Motor Cycle Maintenance and Repair Series

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A.J.S. TWIN MOTOR CYCLES

A PRACTICAL GUIDE COVERING MODELS MANUFACTURED SINCE 1949

By

F. W. NEILL

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With over 50 Illustrations

LONDON
C. ARTHUR PEARSON LIMITED
TOWER HOUSE, SOUTHAMPTON STREET
STRAND, W.C.2

First Published 1956

PRINTED IN GREAT BRITAIN BY RICHARD CLAY AND COMPANY, LTD.,
BUNGAY, SUFFOLK.

PREFACE

IN this book the author has provided details of possible faults and the remedies, based on experience in the Service Department of Associated Motor Cycles Ltd., the makers of the A.J.S. Model 20 " Springtwin ". All the modifications that have been introduced from 1949 to 1955 are included.

The engine of this popular machine is dealt with comprehensively in Chapter I; the equally important subjects of carburation, transmission, frame and forks, brakes, wheels and tyres, and electrical and ignition equipment are each dealt with adequately in Chapters II–VI. For the benefit of owners who desire to increase engine efficiency, recommendations on this subject are given in Chapter VII.

Technical data is given in the Appendix for all bearing sizes, with other important details, to enable dealers, distributors and service staff to check parts for wear and for finished size, together with the makers' tolerances.

Without experience and good workshop facilities, owners are advised to have work of major importance carried out by the makers of these machines or, alternatively, by experienced dealers who have the necessary equipment for this work.

The author would like to express his appreciation to Messrs. Associated Motor Cycles Ltd., and Joseph Lucas Ltd., for permission to reproduce their illustrations in this manual.

The publishers wish to thank Associated Motor Cycles Ltd. for permission to use the A.J.S. trade mark in the cover design.

F. W. NEILL.

CONTENTS

CHAPTER I

THE ENGINE

THE A.J.S. twin-cylinder Model 20 "Springtwin" is designed to give a high maximum road performance. The robust design of the lower half of the engine permits many thousands of miles to be covered without renewals, provided that the machine is maintained satisfactorily. The crankshaft, cast in one piece from Meehanite, gives rigidity with good bearing surfaces. Roller bearings are used on both ends of the crankshaft, which is supported by a plain bearing for the centre journal.

Highly polished forged light-alloy connecting-rods are fitted with Vandervell split bearings at the big-ends, as is also the centre bearing. Separate cast-iron cylinders with an air space between them are used in conjunction with individual cylinder-heads of light alloy with cast-in valve seats. The inlet valves are made from Silchrome, heat-treated on the tips. The exhaust-valve material is KE 965, Stellite tipped. Chilled cast-iron valve guides located with a circlip are common to all four valves. One-piece rockers mounted on eccentric spindles provide a rapid and easy form of rocker adjustment. Alloy push-rods, fitted with hardened ends, work directly on the cam followers for differential expansion to deal with cylinder expansion at normal running temperature. Twin gear-driven camshafts are fitted high up the crankcase, enabling light-poundage valve springs to be used.

Lubrication System

The engine is pressure lubricated on the dry-sump principle, using separate gear-type pumps for feed and return. Both pumps are mounted on a carrying plate in the timing chest and are driven by slots in the ends of the camshafts. A ball-valve, designed to keep the return pump "wet" and to make the return pump function immediately the engine is started, is fitted. This valve, which needs no attention, is shown in

Fig. 2. The feed pump, which is narrower than the return pump, is mounted on the right side of the carrying-plate, and uses gears $\frac{1}{4}$ in. wide, whereas the return pump, which is of greater capacity to ensure adequate scavenging, has gears $\frac{3}{8}$ in. wide. The feed pump passes 30 gallons of oil per hour through the engine at 7,000 r.p.m.

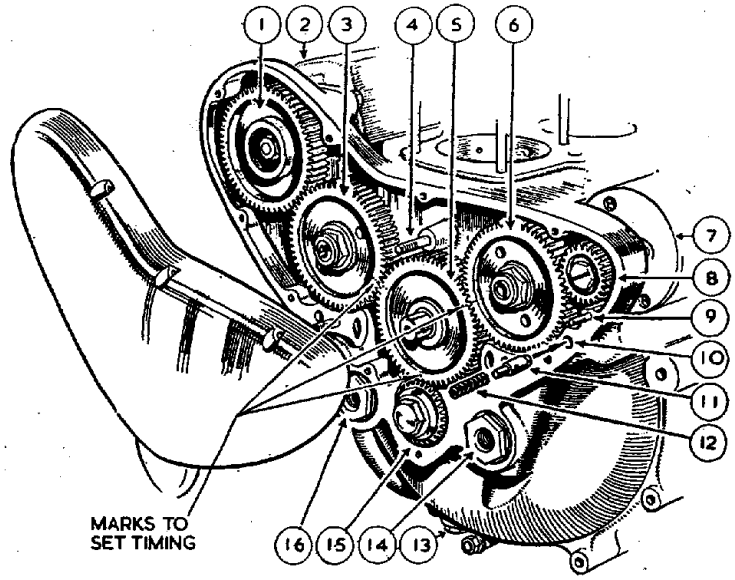

FIG. 1.—TIMING GEARS, SHOWING THE TIMING MARKS.

1. Gear wheel on magneto armature shaft.
2. Magneto.
3. Gear wheel on inlet camshaft.
4. One of the three studs retaining the oil pumps assembly.
5. Intermediate (or idle) gear.
6. Gear wheel on exhaust camshaft.
7. Dynamo.
8. Gear wheel on dynamo armature shaft.
9. Stud, in dynamo body and passing through crankcase and timing gear cover.
10. Orifice to accommodate relief valve.
11. Oil relief valve.
12. Spring, controlling oil relief valve.
13. Crankcase drain plug.
14. Adaptor to accommodate oil feed banjo pin.
15. Timing pinion on crankshaft.
16. Adaptor to accommodate oil return pipe banjo pin.

Oil Circulation

Oil in the feed line passes through a wire-mesh filter direct to the feed pump, thence to a chamber in the crankcase via a close-grained felt filter.

The function of the pressure-relief valve (Fig. 5), adjacent to the oil-feed connection on the crankcase (engines before 1953), or in the timing-side crankcase (engines after 1953), is as follows. When the engine is started during cold weather, using thick oil, if the felt filter is choked, the relief valve will lift, thus preventing damage to the feed-pump gears. As an additional safeguard a further " blow-off valve " is mounted at the end of the oil filter in the crankcase.

The blow-off valve at the end of the fabric filter is an alloy plunger retained by a spring, which is shown in Fig. 6. After passing through the fabric filter in the crankcase, the oil under pressure has to lift a non-return valve (Fig. 7), designed to prevent oil seeping into the crankcase and back from the top part of the engine.

After passing the non-return valve oil is forced to a drilling in the driving side of the crankcase, where it is divided; the main supply is directed to the centre of the crankcase, feeding the centre bearing and big-ends, as shown in Fig. 8. Oil diverted at the by-pass goes to a chamber, which houses a distributor bush, rotated by the exhaust camshaft. A metered hole in this rotating bush $\frac{3}{64}$ in. in diameter feeds oil to the top part of the engine via drillings in the crankcase through the annular grooves machined in the cylinder spigots, up through passages in the cylinder barrel to the cylinder-heads.

The oil-feed passages are also metered in the cylinder-heads, by the use of brass plugs, which at first glance appear to be sealing plugs. In fact, small flats are used on these plugs to restrict the oil supply. Three of these plugs are used on engines made up to 1953, from then on four plugs are used. There is also a small oil-hole drilled in the rocker pillar, or post, to lubricate the push-rod ends (engines before 1955).

Engines made in 1955 have drilling in the rockers and grooves machined to permit oil to drop on to the push-rod cups. From this point oil drains by gravity back to the timing chest, then to the crankcase sump.

On 1955 models a brass jet is used to meter the oil supply to the top part of the engine, the distributor bush being discarded. On 1955 type engines oil draining by gravity from the top part of the engine galls into the camshaft tunnels, with a " spill level ", to keep camshafts lubricated immediately the engine is started. Oil drains by gravity from the timing gear, where the spill level overflows, then is returned to the oil tank via a second close-grained felt filter. 1955 models after Engine Number 26762 were delivered with original oil-distributor bush, but with oil hole of $\frac{1}{16}$ in. diameter, instead of $\frac{8}{64}$ in. This alteration increases oil supply to the rocker gear and tends to subdue engine noise. Early 1955 engines can be

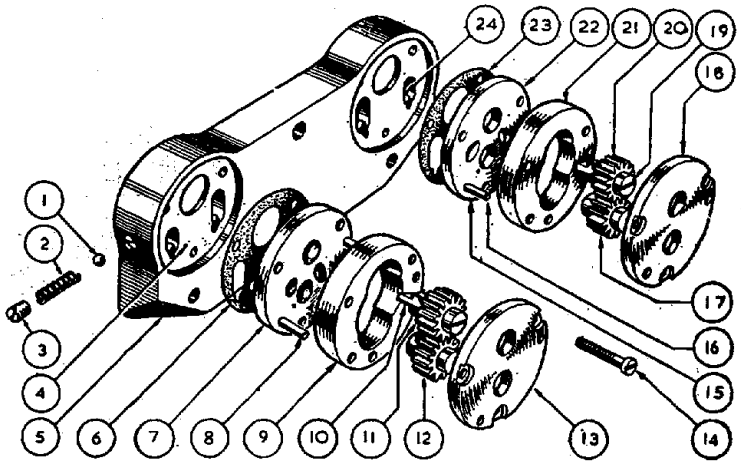

FIG. 2.—EXPLODED VIEW OF THE OIL PUMPS.

1. Ball, for non-return valve.
2. Spring, for non-return valve.
3. Plug, retaining non-return valve spring and ball.
4. Bleed hole.
5. Plate, carrying oil feed and return pumps.
6. Paper washer for oil return pump.
7. Back plate of oil return pump.
8. Dowel pin, locating pump plates and body.
9. Body of oil return pump.
10. Dog end of pump gear to engage in end of camshaft.
11. Driving gear, for oil return pump.
12. Driven gear, for oil return pump.
13. Front plate of oil return pump.
14. Screw (1 of 6) used to retain plates and bodies of oil pumps to the carrying plate.
15. Back plate of oil feed pump.
16. Dowel pin, locating pump plates and body.
17. Driven gear, for oil feed pump.
18. Front plate of oil feed pump.
19. Screwdriver slot, to enable driving gear to be correctly positioned during assembly.
20. Driving gear, for oil feed pump.
21. Body of oil feed pump.
22. Back plate of oil feed pump.
23. Paper washer for oil feed pump.
24. Bleed hole.

modified, by discarding the oil jet in crankcase, fitting distributor bush Part No. 014246 together with distributor cap Part No. 014247 also washer 011642. See Fig. 6 No. 13 for location.

