*) See that none of the valves are sticking. A sticking valve is most probably due to shortage of (or unsuitable) oil. Clean out the baffle and oil pipe to the rocker box and check the oil delivery (35/40 drops per minute).

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 only for starting, and occasionally slightly retard for hill climbing.

Don't hang on to too high a gear. Change to the next lower gear immediately the engine shows signs of labouring or, if on the level, 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.

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

THE ENGINE.

Construction.

The general arrangement is as follows :—

The four cylinders are arranged vertically, and form the corners of a square. The two front cylinders have conventional type pistons and connecting rods operating on a crankshaft placed across the frame. The two rear cylinders have similar conventional type pistons and connecting rods operating on another parallel crankshaft, these two shafts being geared together by a pair of massive gears carried in an oil-bath housing, the two shafts being carried on five large ball bearings. The big end bearings are single row roller, three bearings being carried on overhung

cranks whilst the fourth (No. 3) is of the conventional built-up flywheel type to take the drive through to the engine sprocket.

Lubrication is by oil circulation from the large capacity sump.

The valves are mounted vertically in the cylinder head and are operated through rockers from an overhead camshaft which is chain driven from the half-time shaft.

The compression ratio is approximately 5¼ to 1.

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

The Lubrication System.

Mounted in the lower half of the crankcase on the right hand side, is the single acting plunger pump; the drive is from an eccentric on the half-time shaft through the medium of a connecting link. The oil is drawn from inside a submerged gauze filter in the sump, passes through the pump, through the external felt pad oil filter and thence direct to the inner gearcase, creating an oil-bath for the crankshaft coupling gears. A small quantity of oil is blown directly into the cylinder bores through vent holes in the top of the gearcase, whilst the balance escapes through small holes below the main bearings into the four dipper troughs, creating splash lubrication as the connecting rod dippers catch the oil. The used oil then drains down into the sump for recirculation.

The overhead rocker and valve gear is lubricated separately, a small quantity of oil being tapped off from the main supply and carried up to the rocker box by an external oil pipe. Interposed in the main oil lead between the pump and the external Tecalemit filter is a pressure regulating ball valve. As the oil connection to the rocker gear is on the pump side of this valve, screwing up the regulator so that the oil pressure is increased will force more oil up to the rocker gear; to prevent an excessive feed the oil passes through a baffle connected to the front of the rocker box. This baffle consists of a screw plug in the oil passage, the tops of the threads in the passage being removed so that the oil has to force its way along the spiral so formed between the threads. A small thimble-shaped gauze filter is fitted to the baffle

inlet, and filter and baffle should be cleaned periodically. From the baffle the oil passes into the camshaft tunnel via the feed pipe and hole F (Fig. 3). The oil flows both ways along this camshaft tunnel, so that as the cams rotate they dip into the oil, lubricating themselves and the rocker lever end pads, and creating splash lubrication to the rocker lever bearings and the valve stems and guides. Surplus oil drains to the driving side of the rocker box and passes through oil holes drilled in the end of the box, into the camshaft chain case where it drips on to the chain, lubricating this, and creating a heavy oil mist, which lubricates the magneto driving chain. This oil ultimately drains down into the bottom of the two chaincases and so back into the main sump.

Oil Level in Sump.

Maintain the oil level half to two-thirds of the way up the flat formed on the dipstick situated forwards on the right side of the crankcase. This corresponds to about 3 pints of oil in the sump.

Notes on the Oil Supply.

Pressure Gauge.

A pressure gauge is incorporated in the oiling system so that the rider can tell at a glance that the oil is circulating. The gauge is connected to the delivery side at a point immediately following the pump, the pressure being created by a spring-loaded ball valve.

Although a means is provided for varying the oil pressure, it should be understood that a pressure registered on the oil gauge simply indicates that the lubrication system is functioning. The quantity of oil passing to the engine is governed entirely by the efficiency of the pump and the actual engine speed. **Increasing the oil pressure does not increase the efficiency of the lubrication system or the amount of oil passing to the engine,** and a pressure regulator is used mainly to facilitate setting the gauge to give a normal reading of 10-15 lb. per sq. inch, although, as previously described, varying the oil pressure will give some control over the amount of oil passing to the overhead rocker gear.

The pressure is adjusted by means of the small hexagon headed screw projecting from the centre of the rear

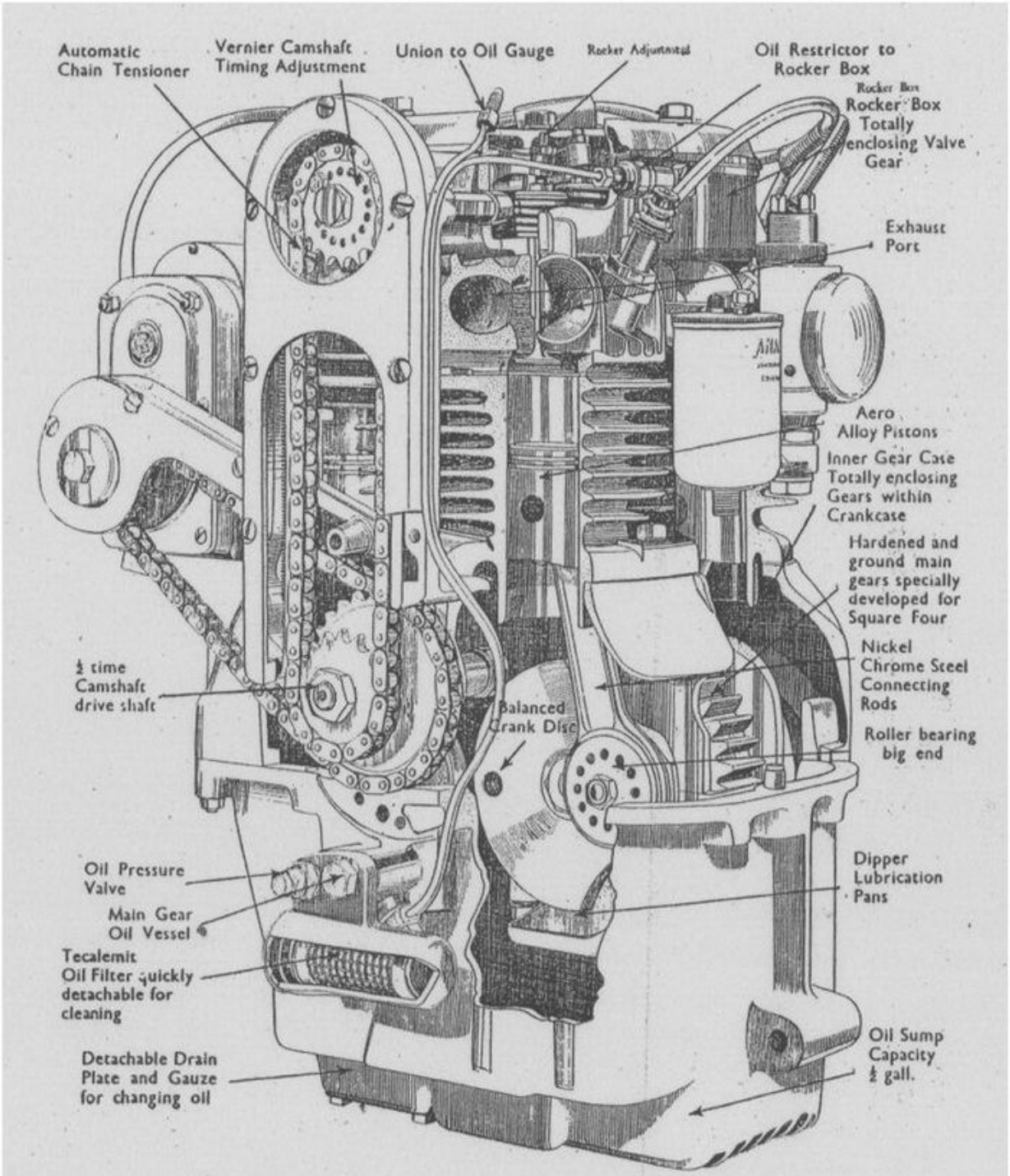

FIG. 2.

PART SECTION VIEW OF ENGINE.

plug of the two securing the external oil filter to the crankcase. Turning the screw clockwise increases the pressure whilst rotating the screw anti-clockwise has the reverse effect.

The flow of oil can be tested by removing the plug to the right of the regulator when, with the engine running, oil will be pumped out at this point instead of passing along the oil pipe to the inner gearcase.

When first starting up the engine after draining the sump or if the engine has been standing for some time, it may be necessary to slack off the pressure regulator 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 regulator until the oil starts to leak past, then retighten.

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

1. Remove pressure regulator, clean in petrol and reassemble as follows : *a*, Steel ball ; *b*, spring ; *c*, adjusting screw and locknut.

2. Clean oil filters (sump, external and rocker box baffle) and if the oil has been in use for some time, refill with clean oil.

3. Clean the ball valve and spring, carried in the cupped plug below the pump body. Access to the valve is obtained via the plug at the top end of the groove running up the side of the crankcase immediately below the timing chain covers.

Oil Filters.

A gauze oil filter is situated in the crankcase sump and should be cleaned every 1,000 to 1,500 miles, at which time the old oil should be thrown away, the crankcase swilled out to remove sludge, etc., and the engine refilled with fresh, clean oil. When replacing the sump filter be sure that the internal oil pipe is located in the hole through the gauze and support. The felt pad oil filter which is situated in the cylindrical aluminium housing just below the camshaft chaincase must be cleaned every 500 to 750 miles unless it is found to contain little dirt or sludge, in which case the cleaning interval can be extended. To clean the filter, undo the end plug and withdraw the felt filter element. Undo the two locknuts on the centre rod and so remove the two end plates. Now wash the filter element in petrol. When it is quite clean, re-assemble, taking care to screw the locknuts as far down the centre rod as they were previously. This is important, as they regulate the spring tension of the relief valve which allows the oil to by-pass the filter if it becomes thoroughly choked with dirty oil. Do

not omit the fixing spring which is inside the end cap and which holds the filter element against the shoulder in the body.

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 three/five thousand miles under average conditions of use. This is a perfectly simple operation and is carried out as follows :—

(1) Remove the exhaust pipes, sparking plugs, carburetter, distributor cover and rocker box lid.

(2) Disconnect the oil pipe to the front of the rocker box and the connection in the oil gauge pipe.

(3) Unscrew the plug in the top of the camshaft chaincase. This exposes the sprocket securing bolt, which must be removed. Insert into this hole a flanged collar which is provided in the toolkit. This collar is somewhat similar to the plug which has just been removed, but it has no thread, and has a hole through its centre. Through this hole place the extractor bolt and screw this up into the sprocket. This will pull the sprocket off the camshaft. Leave the extractor bolt and collar in position ; they will hold the sprocket and prevent the valve timing being upset through the camshaft sprocket coming out of mesh with the chain when the engine is rotated. Do not touch the small vernier bolt. Remove the cheese-head screw on each side of the extractor. These screws hold the chaincase up to the rocker box.

(4) Remove the eight head securing bolts, free the head from the block by gently prising up and draw the head away on the near side. Take care not to damage the copper asbestos joint washer, and do not attempt much prising up on the camshaft drive side as the rocker box is spigotted into the chaincase. Note how the cylinder head washers are fitted, ready for replacement. They must be refitted so that the inside shape of the washer conforms to the contour of the combustion chamber.