Checking Lubrication System

Provision is made to see if the oil is circulating. If the oil-tank filler cap is removed, oil returned from the engine will be

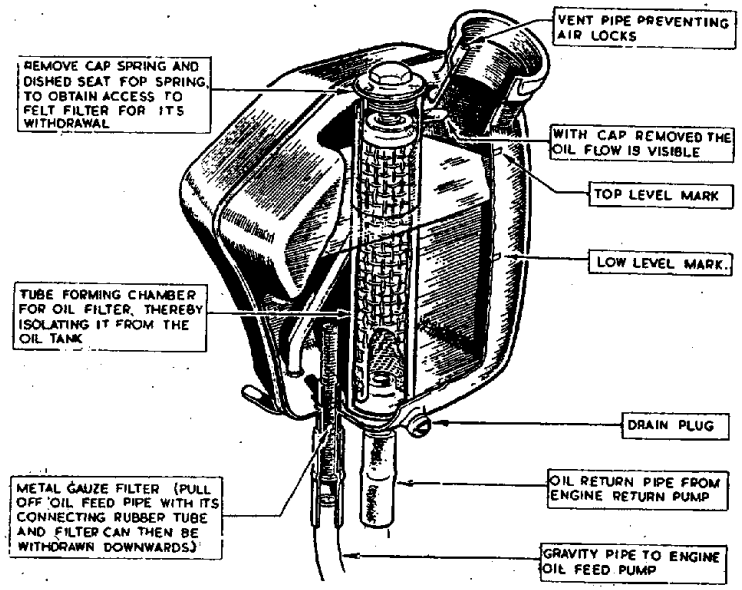

FIG. 3.—CUTAWAY VIEW OF THE OIL TANK FITTED TO PRE-1955 MODELS.

seen emerging from the spout in the oil tank. A check should be made on first starting the engine, for at this stage there should be about 20 oz. of oil in the sump, thus a steady stream of oil should emerge, until the crankcase is scavenged, when the return will not be so positive.

Checking Oil Pressure

Should the engine be dismantled at any time or should the oiling system become deranged, it is essential to check the oil

pressure. To do this an oil-pressure gauge graduated to 150 lb./sq. in. with a screwed shank ¼ in. B.S.P. (0·518) by 19 T.P.I. is required. To fit the gauge remove the slotted screw in the non-return valve (Fig. 7), then fit the gauge, with the dial uppermost (Fig. 4). With a cold engine at idling

FIG. 4.—CHECKING THE OIL PRESSURE.

speed, the recorded pressure should be approximately 140 lb., which is the blow-off pressure of the relief valve shown in Fig. 5.

When the engine is hot and the oil thin, pressure falls to between 20 and 40 lb. under idling conditions, rising as the engine speed increases.

Low-pressure Recording

First check the pressure-relief valve. If the plunger is not seating through dirt or a weak spring, oil will circulate round the feed pump instead of passing the fabric filter in the crankcase. Details of the springs used are given on page 146. On engines that have covered considerable mileage or the oil has not been changed regularly, a worn centre-bearing will cause a drop in the recorded oil pressure.

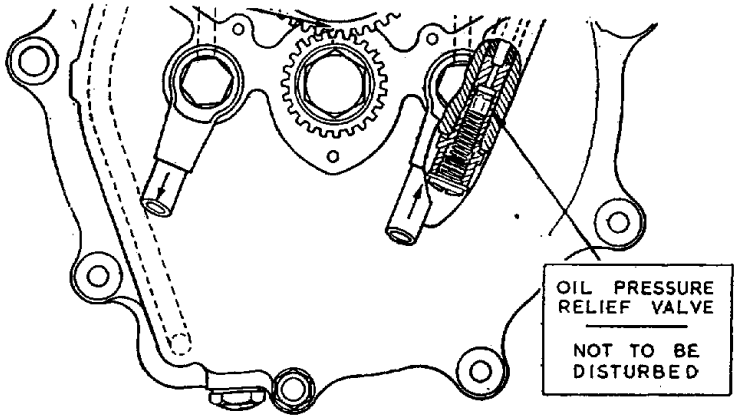

FIG. 5.—OIL PRESSURE RELIEF VALVE.

No Pressure Recorded

Check oil supply by disconnecting the oil-feed pipe on the crankcase; allow oil to drain away until air bubbles are excluded: recheck. If the position remains the same, remove and dismantle feed pump for possible damage to the gears, which can only happen by reason of foreign matter entering the pump. Should the pump be normal, turn to the pressure-relief valve, making sure the plunger is not jammed by foreign matter. If the ball in the non-return valve cannot move (when the gauge is fitted), a nil recording will result. Cases are known when springs used in the various valves have been replaced incorrectly. If in doubt, or if the machine has had previous owners, check, in view of the vital nature of this part of the engine, all the springs for the valves in the lubrication system. (See table of springs on page 146.)

VALVES USED IN LUBRICATION SYSTEM

Pressure-relief Valve

Mounted close to oil-feed pump and housed in timing-side half crankcase (engines up to No. 9607). Engines after this number have valve mounted in the face on the timing-gear chest, exposed when the timing-gear cover is removed. The spring for this valve is now captive on the plunger, earlier type spring was loose and could be mislaid when refitting timing-gear cover.

Crankcase Filter Blow-off Valve

This valve is an alloy plunger inserted in the transmission-side end of the felt filter, retained by a spring, which abuts against the non-return valve body. The object of this valve is described on page 11.

Non-return Valve

Mounted in the driving-side half of the crankcase and needs no attention other than to ensure that the ball is seating properly. Should this valve be difficult to unscrew, take the machine on the road, or run the engine, until the crankcase is hot, when it should unscrew easily.

Note

If the fibre washer is replaced, retighten the valve after the machine has been used on the road for a short while, as the fibre can shrink and cause a loose valve, with consequent oil leakage.

Oil-return-pump Bleed Valve

Should only be examined as part of a routine check if the oil pick-up from the sump is poor.

Crankcase Pressure-release Valves

Whilst these valves are not incorporated in the actual oiling system, the oiling system can be affected if these valves are deranged. Early type release valve (machines up to 1951) was a timed crankcase pressure-release valve, in the form of a

cylindrical block, rotated by the inlet camshaft, with a port drilled in the block, to allow positive pressure, caused by piston displacement (as the pistons descend), to escape into the atmosphere via a rubber tube attached to a union on the crankcase at one end, the other end being attached to a pipe protruding from the oil tank.

If this valve is dismantled there is no special way for it to go back. The only possible fault, which is very remote, is for the block to seize in the crankcase or for a kink to occur in the rubber tubing, which would restrict engine breathing, with a risk of an oil discharge from the crankcase into the front chain-

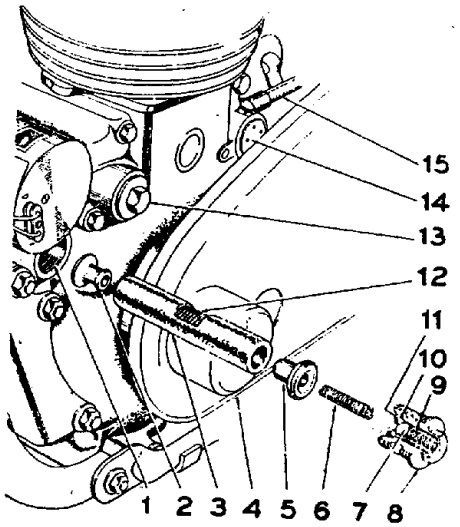

FIG. 6.—EXPLODED VIEW OF FELT OIL FILTER IN DRIVING SIDE CRANKCASE.

1. Housing (part of crankcase) for oil felt filter.
2. Seat, for oil felt filter.
3. Felt fabric filter.
4. Front chain case.
5. Relief valve, for felt fabric filter.
6. Spring, for felt filter relief valve.
7. Ball, for non-return valve.
8. Cap, for felt filter housing.
9. Spring, for non-return valve.
10. Circlip, retaining non-return valve seat.
11. Seat, for non-return valve.
12. Wire former, or support, for felt fabric filter.
13. Cap, for oil distributor housing.
14. Cap, for release valve housing.
15. Pipe, from release valve to oil tank.

case. On engines made from 1952 onwards the crankcase pressure-release valve was transferred to the driving side of the crankshaft, valve body also serves as a lock-nut for the engine shock-absorber spring on cam (Fig. 8). This is a flap valve using a steel diaphragm and a spring (*see* table of springs) to release positive crankcase pressure into front chaincase. As a result of trouble with the diaphragm breaking up, a heavier-gauge material was introduced, the thickness of the new type diaphragm is 0·010 in., which should be checked if a replacement is obtained from a dealer. For this valve to function satisfactorily it is essential that the diaphragm is perfectly flat, without burrs.

To examine, the valve should be removed from the crankshaft. When refitting the diaphragm hold the valve body vertical with the large hole uppermost, when it can be ascertained that the diaphragm is properly seated before the spring and retaining sleeve are fitted.

To check the valve after assembly, place the threaded end between the lips, when it should be possible to blow out air through the valve but not suck air inwards. If air can be sucked in, then either the diaphragm or the seating in the body is faulty. Engines made before 1952 can be altered to use the latest type release valve by drilling a $\frac{1}{4}$ in.-diameter hole through the driving-side shaft of the crankshaft.

TRACING LUBRICATION TROUBLES

If the engine oil is changed regularly, with clean oil filters, the possibility of any derangement in the oiling system is extremely remote. The most common oiling trouble was associated with engines before No. 16939, due to oil discharging from the crankcase into the front chaincase. This trouble was brought about by placing the oil-drain hole in the timing chest at a higher level than in previous models. This allowed about 13 oz. of oil to accumulate in the timing chest. When the machine is left stationary for a short while this oil drains back into the sump, causing a temporary high level of oil in the crankcase, which is discharged into the chaincase, until the crankcase is scavenged.

In May 1953 a Service Bulletin, together with a blueprint, was issued to all dealers to indicate the position of an additional oil-drain hole to be drilled in the timing chest. This modification can be effected without dismantling the engine, by carrying out the following instructions and referring to Fig. 9.

Proceed by removing the timing-gear cover. Mark off the inner wall of the timing-gear chest, as shown in Fig. 9, where the hole has to be made (a centre punch should be used for the drill to start easily). Using a $\frac{5}{16}$-in.-diameter drill, mounted in an electric drill or brace, generously coat the flutes of the drill with grease, and start to make the hole. Clean the drill from time to time and re-grease to prevent metal chippings falling into the crankcase. Replace cover and test machine.

Oil Seepage into Chaincase

On engines made from 1952 and where the oil modification has been carried out, this fault can take place as a result of:

(*a*) Broken or distorted diaphragm for the release valve.

(*b*) Abnormal crankcase pressure due to gas leakage past the piston rings, by reason of piston-ring wear or worn cylinder bores.

If it is found that the release valve and cylinders are normal, check the distance piece or sleeve behind the engine sprocket. If the outside diameter of the distance piece or sleeve is plain, change it for one that has scroll machined in the outside diameter to stop oil from passing the sleeve. The sleeve is a close fit in the crankcase, so care should be taken to ensure it is inserted squarely to prevent damage to the crankcase. Apply a little graphite to the outside diameter before fitting.

Oil Drains into Crankcase—Engine Stationary

If the machine has been left standing or stored for any great length of time, oil can seep past the feed pump and accumulate in the crankcase. To remedy, the sump should be drained in preference to wasting energy by attempting to start the engine. Should this fault develop when the machine has been stationary for a short period, check the non-return valve at the end of

filter compartment in the crankcase for dirt under the ball seating.

In the case of a machine that has covered great mileage, the fault may be due to wear in the spindle holes in the feed-pump plate. The pump gears and shafts are hardened, the plates being made from cast iron; remedy is to fit new parts as required.

Oil Shortage to O.H.V. Gear

Oil circulation has been described already and that section should be read before dealing with this fault. To investigate, first check the $\frac{3}{64}$-in. hole in the oil-distributor bush (*see* 13, Fig. 6, for location) on engines made before 1955.

If at any time the fibre washer for the cap covering the oil-distributor bush is renewed, a thick washer of the normal size must be used. A thin washer can cause the bush to seize by end pressure.

If obstruction occurs in the oil passages drilled in the cylinder-head, which are metered by a brass plug, squirt oil down the holes drilled in the rocker post, after removing the rocker spindles. Should it be necessary to remove these plugs, which are a force fit, cut up very short pieces of wire or a spoke slightly smaller in diameter than the hole in the rocker post. Insert the short pieces of wire one by one down the hole, leaving the last piece protruding about $\frac{1}{4}$ in., now press down the protruding wire with the end of a screwdriver or similar tool, which will dislodge the plug. If the plug is difficult to push out, gentle heat will facilitate removal.

Note

Up to 1954 metering plugs used small flats, 1954 onward have a small-diameter hole drilled in the centre of the plug.

Oil Fails to Return from the Sump

A fault of this kind is extremely rare, but cases are known where this trouble has been caused by pieces of broken piston rings being sucked up the return oil pipe, which is cast in the crankcase. The shape of this pipe, with many bends, prevents the use of wire to dislodge obstruction. Should the use of

compressed air be ineffective, an unorthodox but effective method can be used to clear this oil passage. Insert at the top end of the hole some $\frac{1}{4}$-in. diameter ball bearings until the hole is full, then press on the top ball, which will move the obstruction a trifle, add more balls and repeat the process until the broken ring or foreign matter falls out, when the balls inserted will follow suit.

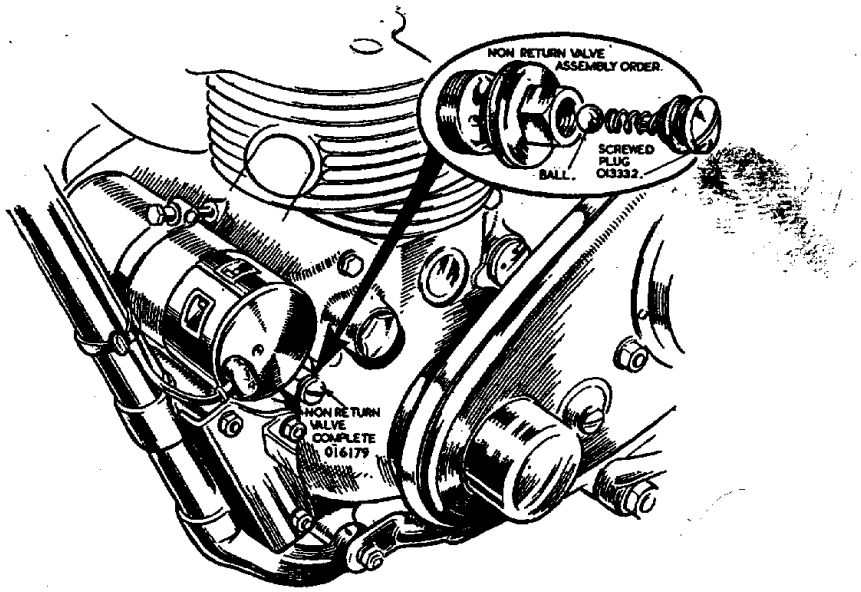

FIG. 7.—NON-RETURN VALVE.

Poor Scavenging from Sump

This is most likely due to an air leak between the paper washer behind the return pump, the return-pump screws are loose or the pump has lost efficiency—due to end play between the gears and the end plates. A choked felt filter in the oil tank will produce a similar effect. If the pump has lost efficiency, rubbing down the end plate on a surface plate will reduce the end play.

Over-oiling on the Offside Cylinder

If an engine with a number below 10797 is affected, a

modified small timing pinion, together with the use of an oil-thrower ring, can be fitted as a cure. The original small timing pinion was $\frac{15}{16}$ in. long, which was reduced to $\frac{23}{32}$ in. The thrower ring or control washer is 0·215 in. thick, Part No. 016210.

To work efficiently, the clearance between the outside diameter of the control ring and the aperture in the crankcase should be 0·002 in. Part No. for the new pinion, which is now a standard fitment, is 016209. This alteration also helps to reduce valve-gear noise by preventing oil draining rapidly back into the sump. Oil will spill when reaching the oil-hole drain level. Should the fault occur on engines with the new arrangement and providing the cylinder bore and piston rings are normal, try the effect of using high-radial-pressure piston rings.

Oil Enters Dynamo

Usually associated with engines that have a high oil level in the timing chest, or the crankcase release valve is inoperative. A faulty oil seal on the dynamo shaft can cause the same effect.

Oil Discharge from Oil-tank Vent Pipe

It has already been explained that about 20 oz. of oil will accumulate in the sump after the machine has been stationary, by drainage from the timing chest and other parts of the engine. Should the oil tank be topped up, under such circumstances it will be clearly understood that when the engine is started, oil will return from the sump to the tank at a far greater rate than the delivery to the engine, thus overfilling the oil tank, causing an oil discharge from the vent pipe. Owners are advised to run the engine for a short while to scavenge the sump before topping up the oil tank to the recommended level. In machines made before 1950 that were affected by this trouble it was not due to overfilling, but through the vent pipe being too close to the oil-return spout. To remedy this the vent pipe was bent away from the return spout in the oil tank.

Note

Should the high- and low-level transfers on the oil tank be obliterated, the high level is $5\frac{7}{8}$ in. from the bottom of the tank, the low level $3\frac{1}{4}$ in.

Cleaning Crankshaft Sludge Traps

To safeguard the makers' interests, a recommendation was made in the manual supplied with the machine, to clean the sludge traps and crankshaft passages at 15,000 miles. To do this is a major operation, entailing completely dismantling the engine. This may be necessary in cases where owners do not change the oil regularly, and it is for this reason the recommendation was made, but if the oil is changed regularly the formation of sludge is very remote, particularly as most oils today are of the detergent type. In consequence, this advice can be disregarded if the engine is serviced as it should be.

O.H.V. Rocker Adjustment

This adjustment can be effected without removing the petrol tank. It should be explained that due to the use of quietening curves, which are small humps on each cam flank just clear of the base circle of the cams and designed to close up slowly the push-rod clearance and prevent valve-gear noise, it is essential that the engine is positioned so that the piston on each cylinder is on the top dead centre of the firing stroke when the rocker adjustment is made.

Obtain a set of feeler gauges, or a strip of sheet foil 0·006 in. thick, which is the normal rocker clearance. Remove inlet-rocker cover first, close the throttle, to make it easier to turn the engine over compression, slowly turn the engine in its direction of rotation, until the inlet rocker goes down and returns, which will be nearing the top dead centre of the firing stroke. Position the piston as detailed for setting ignition timing. With the engine in this position the rockers can be adjusted by releasing slightly the self-locking lock-nut for the rocker-spindle clamp bolt (Fig. 10) and sufficient to allow the rocker spindle to be moved. With a screwdriver in the slot in the rocker axle turn the axle to bring the rocker away from the valve end. Lay the feeler gauge (0·006 in. thick) on the end of the valve, then turn the rocker axle in a reverse direction until

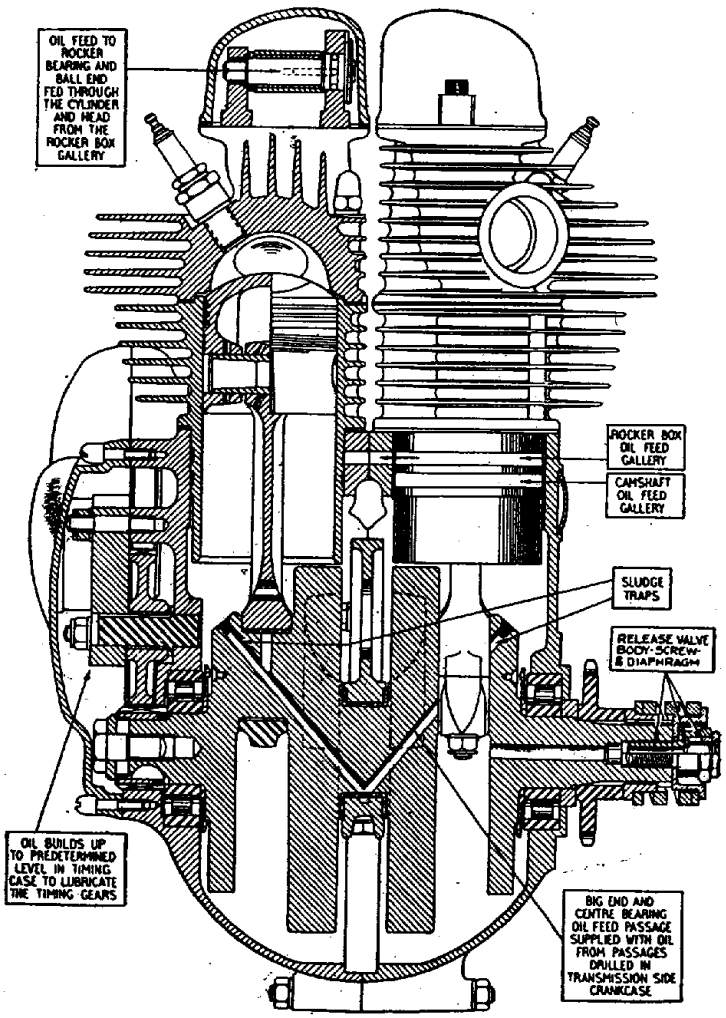

FIG. 8.—CROSS-SECTION OF ENGINE SHOWING OIL GALLERIES, OIL PASSAGES AND RELEASE VALVE.

the rocker just "nips" the feeler. Retighten the nut for the clamp bolt, do not overtighten, then deal with the other cylinder as described.