(5) Scrape all carbon from the piston tops and combustion chambers ; clean the joint washers.

(6) To remove and grind in valves, rotate the camshaft until all four valves belonging to the two front cylinders are on their seats. Removal of the distributor cover back plate reveals two holes in line with the two rocker spindles. Obtain a $\frac{1}{4}$in. dia. bolt screwed 26 t.p.i., *e.g.* head lamp bracket bolt, etc., and screw it into the end of the front rocker spindle. Pulling this bolt outwards will pull the rocker spindle out of the case and free the rockers, distance shims, spring washers, etc. Carefully collect these as the spindle is pulled out, and lay out each item on the bench in the same order. These parts are all interchangeable, but it is always better practice to replace a part in the same position. The rear rocker spindle is dealt with in exactly the same manner. Remove the valve stem end caps, and put them in a safe place.

To take out the valves, support the valve head and compress the spring by pressure on the top collar; the split cones can then be removed.

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

(7) It is not necessary to remove the cylinder block as the piston tops can be scraped clean in position. If it is desired to remove the block, first remove the camshaft and magdyno chaincases and take off the magdyno. The block is held by eight studs and nuts and can be lifted straight up after removal of the nuts. Mark the block to ensure replacement in the same position or it may be turned front to back.

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

(*a*) The head gaskets *must* be fitted with the greatest diameter *across* the cylinder bore, side to side, so as to match up with the contour of the combustion space in the head. If this is not done the gasket will overlap the combustion space and lead to pre-ignition. If a gasket is damaged and requires replacement a new set of four pieces *must* be fitted. Each side of the gasket should be smeared with a little jointing compound.

(*b*) When tightening the head bolts, screw all down to make contact with the head and then go round in

the order 1, 5, 8, 4, 2, 6, 7, 3, giving each bolt a one-eighth turn and then passing on to the next, proceeding round in this manner until all are quite tight. The method of numbering the bolts is as follows :—stand in front of the machine, facing the engine and number the front bolts, 1, 2, 3, 4 from right to left, and the rear bolts 5, 6, 7, 8 from left to right. When the engine has been run a short time repeat the tightening as the gasket will probably give a little.

(*c*) To refit the camshaft sprocket it is necessary to take off the outer chaincase cover. First unscrew the sprocket extractor bolt and withdraw the bolt and collar ; the sprocket will drop down on to the edge of the camshaft bearing housing and will remain here, keeping the chain properly in mesh with the sprockets, whilst the chain cover is taken off. Now press the tension spring up against the side of the chaincase, place the retaining bolt through the sprocket and lightly screw it up into the camshaft. Rotate the engine slowly, pressing the sprocket inwards against the camshaft until the sprocket key engages with the camshaft keyway. Now *securely* do up the bolt and replace the chain cover.

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

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 will readily 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. Replace pistons 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 top ring (new) is .006-.007in., and of the lower (spring loaded) ring .018-.020.

Gudgeon Pins are fully floating and are retained in the piston by spring circlips. When fitted, these should expand into the grooves and fit firmly.

Engine Dismantling.

Owners, unless having considerable mechanical ability, are strongly recommended not to attempt any dismantling whatever beyond that necessary for periodical decarbonising, and removal of the cylinder block for examination of pistons and rings. The procedure, however, is as follows :—

1. Remove primary chaincase, including necessary dismantling of clutch.

2. Take engine from frame.

3. Remove the camshaft chain cover by removing the eight remaining cheese-headed screws securing the front of the cover. Turn back the tongue of the lock washer behind the driving sprocket, and undo the securing nut. The camshaft sprocket, chain and half-time shaft sprocket may now be removed. Next take off the magdyno chain cover and undo the magdyno sprocket (extractor provided). The two half-time shaft chain sprockets, secured to the parallel shaft by means of a common key, can now be slid off, and the back half of the chaincase removed ; this has been freed by the removal of the outer chaincase screws. Take care not to lose any parts of the camshaft and magneto chain tensioning devices.

4. **The Rocker Box.**—To remove the rocker box from the head first remove the rocker gear and valves. Next undo the four securing studs and knock out the valve guides—these are shouldered and should be driven from the head into the rocker box. The box is now free.

When replacing the box, make quite certain that the joint faces round the valve guides are perfectly clean and smooth, and pay similar attention to the joint faces on the base of the rocker box. See that the joint packing shims are also perfectly clean, smooth and dead flat ; smear the joint faces with a heat resisting jointing compound, drop the rocker box into position, replace the four retaining studs and valve guides, screwing up the former evenly and firmly.

It can be noted that the camshaft is carried by a ball bearing at each end. The bearings are a press fit in the rocker box, the driving end bearing being located endways by a spring check ring, which is sprung into a groove in the housing after the race has been inserted.

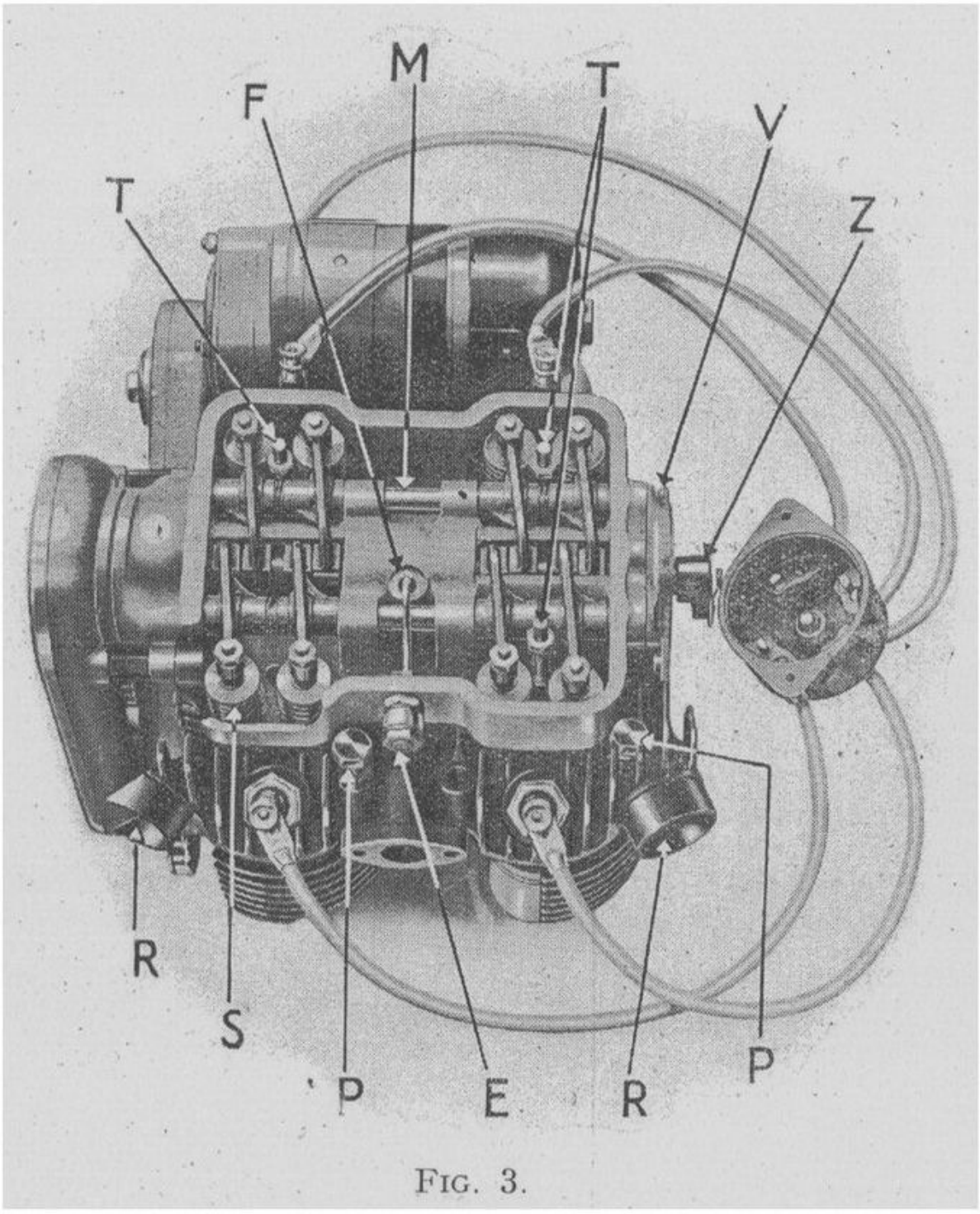

FIG. 3.

VIEW OF ROCKER GEAR.

This end of the camshaft is free to float in the inner race. The distributor end bearing is located endways by the distributor back plate which is spigotted into the bearing housing. The camshaft is secured to the inner ball race by a locknut.

5. **The Crankcase.**—Dismantle the shock absorber assembly and take off the large circular aluminium plate which carries the drive shaft outer ball bearing.

This plate is secured by six studs and nuts. If there is any difficulty whatever in withdrawing this plate after the nuts have been removed insert three screws into the tapped holes used for securing the primary chaincase. It will be noted that these holes are tapped all the way through, so that if three screws are inserted through the top, bottom and rear bosses, not using the front boss (so as to form an equal sided triangle), and are then screwed up against the face of the crankcase, they will form extractors and so draw the plate off the crankcase and along the driving shaft. Note the position in which this plate is fitted. The screw holes in the primary chaincase will only register with those in the plate when the latter is in one position. Remove the oil filler spout. Now turn the engine over and undo the stud nuts holding together the two halves of the crankcase ; these are spaced all round the outside of the case. The lower half of the case can now be lifted clear.

6. **Main Gears and Inner Gearcase**. — The lower half of the gearcase is secured to the upper half crankcase by means of eight studs. Two of the corner studs are shouldered and are an accurate fit in their respective holes through the lower half of the gearcase. The other stud holes are clearance holes. After undoing the eight stud nuts, lift the gearcase and so expose the main gears. These can be lifted out complete with the mainshaft bearings. It will be noted that the two timing shaft side bearings are located sideways by means of H pieces.

With the main gears out, it is possible to remove the half-time shaft. Undo the nut securing the large half-time gear to the end of the half-time shaft inside the inner gearcase ; then pull this gear off the shaft. It is a parallel push fit and is keyed into position. The half-time shaft itself is removed outwards, taking with it the ball race in the outer crankcase housing.

When replacing the main gears, see that the one marked tooth on the one gear wheel comes in between the two marked teeth on the other gear wheel.

7. **Big End Bearings.**—It is now possible to dismantle these bearings. To remove the three on overhung cranks prise up the tab of the lock washer and unscrew the nut—right-hand thread. The tab

washer and drilled retaining plate can then be taken off and the connecting rod with outer race slipped out. The rollers will fall out, when the inner race can be pulled off the crank by hooking an extractor round the back of the outer flange. The outer roller race is a press fit in the big end of the connecting rod.

Note that the thread projecting from the crank centre is actually the outer end of a bolt. The bolt head is located in a recess formed in the back of the crank web, a suitable peg preventing the bolt rotating as the nut is tightened. This peg is on the under face of the bolt head and locates in a hole in the recess. Before tightening the nut, make sure that the peg is "home" in its hole.