Note

Should the nut for the rocker-axle clamp bolt be unscrewed to an unnecessary extent, the steel flat washer (3, Fig. 10) can fall out of position by reason of side movement caused by the spring washer used in this assembly. Omission to reposition these washers can cause damage to the rocker axle and possibly the rocker-box pillar when the clamp nut is retightened.

Setting and Checking Ignition Timing

The magneto pinion is a taper fit on the armature shaft and needs a special extractor tool (Part No. 015273) to remove it. A piece of rod or stiff spoke is also required to check the piston position. Before checking or resetting ignition timing first ensure that the contact-breaker gap is correct, i.e., between 0·010 and 0·012 in. A feeler is attached to the contact-breaker spanner for this purpose. To check the ignition setting, rotate engine until the piston is on top dead centre of the compression stroke. With the sparking-plug removed from the off-side cylinder, introduce the rod or spoke down the sparking-plug hole, rocking the engine slowly backwards and forwards, with the rod held as vertical as the hole will permit, until top dead centre is found. Make a mark on the rod to register with the seat for the sparking-plug hole, withdraw the rod, then make a further mark $\frac{3}{8}$ in. exactly higher up, which is the correct ignition advance.

Reinsert the rod, turn engine *backwards* slowly until the highest of the two marks on the rod registers with the sparking-plug seating in the cylinder-head. Set the ignition-control lever in the fully advanced position, when, if the timing is correct, the contact points should be just about to break. The exact point of separation is best found by using a strip of cigarette paper between the points, when a light pull on the paper will indicate the point of separation.

If it is necessary to retime the ignition, remove timing-gear cover, release the armature nut securing the pinion, which has

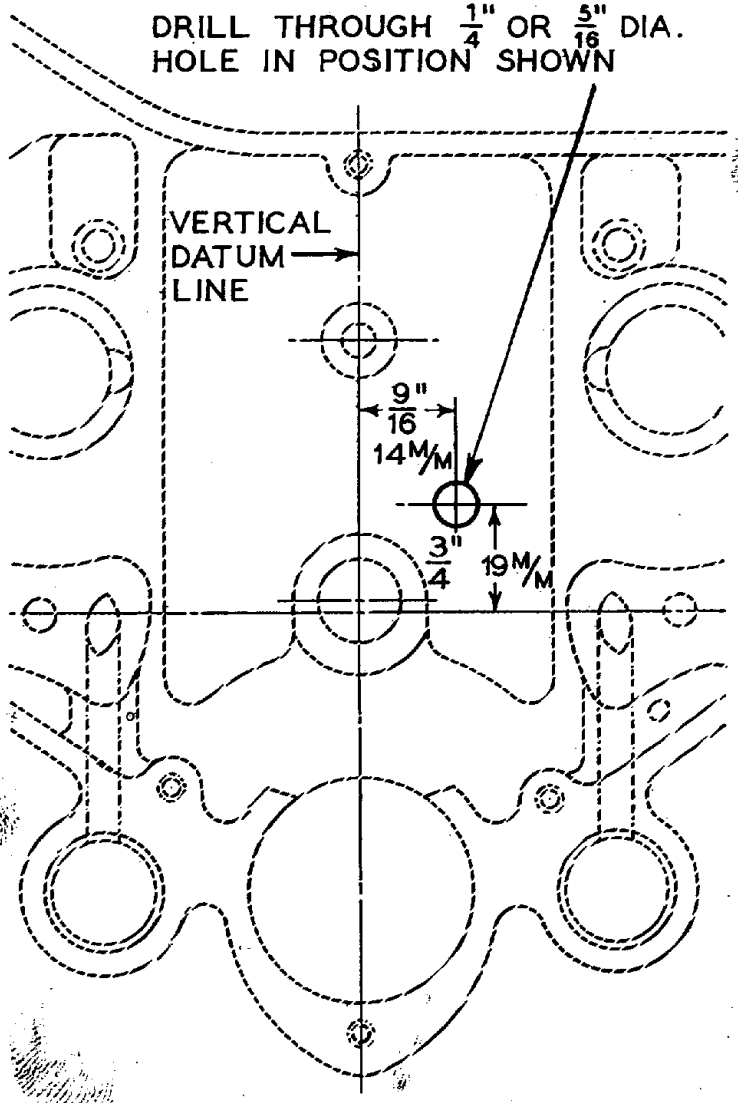

FIG. 9.—ADDITIONAL OIL DRAIN HOLE IN THE TIMING CHEST.

This modification has the effect of lowering the level of oil in the sump when the machine is stationary.

a right-hand thread, screw the extractor into the pinion, when by tightening the centre bolt for the extractor the pinion will then be released. Unscrew the extractor and position the engine as detailed for checking ignition, fully advance the control lever.

Making sure the engine does not move, turn the magneto in a clockwise direction (looking at the contact-breaker end of the magneto) until the fibre pad on the breaker arm touches the *lower hump* or *cam* in the cam ring. Place a piece of paper in between the contact points, turn the magneto until with a light pull the paper can be moved; push the magneto pinion on the armature shaft, lightly tighten the fixing nut. In view of the importance of this setting it is advisable to recheck the setting, then firmly tighten the armature-shaft nut. Clean

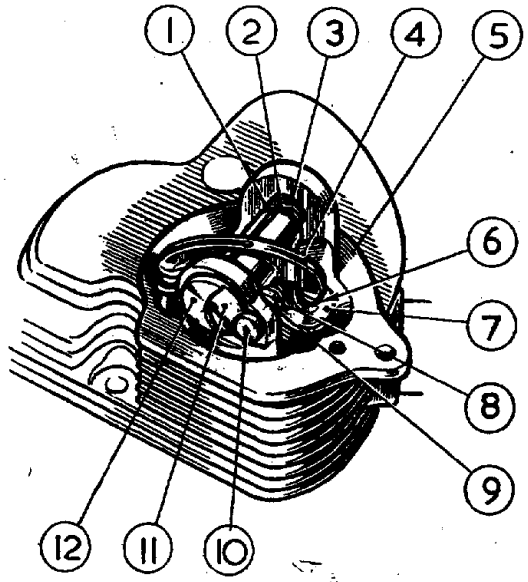

FIG. 10.—THE COMPONENTS OF THE O.H.V. ROCKER GEAR.

1. Plain washer.
2. Spring washer.
3. Plain washer.
4. Rocker.
5. Cylinder head.
6. Rocker clearance (0·006 in.).
7. Valve spring cap.
8. Clamping bolt nut.
9. Clamping bolt washer.
10. Clamping bolt.
11. Cutaway on rocker spindle.
12. Eccentric rocker spindle.

faces on crankcase, also the timing-gear cover, apply a little Wellseal, allow the jointing compound to become tacky before refitting cover.

Note

The high-tension cable for the off-side cylinder is connected to the brush holder at the rear of the magneto. It may so happen there is a slight variation in the contact-point gap for each cylinder. This is of no serious consequence, providing the exact point of separation for each cylinder is identical. If there is a variation, the cam ring should be exchanged by a Lucas Service Depot.

Removing Timing Gears

To take out all the timing-gear pinions, a bridge-type extractor, Part No. 015374, and an extractor for the magneto pinion, Part No. 015273, will be necessary. Start by removing the timing-gear cover, with care not to lose the plunger for the relief valve if fitted, also the pump plate. Before attempting to remove any one pinion, unscrew all the nuts for the pinions, noting the camshaft nuts are *left-hand thread.*

With both camshaft nuts removed, the bridge extractor should be applied by screwing into the pinion the two outside bolts, then screw in the centre bolt for the extractor, which will draw the pinion off its shaft. The intermediate pinion can be withdrawn by hand without a special tool. Deal with the magneto pinion as described in timing the ignition on page 25.

The extractor for the magneto pinion is also used for the small timing-gear pinion, which can be left in position if the crankshaft is to be removed, as the pinion will pass through the aperture in the timing-half crankcase. If this pinion has to be removed apply the extractor on the thread provided. To remove the dynamo pinion this instrument should be removed with the pinion on it, when it is a simple operation to remove it from the armature shaft by using a claw-type extractor.

Replacing Timing-gear Pinions

Carefully wash all the pinions, making sure dirt or foreign matter is not lodged in the teeth. One tooth on the small

pinion is marked with a centre-punch dot, the intermediate pinion is marked likewise with a dot at the bottom of a tooth gap. With these two marks set to register, a study of Fig. 1 will indicate the assembly of the camshaft pinion, which has *two* centre-punch dots that register with two similar dots on the intermediate pinion. With the pinions correctly meshed the valve timing should be correct.

The magneto and dynamo pinions are not marked. Pinion fixing nuts should be finally tightened when all the pinions are assembled.

Valve Timing

If it is desired to check the actual position where the valves open and close a timing disc made from Ivorine will be required. This can be obtained from the makers of the machine. To ensure accuracy it is recommended that this disc is attached to a steel disc of the same diameter with a hole in the centre to take the fixing bolt. The engine can then be rotated, a minute amount at a time, to determine the exact points of opening and closing of the valves.

A pointer must be made from an old spoke or stiff piece of wire with a loop at one end to anchor the pointer to one of the crankcase bolts each side of the near-side cylinder. The other end of the pointer should be bent at a right angle about midway between the crankcase or at twelve o'clock to the crankcase medallion.

Remove the near-side rocker covers for the inlet and exhaust valves, take out both sparking-plugs and position the engine as recommended for timing the ignition. Remove the outer portion of the front chaincase, take out the crankcase-release or shock-absorber bolt, whichever is fitted. Now secure the timing disc with the zero marking to register with the pointer (which should have a fine point if a thick wire is used).

With a bar through the sparking-plug hole, rock the engine backwards and forwards until the exact top dead centre is reached. Bend the pointer end to register exactly with the zero mark on the timing disc. As quietening curves are used on all cam flanks, the rocker clearance should be 0·012 in.

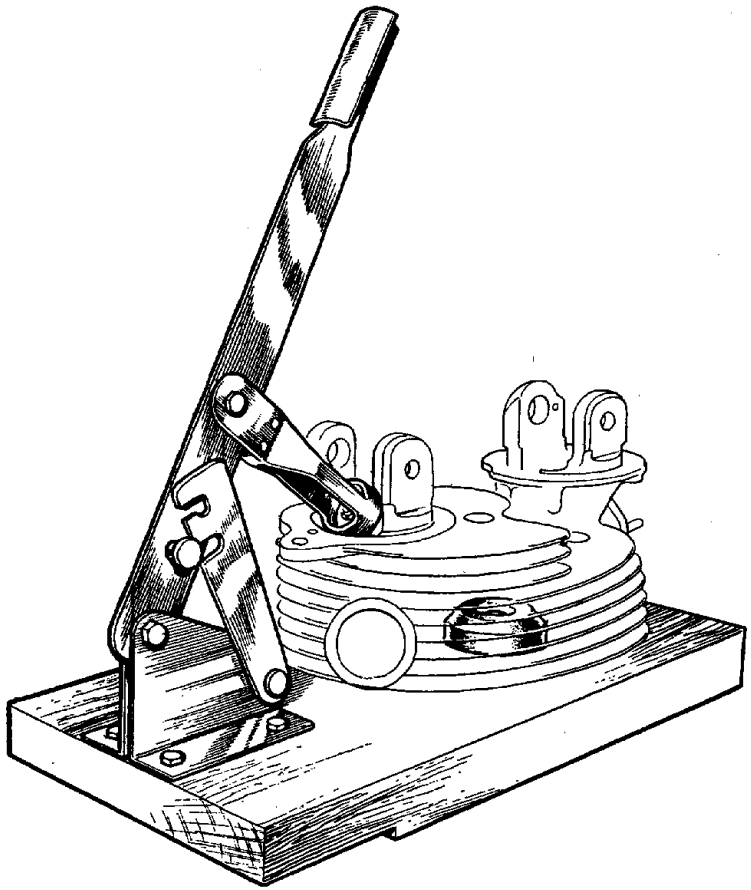

FIG. 11.—VALVE SPRING COMPRESSOR.
This tool is recommended where the utilisation justifies the expense.

Some owners may find it difficult to reproduce the average valve-timing figures the makers recommend, due to the use of a feeler to find the point of opening and closing of the valves.

The checking clearance is 0·012 in., as already explained. Supposing a feeler 0·005 in. thick is used, then the checking clearance is reduced to 0·007 in. Consequently the rocker clearance should be increased by the thickness of the feeler used.

Release the rocker clamp-bolt nuts as described for setting rocker clearance, using the feeler placed between the valve end and the rocker arm. Set to checking clearance, then deal with the inlet valve first (which is the most important setting) by holding the feeler in the left hand, slowly rotating the engine with the timing disc (if a steel disc is also used, if not, remove the timing-gear cover and use a spanner on the small timing-pinion nut), rotate the engine and immediately the feeler is nipped by the rocker read off the figure on the dial plate and record it. Continue to find the valve-closing position in the same way, when the exhaust-valve timing can also be checked if desired.

If the timing is correct on one cylinder there is no need to check the other, as a single-piece camshaft is used. Reset the rockers to running clearance, remove timing disc, refit chain-case cover. It must be stressed that if any degree of accuracy is to be obtained then the work must be carefully executed. A slight variation from the makers' timing to the extent of a few degrees will have no adverse effect on performance. Valve-timing figures quoted are mean readings taken from a number of engines.

A more accurate method is to use a dial gauge (Fig. 12) mounted on the cylinder-head with the pointer against the valve-spring collar and take a reading with the valve 0·001 in. off its seat.

Note

If the valve timing on an old engine is at considerable variance with the makers' figures, the cam followers may be worn.

Decarbonising the Engine

Owners often ask at what mileage should the engine be decarbonised; the answer is that there is no fixed or known mileage when this should be carried out. With the advent of premium grades of fuel, detonation or "pinking" is not so prevalent as in the days of Pool petrol. Consequently, if the performance and petrol consumption has not deteriorated it is

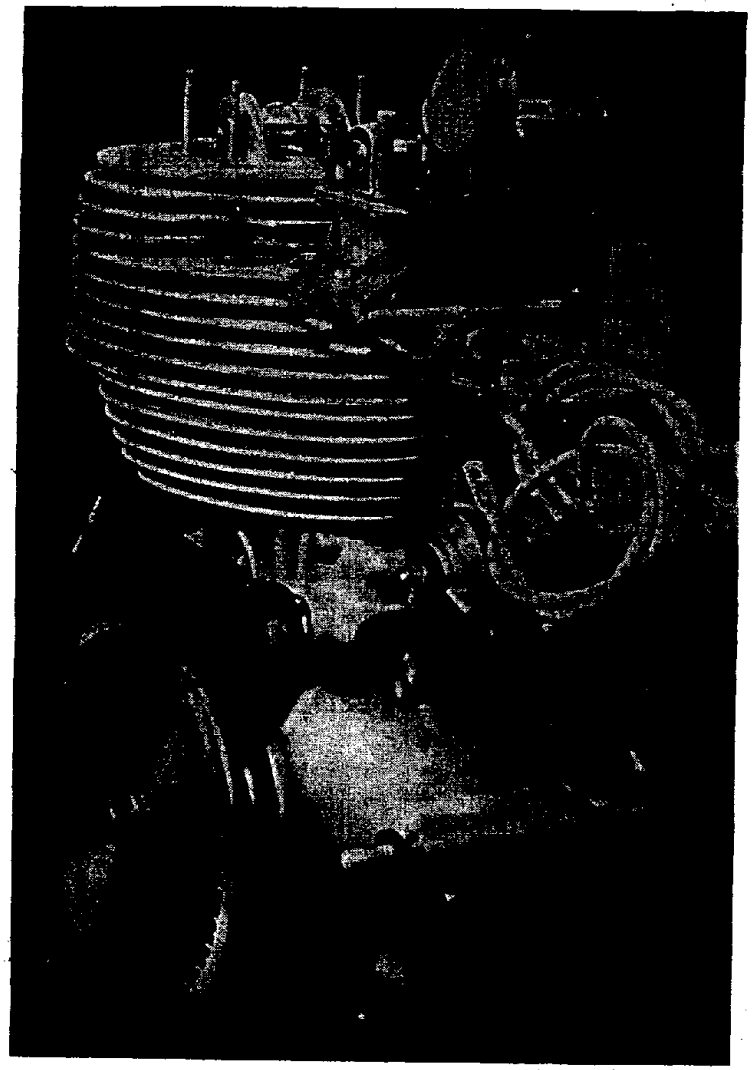

FIG. 12.—METHOD OF USING DIAL TEST INDICATOR FOR DETERMINING VALVE TIMING.

reasonable to assume that the internal condition of the combustion chambers is normal. One risk in covering considerable mileage (e.g., more than 10,000) without examining the combustion chambers is that the exhaust valves and the seatings in the cylinder-head may become damaged, due to a lead separation from some fuels.

If an exhaust valve is held off its seating by a lead deposit or by insufficient rocker clearance, the flame, on combustion, will act as a blow torch, forcing itself through the minute space between the valve head and its seating, thus burning the valve.

It must be realised that heat collected in the valve head can be dissipated only by contact between the valve and its seating. Therefore a check on the compression should be made from time to time if large mileage between decarbonisation is made. To test compression, it is essential to fully open the throttle to charge the cylinder. If the valve is damaged and the silencer is removed, the ear placed close to the exhaust pipe exit, a hissing noise should be heard when the engine is turned against compression. In such a case the cylinder-head should be removed as soon as it is conveniently possible.

To decarbonise, have available a gasket set, some fine grinding paste, a small quantity of clean rag, a small flat tin and a clean paint-brush. A valve-spring compressor will facilitate valve removal, alternatively, a small block of wood about 2 in. cube can be used for this purpose.

Proceed by removing petrol tank (it may be necessary to lift the Twin seat). Take away both exhaust pipes and silencers in one piece. Do not rock exhaust pipes to and fro, which may close in the end of the pipes and cause gas leakage when refitted. A little paraffin squirted on to the exhaust pipe will assist easy removal. Hang the pipes up on a rope or piece of string in the garage to prevent damage and scratching the chrome if left lying on the floor.

Remove the carburetter, wrap a piece of rag round the slide, tie slide to the top frame tube to avoid damage. Take away the manifold, mark it for refitting in same position as it came off, remove cylinder-head steady. Remove sparking-plugs, and if petrol is to be splashed about for cleaning, place the high-tension terminals against the frame.

Take off rocker covers, then with the use of a suitable box spanner the cylinder-heads can be removed. If difficulty occurs in separating the head from the barrel, this is a two-handed job, help by a second person to hold down the cylinder barrel. Using a short piece of wood under the thickest part of the exhaust port, a sharp tap with a hammer on the free end of the wood should part the head from the barrel. If the barrel is allowed to go up, the piston rings might " pop out ", and when the cylinder falls the rings can break and *may* fall into the crankcase.

If the prime object in removing the cylinder-heads is to clean the combustion chamber (sphere of the cylinder-head), also the piston crown, the condition of the valve seatings can be checked by filling the exhaust and inlet ports alternatively with petrol, with the port uppermost for a short time. If the petrol does not leak past the valves the seating is in good order. This check should also be carried out after valve grinding to prove that the seatings will be gas tight. This method is used in preparing racing engines.

If the valves are to be removed it is best to remove all carbon deposit from the cylinder-head before the valves are extracted. This action will prevent carbon entering the ports, which is not easy to dislodge unless compressed air is available. When the valves are out the small amount of carbon close to the valve seats can be scraped away.

If the piston crowns are to be cleaned without disturbing the cylinder barrels, use a sharp-edged tool like a 6-in. steel rule. When the piston crowns are cleaned, particles of carbon will become lodged in the cylinder bore and on the edge of the top ring.

An easy and effective method of removing this carbon is to turn the engine until the piston is about ½ in. down the stroke. Press a little grease in the recess formed between the top land of the piston and the barrel. Turn the engine again until the piston passes the top dead centre and down again about 1 in. This will leave a ring of grease in the cylinder bore with carbon chippings adhering to it, which can easily be removed. Repeat this process, thus making sure all traces of carbon have been removed.

Removing Valves

This process necessitates the removal of the rocker spindles before a valve-spring compressor can be used. If this tool is not available obtain a block of wood as previously described, which should be placed on a bench to prevent the valves moving when the springs are compressed. By pressing on the valve-spring collar with a stout screwdriver or similar tool, tap the spring collar sharply, when the collar will move, so compressing the springs. Whilst this pressure is retained the collets can be taken away from the valve stem. Fig. 11 shows a valve-spring compressor for service use in dealers' workshops.

With the valves removed, carbon formed on the valve seat and on the throat of the valve should be scraped off with a suitable tool. Valve stems are chromium plated, after manufacture, to give a hard, " soapy " surface, thus reducing the possibility of the valve seizing in the guide or causing premature wear. The use of emery cloth on the stems should be avoided, but where the stem of the valve is coated with carbon, use a sharp knife to clean it. If emery cloth has to be used, use it up and down the valve stem, *not* across.

Valve Grinding

A short piece of rubber tube with a ¼-in.-diameter hole can be used on the end of the valve to grind it. Usually, slight application of fine grinding paste only will be necessary to reseat the inlet valves. The exhaust valves may need a little more attention, but if the valve seat is badly pitted or burnt, get the seating refaced on special equipment designed for this purpose, which is usually available in most service stations.