To dismantle the big end bearing on the transmission side of the rear crankshaft, undo the nut which secures the outer flywheel and main drive shaft to the crankpin. This crankpin is a taper fit in the flywheel, and the wheel and shaft can be pulled off by normal methods. The bearing construction is the same as for the other cranks. To secure correct alignment of the outer drive shaft and the gear mainshaft when re-assembling this outer flywheel on to the crankpin, insert a seven-sixteenth inch diameter ground steel bar through the two holes which will be found opposite the crankpin in the outer flywheel and inner crankweb respectively. Securely pull up the flywheel on to the taper, and see that the retaining nut is dead tight. No locking device is used. With the shafts in proper alignment, the ground steel bar should be capable of being easily rotated with the fingers.

Rods and bearings should preferably be re-assembled on to their own cranks with the rods the same way round.

Engine Re-assembly.

1. **Main Gears and Half-time Shaft.**—Pay very particular attention to the fitting of the main bearings into their housings, and do up the gear case stud nuts, not forgetting the split pins. Do not overdo the tightening or the stud may strip the aluminium thread in the crankcase. Fit the pump and pressure regulator into the lower half of the case and also the sump cover with gauze filter. Make sure that

the joint faces of the two halves of the case are absolutely clean and dead flat. Any small bruises or small burrs on a joint face should be smoothed down with a dead smooth file. Fit the two halves of the case together, making sure that the oil pump connecting link is properly located on the half-time shaft eccentric and that the pump plunger is located in the pump body. If new pump parts have been fitted *be sure that the plunger is not bottoming* in the pump body. The two dowels at the ends of the case will attend to correct case alignment. A good jointing compound such as Shellac Cement, should be used on this joint face, and the securing bolts should be done up evenly and tightly. Work across from one bolt to another, doing each one up a little at a time in a manner similar to that adopted for tightening the head bolts. This ensures that there is an even pressure on the joint face all the way round.

2. **Cylinder Block and Pistons.**—Before fitting the cylinder block, the pistons must be fitted to the connecting rods. See that each piston is fitted into its own cylinder and make sure that it is replaced the same way round. 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 to obtain two steel strips approximately 9ins. long by 1in. wide by $\frac{3}{16}$in. thick, and place these longitudinally on top of the crankcase and touching the connecting rods so that one strip bears against the two nearside rods and the other against the two offside rods. Now rotate the engine until all four pistons are resting firmly on the two strips when it will be found a very simple matter to lower the block into position without damage. Note that if new spring piston rings have been fitted the engine will be quite stiff to turn until it has been run for some little distance.

3. The remainder of the re-assembly is quite straightforward if proceeded with in the reverse manner to the instructions given on dismantling and re-assembly after decarbonisation. Reference to the notes on the

timing gear will also be useful, particularly for the final valve timing.

Timing Gear.

The timing gear of "Square Four" is perfectly simple, and absolutely straightforward in replacement if a few simple instructions are carried out. The actual 2 to 1 reduction between the engine crankshaft and the camshaft is brought about by the small gear on the front crankshaft meshing with the larger gear on the half-time shaft. The large gear fits with the boss up against the shoulder on the half-time shaft. These two gears are inside the centre gearcase. The half-time shaft has one plain bearing in the wall of this centre gearcase and the other bearing (a ball) in the wall of the outer crankcase. Keyed on to the outer end of the half-time shaft is the magneto driving sprocket and then the camshaft driving sprocket. The large sprocket, *i.e.* the magneto driving sprocket, fits with the small boss inside, whilst the camshaft driving sprocket should also be put on with the boss inwards.

The camshaft sprocket is keyed and bolted to the end of the camshaft and has the same number of teeth as the driving sprocket, the reduction having already been brought about by the half-time gears. These two timing pinions inside the main gearcase, are keyed to their respective shafts, whilst the two sprockets already mentioned are also keyed to their shafts. The valve timing is therefore fixed, except for the variation brought about by altering the mesh of the interior timing gears, or by altering the mesh of the two chain sprockets with the camshaft chain. To get accurate adjustment of the valve timing when first assembling the engine, a vernier arrangement is incorporated in the camshaft sprocket. During the ordinary course of re-assembly, that is to say, so long as the reduction gears inside the centre gearcase are not disturbed, it is quite unnecessary to disturb the vernier setting. Assemble the half-time shaft sprocket, rotate the engine until No. 1 piston is at top dead centre, and then turn the camshaft clockwise, when looked at from the driving end, until the inlet valve of No. 1 cylinder has just commenced to open (this valve commences to open with the crank 10° before top dead centre). Slip the camshaft sprocket into position on the end of the

camshaft so that the key is engaging with the keyway ; slip the chain on to the lower sprocket, taking care not to rotate the engine, and pull the chain up into position. It will then be found that the teeth on the camshaft sprocket are in line with the side-plates on the chain ; that is, the chain and the sprocket are ready to mesh. Mark one of the teeth of the camshaft sprocket and the corresponding side-plate of the chain, slip the sprocket off the camshaft, insert it into the chain, so that the marked tooth is in mesh with the marked link, and then slip the sprocket back on to the camshaft and tighten up with the centre bolt. If the instructions have been followed out correctly, the timing will be right. If an error has been made the timing will be one or more complete teeth out.