After applying grinding paste to the valve seat, wipe the stem clean each time it is inserted through the valve guide. With the valve in the head, push the rubber tube on to the valve stem, then with a light pull on the valve, rotate it backwards and forwards (not round and round), lifting the valve off its seating occasionally until the grinding paste ceases to " bite ". Take the valve out, wash it in petrol, also the seat in the cylinder-head. If there is a continuous matt surface on both seatings, further grinding is not necessary.

If one cylinder-head is dealt with at a time, the valves cannot be incorrectly fitted, as the valve-stem diameters are of two sizes. Before assembling the valves, pass a piece of fluff-proof rag through each valve guide, squirt petrol through hole drilled in the guide. At this stage the metered oil-ways in the cylinder can also be checked, by squirting petrol down the hole drilled in the rocker pillar, or post.

Replacing the Valves

Oil the valve stem and guide with clean oil, put the springs over the stem with the bottom valve-spring seat, *wide* edge downwards (if this is reversed the springs will close up solid when the valve is at full lift, causing wear on the cam followers or on other parts of the valve gear). Fit the valve collar, repeat the process described for dismantling if a compressor tool is not available. When assembled, give the end of the valve a light blow with a hammer to " jerk " the collets home, the valve must be free to move when this is carried out.

Removing Valve Guides

All valve guides are made from chilled cast iron, and they are somewhat hard and brittle. As they are positively lubricated, and having chromed valve stems, they usually have a very long life. These guides, located by a circlip, are a force fit in the cylinder-head. Should it be necessary to remove or replace the guides, the cylinder-head must be heated by applying gentle heat, when the guide can be tapped upwards from the port in the cylinder-head in order that the circlip can be removed.

A tool with a sharp point, like a knitting-needle, is required to prise the circlip out of its groove. Clean the exposed part of the guide with emery cloth to remove any burnt oil or carbon, reheat the head, when the guide can be tapped downwards out of the port.

Replacing Valve Guides

To ensure the guide will start squarely when refitted, it is a good plan to pass the valve through the hole in the cylinder-

head, where the guide is fitted. Holding the valve head on its seating, pass the guide over the valve stem and press down the guide, now located by the valve itself. The cylinder-head must also be heated when the guides are replaced. The circlip can be fitted to the guide before it is replaced, when the guide can be tapped down until the circlip rests on the guide boss.

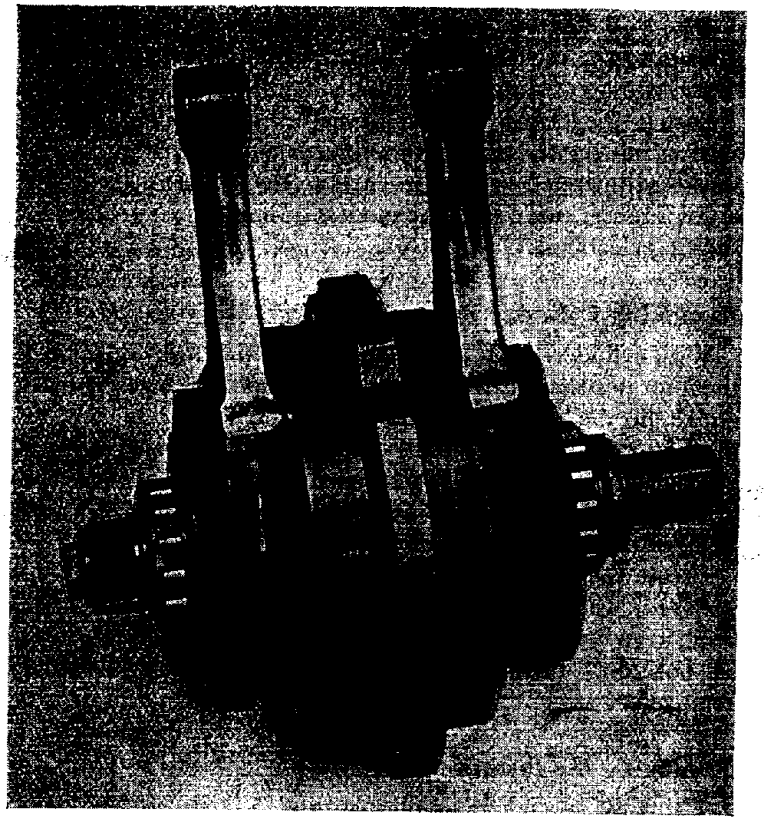

FIG. 13.—ROTATING ASSEMBLY OF THE MODEL 20.
The outer races of the roller bearings are peened into the crankcase.

Replacing the Rockers

Every moving part of the engine must be cleaned and oiled before replacement. Pass a clean piece of non-fluffy rag

through all the rocker bushes, then apply clean oil to the bushes in preparation for assembly. Pass the rocker just through the rocker pillar, place over the end a plain steel washer. Offer up the rocker, move the spindle towards the opposite end of the pillar, fit another plain steel and spring washer, and finally the third plain steel washer.

A piece of spoke is useful to " juggle " the third washer into position. Failure to correctly locate this washer can cause damage to the rocker spindle and the pillar on the cylinder-head.

Ensure the clamp bolt is located correctly, tighten self-locking nut lightly to allow rockers to move for adjustment. Rockers illustrated in Fig. 10 have a groove machined in top of each rocker, used on 1955 models onward. Set rockers to running clearance.

Removing Cylinder Barrels

With cylinder-heads removed, take out the push-rods, label them for position, turn engine till the pistons are on top of the stroke, lift the barrel sufficiently high enough to enable a piece of clean rag to be used to fill the throat of the crankcase as a precaution against a broken piston ring dropping down into the crankcase. The engine can then be turned again sufficiently to allow the cylinder barrel to be lifted away.

Before the cylinders are replaced, new base gaskets should be used, which should be stuck on the cylinder base after applying a little Wellseal on the cylinder face to hold the gasket in position. Ensure push-rods are refitted in the order removed.

Removing the Pistons

Using the special circlip pliers supplied in the tool-kit, take out the circlip, using a rotary motion, then place it in a safe place. On some engines the gudgeon-pin is a close fit in the piston bosses, in which case heat will be necessary to expand the piston before the gudgeon-pin can be removed. Boiling water in a bucket, with pieces of rag immersed in the water and applied to the piston crown—in relays—will heat the piston

sufficiently to expand it, when the gudgeon-pin can be extracted. Carbon formed on the piston crown can be scraped off with a 6-in. steel rule, without damage to the piston.

A clean piece of rag round the piston rings and skirt will prevent carbon entering the piston-ring grooves. Do not take off the piston rings, unless absolutely necessary. Distortion must inevitably occur when the rings are opened out for removal, and it will take some time before they settle down again. If the rings have to be removed, use care to avoid expanding the rings unnecessarily. Using both thumbs in the ring slot, the ring can be opened to permit it to just come out of its groove. The use of a penknife or similar tool is too drastic.

A chromed compression ring in the top ring groove has been used by the makers of the machine since 1952, which undoubtedly reduces cylinder-bore wear. If expense is of no consideration two chromed rings can be used, which will have a further beneficial effect. Piston rings of this type have a slightly chamfered surface which makes contact with the cylinder. When new, these rings have the word " *TOP* " etched on one side of the ring, for correct location. With use the etching disappears after large mileage.

The correct position for assembly can then be identified by a brightness on the surface face. The bright edge is the lower one. With prolonged wear the ring surface becomes uniform, in which case correct location is unnecessary.

The split-skirt wire-wound pistons used in these engines are made to very close limits, the normal clearance when new is 0·0009 in. only. Therefore handle these pistons carefully, for distortion of the piston skirt can create piston slap. Full contact between the piston skirt and the cylinder wall is not intended. The pistons are taper and oval ground, making contact only on the thrust side of the skirt (slotted side), also the pressure side (opposite to the slot). Discoloration on the skirt below the gudgeon-pin bosses does not indicate gas leakage or a distorted piston.

Fitting New Piston Rings

If replacement rings are supplied by the makers the ring gap is allowed for in the process of manufacture. Suggested ring

gap is 0·003–0·005 in. for each inch in cylinder-bore size. It is essential that all traces of carbon are removed from the ring grooves in the pistons before new ones are used. The danger lies with a carbon formation in the two corners in the ring slot. A broken piece of piston ring will serve as a tool for cleaning the ring grooves. Other than correct assembly of the chrome-type rings, it is simply a matter of avoiding over-expanding the rings when fitted to the pistons.

Make sure the piston and rings are perfectly clean, petrol for cleaning is preferable to paraffin (which collects dust) for this process. Apply oil in the gudgeon-pin bosses, using the same procedure for refitting the pistons as described for removal. Make absolutely certain the circlip is correctly in position before replacing the cylinder barrel.

Replacing Cylinder Barrels

Thoroughly clean the crankcase face, make sure there are no broken portions of the base washer round the holding-down studs. A new base-washer stuck to the cylinder has already been fitted, now apply some clean oil on the pistons, pass some clean fluff-proof rag through the cylinder and then oil. At this stage the throat of the crankcase should be filled with rag to safeguard against piston-ring breakage during the process of refitting the cylinder.

The cylinder can now be offered up by closing in the top ring with the fingers of the left hand, then place the cylinder over the piston. Watch carefully that the ring enters the cylinder; continue the process until the cylinder is past the rings. Holding the cylinder with the right hand, take out the rag in the crankcase, then place the cylinder in position. Deal with the other cylinder in a similar manner.

Replacing Cylinder-heads

Clean the push-rods, apply oil to both ends, insert them down the push-rod tunnels in former position. Usually, when the cylinder-heads are removed the gasket will adhere to the cylinder barrel. If they are even slightly damaged replace them to avoid subsequent attention. Rotate engine until it is

on the top dead centre of the firing stroke. Offer up the head, locating the rockers in the top cups, place the head into position. Because of the clearance between the holes in the cylinder, also the cylinder holding-down studs, it is possible for a bias to occur between the manifold and both cylinder-heads if the cylinder-head nuts are fully tightened. This can be prevented by leaving the cylinder-head nuts loose before the manifold is refitted. Machines made for the 1953 season used a Hycar ring in a recess machined in the manifold. This was introduced to cure a permanent air leak caused by the carburetter flange bending.

The makers will exchange early-type manifolds for the latest type for a sum of 5*s*. plus postage. Check the faces of the manifold for bruises or similar damage, correct by rubbing down these faces until they are perfectly flat, with a sheet of emery cloth placed on a pane of glass. Fit the paper gaskets, ensure they do not partially mask the ports. Tighten manifold nuts, when the cylinder-head nuts can be finally tightened diagonally, a trifle at a time, until cylinder heads are firmly secured. Rocker clearance can now be set as previously described.

In factory service the engine is run for a short while to settle down the valves, push-rods and rockers, before the rocker covers and petrol tank are refitted. A small tin for fuel, with a union for the petrol pipe in the bottom of the tin, is used for this purpose. It is attached to the petrol-tank frame rail.

When the engine has cooled down, retighten cylinder-head nuts, check the rocker clearance and reset if necessary. Now the rocker cover can be refitted if the gaskets are in good order. On engines made before 1953 the rocker cover tightens down against a soft gasket, it is easy to overtighten these bolts and cause breakage. Overtightening can be avoided by intelligent application of the spanner used for this process. Engines made from 1953 onwards use Allen screws of larger diameter to prevent breakage.

Before refitting the carburetter, place a straight-edge or rule on the flange, hold up to the light, if flange is bent or buckled it must be made flat by rubbing down, using a sheet of emery cloth on a pane of glass, until the whole surface is even and

flat. A gasket is not used when the Hycar ring is fitted. Refit the steady stay. Exhaust pipes should be cleaned underneath and polished before refitting.

Note

A word about chromium plating is desirable here. It is a common assumption that chromium plating is impervious to rust, which is not correct. This finish, apart from appearance, is used because it is less susceptible to rust than most electrically deposited metals. Parts finished in this way must be cleaned frequently if the finish is to be preserved. Without such attention a salt deposit will occur which if not removed promptly by cleaning will deteriorate the finish.

Replacing the Sparking-plugs

As alloy cylinder-heads are used, it is most desirable to apply a little graphite to the threads of both plugs. Cylinder-heads have been ruined as a result of damage to the thread for the plug, by " picking up ", finally locking the plug in the cylinder-head. Set the plug gaps to 0·020–0·022 in. Before replacing the petrol tank, examine the high-tension leads for cracks, or evidence of shorting to frame, ensure dirt from the garage floor has not collected in the nipple recess for the petrol pipes. After fitting petrol-tank retaining bolts, set tank so that these bolts are central in the holes for the tank rails, contact can amplify engine vibration.

Engine Noise

Should a rattle or noise develop, and located in the top part of the engine, check rocker clearance as previously described. If in order, close up the rocker clearance on each valve in turn, with no appreciable clearance. Rotate the push-rod with the fingers, if the push-rod becomes either tight or loose, the push-rod is bent. This is most likely to be associated with the exhaust push-rods, for if the valve becomes sluggish in its guide the rocker will leave the cup and catch on the edge of the cup on the end of the push-rod and slightly bend it. Extract damaged rod, either straighten or replace. Reset rocker clearance on all valves when fault has been traced.

If there is no fault, check the bushes in the rocker post (small end of the rocker spindle) for movement. If the bush is loose, have an electrical deposit of copper made on the outside diameter of the bush to increase its effective diameter, then refit. If the bush is renewed, the same treatment should be applied, for the hole in the rocker post will be enlarged slightly through the movement that has previously occurred. A shortage of oil to the valves and push-rod ends will cause a noise in the top part of the engine as well as worn rocker-axle bushes.

Engine Noisy when Hot

This can be caused by backlash between the teeth of the timing-gear pinions. First check the intermediate pinion for backlash. If excessive, examine bush in pinion for wear. Should it be possible to rock sideways slightly this pinion, the bush and probably the shaft for the bush are worn. To replace the bush is a simple matter (*see* data for reamed size), but to remove the shaft is a little more difficult. To do this a lathe carrier or device to clamp on to the shaft is necessary.

This shaft is a force fit in the crankcase, it can be extracted with a suitable tool without dismantling the engine. Have ready the tool required and a tray to catch the oil when the timing cover is removed. Take the machine on the road to get the crankcase really hot, preferable to running the engine with the machine stationary for any undue length of time. Having done this, work quickly to remove the timing cover and the intermediate pinion, clamp the tool on the shaft, turn and pull out at the same time, when the shaft can be extracted from the crankcase. The tool used is shown in Fig. 14.

The new shaft should be started square and tapped home. For the 1955 engines a larger-diameter shaft is used to minimise wear. This shaft can be fitted to earlier type engines, providing the intermediate pinion is changed also, which obviously has a larger-diameter bush. Should backlash occur between the magneto pinion and the camshaft pinion, slacken the two top bolts securing magneto, when the magneto can be moved forward a slight amount, sufficient to take up backlash.

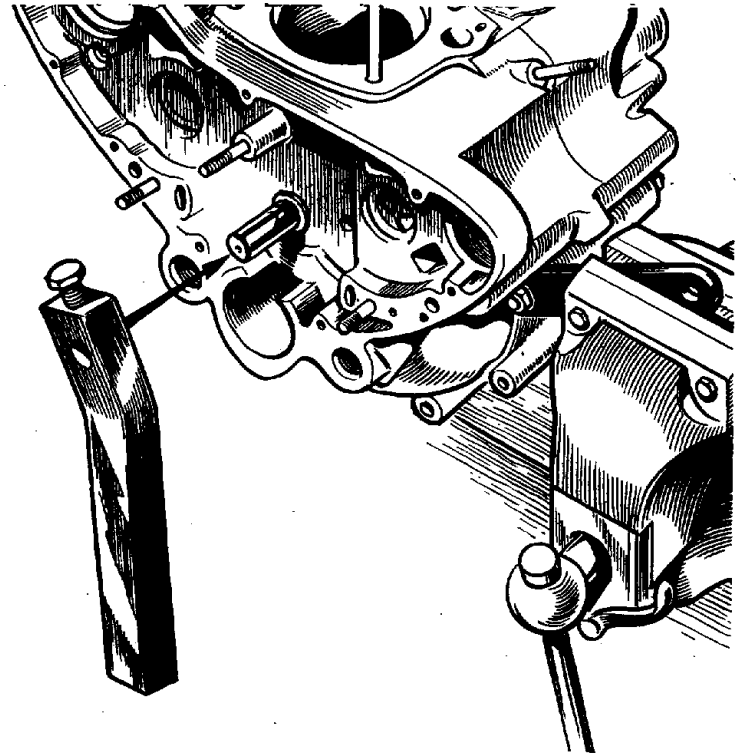

FIG. 14.—AN EASILY-MADE TOOL FOR EXTRACTING THE INTERMEDIATE TIMING GEAR SHAFT.

Note the simple tool for holding the engine safely on the bench.

Earlier types of engines can be modified by removing the magneto, when the two top holes can be elongated to permit this adjustment.

Owners who are not interested in maximum performance can use a rocker clearance of nil for the inlet valve, with 0·002 in. clearance for the exhaust valve.

If a tapping noise develops in the top part of the engine after decarbonising, with correct rocker adjustment, check the valve motion for valve springs closing up solid, due to the valve-spring seats being incorrectly fitted. A check can be made without removing the cylinder-heads by checking each valve

in the following manner. Turn the engine until the valve is at full lift, lever the rocker arm down to open the valve further. If no further movement can be made the springs are closed solid. To remedy, take off the head affected, fit valve-spring seats correctly with the wide edge of the seat against the boss for the valve guide.

If a dull, thumping noise is audible when the engine first fires on starting, the cause is probably a weak shock-absorber spring. This noise can be overcome by either fitting a new shock-absorber spring or, alternatively, by using a suitable washer $\frac{1}{4}$ in. thick (similar to the lock-ring on the front-wheel bearing) to increase spring pressure.

Gudgeon-pin Bearing

This is the most maligned bearing in the engine. So-called "expert" advice usually attributes engine noise to "worn small-end". This is a fallacy, and in factory service no evidence of small-end wear has been manifest even after many thousands of miles; oversize parts are not made.

Big-end Noise

By virtue of the efficient filter system used in these engines, premature big-end wear is extremely remote. From factory service experience it is known that engines of this type can be run for 50,000–60,000 miles without attention to the big-end assembly, providing the oil is changed regularly, also with an unbroken and clean oil filter, without derangement to the oiling system through inexpert manipulation. This applies also to the centre-web bearing for the crankshaft. When checking the connecting-rods for movement or wear, do not be misled by side movement. The normal dry clearance between the connecting-rod bearing and the crankpin is 0·0025 in. maximum.

Obviously, with a high oil pressure a pad of oil will be maintained between these two bearings which, with the above clearance, cannot possibly generate a noise or rattle.

Excessive big-end movement or clearance is usually indicated by a rather high-pitch rattle, audible at 40–50 m.p.h., with the engine running light. Testing the connecting-rods

for up-and-down movement will reveal if the movement is excessive. The only cases known of complete failure of this bearing have been due to owners reversing the springs in the non-return valve with the springs for the crankcase filter, or racing the engine from cold.

When the temperature is low, only a thin wire of oil is drawn through the feed pipe by cavitation, the bulk of oil adhering to the sides of the pipe. It is therefore essential to run the engine slowly at first under such conditions until the oil has become warm.

ENGINE OVERHAUL

When work of this kind is contemplated, some pre-arrangement is obviously necessary. Good workshop facilities are essential. Cleanliness is of paramount importance, the work-bench and tools must be clean and free from abrasive matter. Whilst the engine is simple in construction, it is a highly specialised piece of engineering and must be dealt with intelligently and efficiently. Apart from a selection of normal tools, the special tools already described are necessary.

Have available a Spares List, together with the usual gear, plenty of clean, non-fluffy rag; a petrol squirt for cleaning small oil drillings, and a pressure oil-squirt. A cradle to hold the engine on the bench is shown in Fig. 15, this may be a little elaborate for the private owner but will be of interest for dealers' service.

Removing the Engine from the Frame

First follow the instructions given for decarbonising the engine, but leave the cylinder-heads with barrels on the engine. Drain oil tank, remove both oil pipes. Remove the battery, take out extended bolt uniting the rear chain-guard with the front chaincase. Place a tray under front chaincase to catch oil, release metal band, also outer portion of chaincase.

On early models it may be necessary to move the footrest on the left side to a forward position before the outer portion

of the chaincase can be taken away. To do this, slacken the nuts for the centre stand, brake-pedal bolt, also the bottom frame uniting bolt. Release the nut on the left side of footrest rod, tap the rod towards the offside, then the footrest can be moved. Unscrew clutch-spring adjusting screws, releasing pressure plate. Turn back the tab washer for clutch hub-nut, loosen the nut. Use a good-fitting ring-spanner on the large hexagon for the crankcase release, or shock-absorber spring bolt (whichever is fitted), give the end of the spanner a series of sharp blows with a hammer to loosen the nut.

Disconnect front chain, take away shock-absorber assembly, also sprocket, with distance piece behind sprocket. Unscrew clutch hub-nut, the clutch can then be pulled off the centre without a special tool. Watch for the clutch-bearing rollers (24), which will drop out when the clutch is removed. Turn back three tab-washers for bolts fixing back portion of front chaincase to crankcase. Unscrew nut for centre bolt in chain-case. Chaincase half can be taken away. Pull out all bolts passing through the crankcase and engine plates (put back the nuts with washers when they are out).