The operation of the vernier adjustment is as follows :—The camshaft sprocket is actually a plate carrying 17T on its periphery and having 16 small holes concentric with the centre of the sprocket, see Fig. **2**. This plate is secured to the large centre boss by means of a small peg and lock screw which go through two of the outer holes, and by the large centre bolt which holds this sprocket assembly on to the camshaft. The sprocket centre piece has two holes diametrically opposed to one another for the location of the peg and lock screw. This lock screw is a clearance fit in the sprocket plate hole and screws into the main member. The peg is of thicker diameter in the centre than at the ends, and as the holes in the sprocket plate are dished at the back, as is also the single hole in the sprocket member, this peg is retained in position between the plate and the boss. If, therefore, the sprocket plate and boss are freed from the chain and rotated anti-clockwise one tooth, the assembly will have moved anti-clockwise by one-seventeenth of 360°. Remesh the chain in this position, free the sprocket plate from the boss, and rotate the plate anti-clockwise so as to bring the peg and locking screw into the two holes next to those previously occupied ; the sprocket will now have moved anti-clockwise 1/16th of a turn. When the sprocket assembly is rotated forward so as to bring the key into register with the camshaft keyway, the nett effect is to make the valve timing earlier by the difference between 1/16th of a cycle and 1/17th of a cycle ; that is approximately 2-2/3°.

The correct valve timing is :—

Inlet valve opens 1/32 in. or 10° before T.D.C.
Inlet valve closes 11/32 in. or 50° after B.D.C.
Exhaust valve opens 13/32 in. or 55° before B.D.C.
Exhaust valve closes 3/64 in. or 15° after T.D.C.

Valve Clearance Adjustment.

Keep the adjusters on the rocker arms adjusted so that there is just no clearance between the adjuster and valve stem end cap when the engine is cold. With correct adjustment, the rocker should slide back freely along the spindle after being pushed against the spring spacing washer between adjacent rockers. All adjustments must be made with the valves closed.

IGNITION SYSTEM.

Distribution.

The ignition system is perfectly simple, an ordinary 180° magneto being used. This magneto 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 Z (Fig. 3). This composition end piece is an easy push fit on to the end of the camshaft and is located by means of a key, moulded inside the end piece, engaging with a keyway cut in the camshaft. This centre piece can, therefore, be only pushed home in the one position. The connections between the distributor and the different sparking plugs are clearly shown on Fig. 3.

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 (.012″) 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 up 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 key-way in the shaft. Also see that the securing screw is tight, but do not use undue force or the threads will be damaged.

Further information concerning the ignition and electric apparatus will be found in the Lucas instruction book.

Magneto Timing.

To set the timing, remove any sparking plug and release the magneto sprocket from the taper on the armature shaft. Rotate the engine until the piston is $\frac{5}{16}$ in. before top dead centre—it does not matter whether it is the end of the compression or exhaust stroke—and 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.

The Sparking Plug.

The sparking plug can greatly influence the performance of the engine. Especially on the O.H.V. engines is it necessary that best quality sparking plugs should be used.

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 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—.020in. to .025in.

We recommend the following plugs :—Lodge H.D.14 or H.14 for running in and slow touring, and Lodge H.53 for harder driving and sidecar work after the running in period.

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. Note that the size of the main jet controls mixture strength from approximately three-quarter to full throttle, whilst the positioning of the taper needle which is attached to the throttle slide controls the mixture between approximately one-quarter and three-quarter throttle. As the taper needle and needle jet wear, the mixture is richened up over this range ; this can be compensated for by lowering the needle (*i.e.*, securing in a higher notch). When all adjustment has been taken up, both parts must be replaced.

The standard setting is :—No. 90 main jet ; No. 4/4 throttle slide ; taper needle secured in the third notch from top when new.

For further details of carburetter tuning, see the booklet issued by Messrs. Amal.

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.

Always recollect that a motor cycle engine gives the best results in all ways when it is running easily. It should not be driven at low engine speeds on large throttle openings as this causes "snatch" and harshness in the transmission, leading to rapid tyre wear, worn bearings and unevenly worn chains. At the first sign of harshness when hill-climbing or running slowly on the level, change down into a lower gear.

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. The filling plug is behind the kick-starter case.

Do not forget to lubricate all the joints and pivots in the gear-operating mechanism and to grease the enclosed mechanism via the grease nipple on top of the cover. Greasers are also provided for the K.S. lever bearing, and for the spiral gears for the speedometer drive.

Clutch Adjustment.

Adjustment to the clutch plates and springs is rarely necessary, and all is correct as long as 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 and tightened on the high side until it does.

For correct operation and withdrawal of the clutch there should always be 1/64 in. clearance between the ball C in the clutch operating lever E (see Fig. 4) and the end of the operating rod D.

The cable adjuster on the gearbox should be set to keep the operating lever E in such a position tha the Bowden cable is subjected to the minimum of bending; then adjust A and B to give the required $\frac{1}{64}$" clearance.

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

To Dismantle the Clutch.

Remove the chain case—outer half only, oil bath models—and then undo the four 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 fabric insert plate, and a plain plate alternately, finishing with a plain plate.

To Take off the Clutch Centre.

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 (carried on a roller bearing) and outer clutch housing in position on the shaft. Pull the sprocket endways off the shaft taking care not to lose the rollers as they fall out. The order of re-assembly is :—(i) Plain Washer, (ii) Inner roller race, rollers and sprocket, (iii) Plain washer, (iv) Clutch centre, (v) Securing nut.

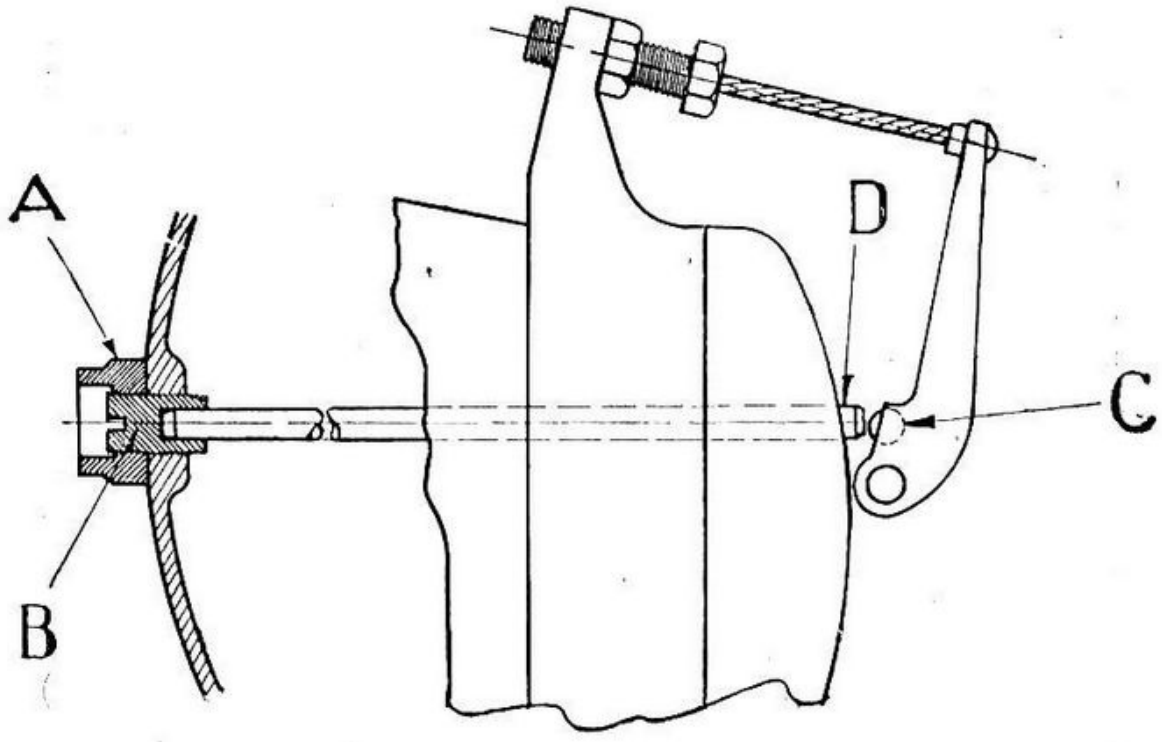

FIG. 4.

CLUTCH WIRE ADJUSTMENT.

Gear Control Rod.

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.

To dismantle the shock absorber assembly, undo the locking sleeve, when the spring collar, spring, sliding member and engine sprocket will come away. The driving member can be pulled off the taper on the mainshaft by means of an extractor.

Note that the shock absorber spring is not adjustable for tension; keep the locking sleeve screwed right up.

The action is lubricated by the oil in the primary chaincase.

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 eccentric adjusting device. Loosen the large locknut and slightly rotate the hexagon ended centre; this swings the box about the pivot bolt, varying the chain tension. Adjust until the primary chain has approximately $\frac{3}{8}$in. up and down movement midway between the sprockets, at the tightest point. Re-tighten (i) eccentric locknut, (ii) clamp bolt, (iii) pivot bolt. Check hand gear control adjustment.

Rear Chain Adjustment.

Slack off the two rear wheel spindle nuts E (Fig. 5) and adjust by rotating the screw adjusters K; turn each adjuster by an equal amount. The rear chain should have approximately $\frac{5}{8}$in. movement at the tightest point, midway between sprockets.

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 will get into the clutch and cause drag.

Rear chain lubrication is carried out by a needle valve controlled overflow from the primary chaincase, just behind the clutch dome; 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. Replenish the primary chaincase as necessary—probably every 200/300 miles.

WHEELS AND BRAKES.

Front and Rear Wheel 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. 5) 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.**

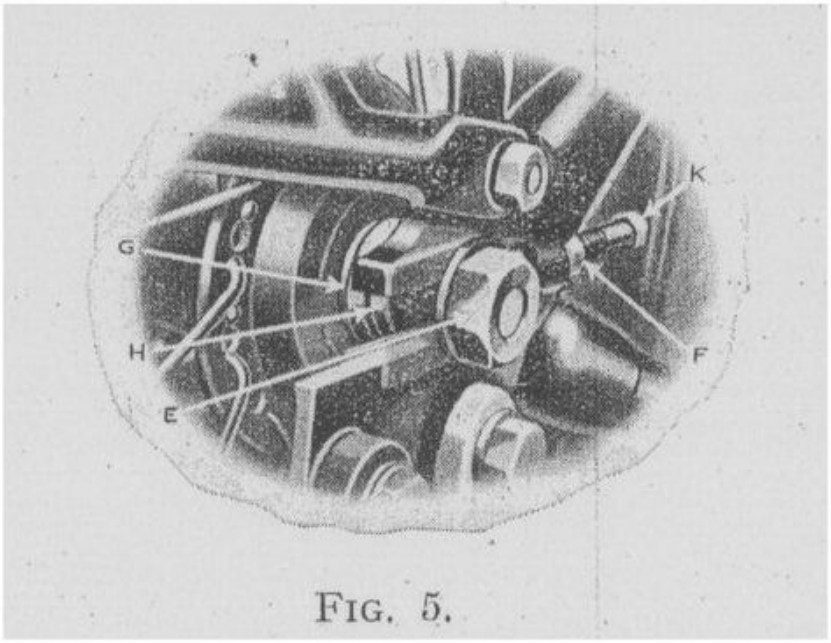

FIG. 5.

REAR WHEEL AND BEARING ADJUSTMENT.

To remove bearings :—Remove wheel from frame. Take off brake plate (see under Brakes). 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.

Brakes.

To remove the brake plate complete with brake shoes and fittings, remove the spindle nut on the brake drum side ; insert a thin spanner on to the hexagon between the fork end and brake plate and loosen this nut a half-turn. Disconnect the brake rod (and chain on rear wheel). Undo the other spindle nut and remove the wheel. With the front wheel, also undo the anchor bar holding the brake plate ; this need be unfastened at the top end only. If the brake plate locking nut (previously slackened) is removed, the brake plate will slip straight off the spindle.

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

To re-assemble, reverse the order given and see that :—Rear Wheel : the brake anchor pin is in engagement with the slot in the brake plate arm. Front Wheel : the anchor bar is securely replaced.

Adjustment.

The rear brake is fitted with a fulcrum adjuster 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 front 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.

Adjust the front brake by means of the hand adjuster on the lower end of the brake rod.

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 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 off-side lower front spindle only. Keep the spindle screwed right home in the near-side 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 every 3-400 miles. A grease gun is provided in the tool kit.

Steering Head Adjustment.

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 relock.

Lubrication.

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

Resilient Handlebar Mounting.

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.

Petrol Tank.

The petrol tank is secured by four set-screws, 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-screws 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 cap :—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.

Ewarts 2-Level Cork-seated Petrol Tap.

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.

Adjustment of corks. As the corks wear with use, adjustment can be effected as follows :—Undo the small hexagon lock nut outside the knurled knob marked " Pull on " or " Pull reserve " as required. Then with a small screw-driver, 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.

Speedometer Fitting.

The speedometer is fitted in the panel and can easily be removed after taking off the panel. To detach the lower end of the driving cable from the gearbox take out the grub screw in the face of the box and pull out the cable. *Note* :—On 3-speed machines also pull out the speedometer driving spindle or the spiral gears may be damaged if the layshaft is rotated.

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.

Set the rests in the position required and securely tighten up the nut. Note that if foot gear change is fitted the right-hand footrest is non-adjustable.

Rim Sizes and Oversize Tyres.

The rims used for the 3.25″×19″ wired-on tyres are size WM2-19 (2½″×19″). Suitable oversize tyres for this size rim, are 3.50″×19″ and 4.00″×19″, but this latter size is better mounted on WM3-19 (3″×19″) rim. As regards clearance, there will be ample for the 3.50″×19″ cover, but the 4.00″×19″ cover will run rather close to the rear chainguards ; in general, this size cover can be fitted if the guards are given a slight set away from the wheel.

Tyre Pressures.

The recommended minimum inflation pressures for Dunlop Cord Tyres in lbs. per sq. in. are as follows :—

Solo, 3.25—19 in., 18 front, 23 rear.

Sidecar, 3.25—19 in., 19 front, 28 rear, 16 sidecar.

Wheel Alignment.

Solo Machine.

Procure a plain board about 6 ft. long, 4 in. wide, and 1 in. 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. By slightly turning the front wheel, if necessary, the board should touch each tyre, front and back, on both wheels. If it does not do so, adjust the alignment of the back wheel by means of the adjusters provided (see rear chain adjustment). If this alignment cannot be obtained the frame or forks are probably twisted.

Sidecar.

The combination must stand on a smooth level floor. Place a board alongside the wheels of the machine; these must be in line as described above.

Procure a second board similar to the first one and place this with its edge touching the sidecar tyre. Measure the distance "A" in the diagram, which should be taken as near to the back tyre as possible. Similarly measure the distance "B," taking this as close as possible to the front tyre. These two distances should be equal in running, but in practice it is permissible to have "B" about $\frac{1}{4}$in. shorter than "A" with the machine stationary. This ensures that the wheels are in correct alignment.

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.

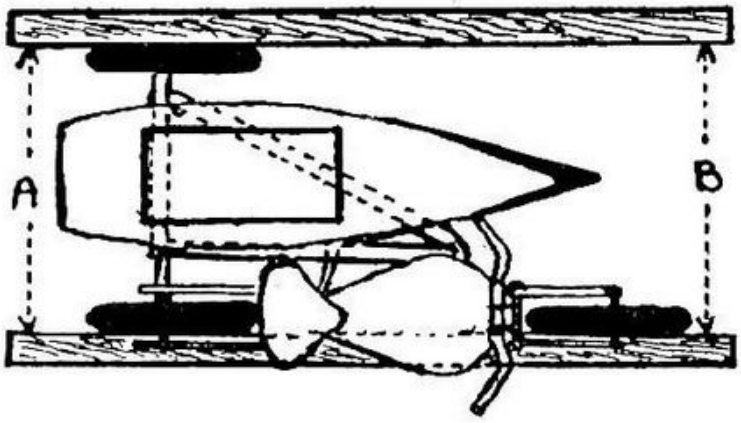

FIG. 6.

METHOD OF TESTING WHEEL ALIGNMENT.

Sidecar Connections.

The Ariel Sidecar Chassis is a special design of triangular construction with 3 point connection ; due to the special 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.

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
5·2	670	1009	1340	1683	2018	2355	2680	3025	3365	3700	4035	4375	4710	5045	5380	5715	6060
5·8	751	1128	1503	1878	2255	2628	3005	3375	3755	4130	4510	4880	5255	5630	6010		
6·0	778	1165	1555	1945	2330	2720	3110	3500	3885	4275	4660	5050	5440	5835	6220		
6·5	843	1262	1684	2108	2525	2945	3370	3795	4216	4640	5050	5470	5890	6320			
7·2	930	1395	1860	2330	2790	3260	3720	4190	4660	5120	5580	6050					
8·0	1036	1558	2070	2590	3115	3625	4145	4665	5180	5705	6230						
8·8	1138	1710	2275	2845	3420	3980	4560	5125	5695	6265							
9·7	1254	1886	2508	3140	3770	4380	5030	5650	6280								
12·6	1630	2445	3260	4075	4885	5705	6520										
13·9	1795	2700	3585	4495	5400	6290											
15·3	1980	2980	3960	4950	5950												