Disconnect ignition cable at handlebar end, together with two wires attached to dynamo. If the colour sleeves on wires are obliterated, label them for position before removal.

Now pull out the bottom frame uniting bolt, when, with a piece of wood to lever the front frame away from the crankcase slightly, the engine can be removed. If difficulty occurs, slacken gearbox bolts to allow engine plates to open out. Before placing the crankcase assembly on the work-bench, clean underneath with a wire brush to remove road grit, particularly round the sump plug.

With engine on the bench, a stand or bar bolted to the crank-case in a vice, as shown in Fig. 14, is most useful. A more elaborate arrangement for this purpose is shown in Fig. 15 for service dealers.

Without these facilities it is advisable to remove cylinder-heads, barrels and pistons, after the transmission, with front chaincase, has been removed, and providing the connecting-rods are protected with rag to prevent bruises on the rods and crankcase before crankcase is removed from frame.

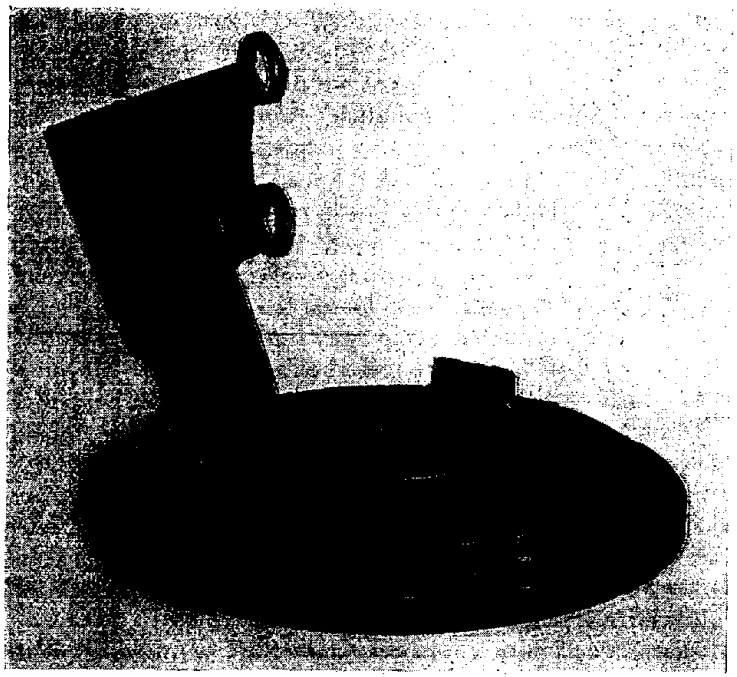

FIG. 15.—CRADLE FOR HOLDING ENGINE DURING MAJOR OVERHAUL OPERATIONS.

Dismantling Engine (Removed Complete)

Start by taking off cylinder-heads, barrels and pistons as previously described. Mark pistons for location. Take out oil-distributor bush (13, Fig. 6); non-return valve, Fig. 7; crankcase felt filter, with its cap fitted at the far end. Remove rotary release valve if fitted (14, Fig. 6). Remove three bolts in crankcase on driving side, one each side of the medallion, the other near filter in crankcase. Remove timing cover; also pump-carrying plate, with pumps attached (three nuts). Take out all timing-gear pinions, as described on page 28.

Remove dynamo, two bolts, one nut securing magneto and place aside. Set connecting-rods at bottom dead centre, then the timing-side half of crankcase can now be lifted off the centre web. Take out tunnels for camshaft chambers.

At this stage note carefully the position of the cam followers and in particular the distance pieces in between the cam followers, which should be labelled or marked to ensure correct assembly. It is essential that the cam followers, which are identical, are replaced in the same position as removed, unless new ones are used. Label camshafts, which might be inadvertently reversed. Two types of cam followers are used, i.e., short type for engines made before 1953; long type for engines made from 1953 onwards. These will not interchange because the cam-follower spindle locations are different.

Centre Web

Take out six bolts securing centre web to driving side of crankcase, when crankshaft and centre web can be taken away. Watch for paper gasket for sealing oil passage.

Crankshaft Assembly

This assembly, when extracted, will have on it the two roller races on the driving-side shaft, also timing-side shafts, leaving the bearing outer races in each half of the crankcase.

Removing Main Bearings

On engines made before 1952 some difficulty may be encountered in removing these bearings, which have a steel washer behind each bearing. On engines made after this date a groove was machined in the face of the crankshaft to allow the use of a wedge or extractor to pull off these bearings. With the early type engines, two sharp-pointed wedges like short screwdrivers are used, they are tapped down at diametrically opposed positions, i.e., 180 degrees, until the bearings and washer can be pulled off each shaft with a suitable extractor. On engines with a groove in the crankshaft face, this operation is of a simple nature and needs no further explanation.

Removing Roller-bearing Outer Races from Crankcase

These races are "peened" over at three equidistant positions after fitting. Using a sharp-pointed scraper or similar tool, remove metal "peened" on the outside diameter

of the races. The races are a force fit in the crankcase, which must be heated to create expansion. In this condition drop the crankcase on to a flat board or clean bench, when the race will drop out.

Note

Heat should be applied gently and uniformly.

Removing Camshaft Bushes

Two flanged bushes for each camshaft are fitted to the timing-half of crankcase, leaving a recess in the housing for these bushes, which makes removal somewhat difficult as both flanges face outwards.

A soft drift, slightly smaller than the bush diameter, can be used with care to drive out one bush, placing the drift each side of the bush edge alternatively, tapping the end of the drift with a light hammer. The removal of plain bushes on driving-side half crankcase presents no difficulty.

Note

It is most unusual for wear to take place in these bushes, excessive movement is most likely to be associated with wear on the camshafts.

Dismantling Crankshaft Assembly

With crankshaft suitably supported, observe the marking on the connecting-rods (journal end) to indicate location of caps, which must be refitted to the same position relative to the crankshaft. Take off both nuts on connecting-rod, pull off the cap, lift away the rod. Replace the cap with nuts on the rod for the time being. Having dealt with the second rod, take off two nuts for centre bearing and separate.

INSPECTION

Crankshaft

Light score marks can be removed with very fine emery, providing extreme care is exercised in cleaning out oil drillings in crankshaft when this work is complete. Similar score marks will be seen on the split bearing for the connecting-rods and

centre bearing. If the scoring is of a minute nature the use of a scraper will level out the bearing surface. The metal for the split bearings (three-layer type at the bottom of the rod, two-layer type at the top) is extremely thin, therefore if the scoring is heavy it is best to fit new bearings of the three-layer type.

Should the crankshaft journals be badly scored, it should be reground —0·010 in. with undersize bearings fitted. For journal clearance and side clearance *see* Technical Data. Sludge traps can be cleaned out at this stage.

Gudgeon-pin Bearing

A detachable bush is not used, any wear between the gudgeon-pin and bearing in the rod is usually confined to the pin only.

Camshaft Bearings

These can be checked for clearance if left *in situ* with shafts fitted. Camshaft diameter is given in Technical Data.

Intermediate Shaft

This is a force fit in crankcase, driven out from inside the case. Gentle heat will facilitate removal. Should this shaft show the slightest signs of wear, it should be replaced to avoid timing-gear noise. If expense is of no consideration the latest type (large-diameter) shaft with suitable intermediate pinion can be used.

Crankshaft Roller Bearings

Inspect carefully for pitting on rollers, also bearing races for indentation of tracks. To avoid subsequent attention to this part of the engine, renew if there is the slightest evidence of wear.

Inlet and Exhaust Camshafts

A slight marking on the apex of the cams is of no consequence. Smooth surface with a fine stone, finish with super-fine emery. Cam followers can be treated likewise, unless a

large depression is formed on the radius, then replacements should be fitted. Fig. 16 shows dimensions of cam height, and radius for followers, for checking purposes.

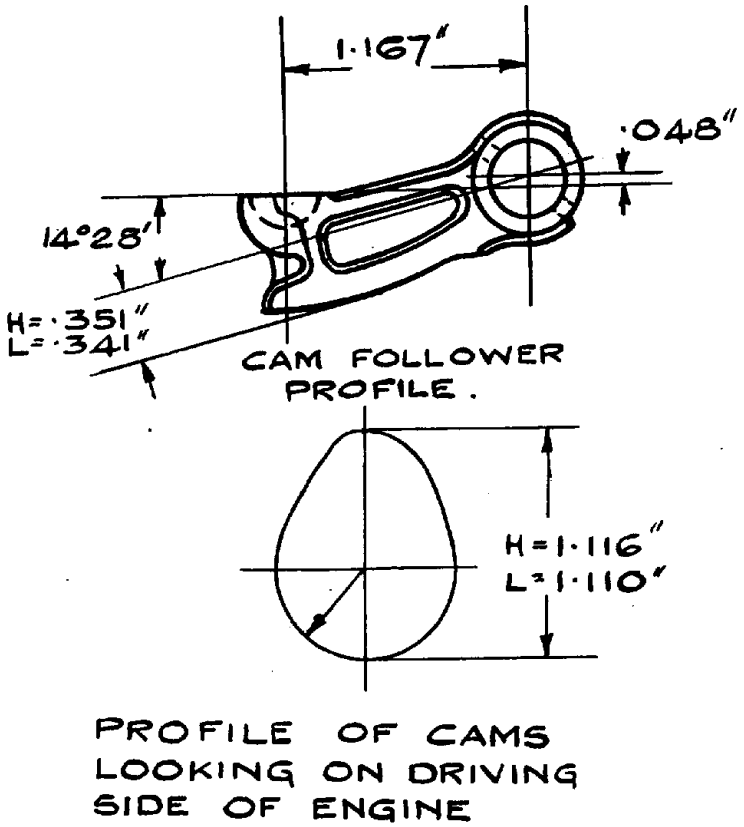

FIG. 16.—CAM AND CAM FOLLOWER PROFILES.

Note

Severe damage or loss of contour for any cam should be investigated, which can only occur by overload, due to the use of incorrect type valve springs and/or spring seat reversed, causing coil binding of valve springs. If a 1953–55 type camshaft is fitted to engines made before 1953, the valve motion should be carefully checked to ensure there is additional valve-spring movement, with valve at full lift, to the

extent of $\frac{1}{32}$ in. This is accomplished by reducing the face for the valve-spring seat, which abuts against the valve-guide boss on the cylinder-head.

REASSEMBLY

Assembling the Crankcase and Crankshaft

Cleanliness in this work is of paramount importance. Before commencing this operation the work-bench, tools, etc., should be scrupulously clean. Have ready new gaskets; new self-locking nuts are required for vital parts of the crankshaft assembly. Wash thoroughly all nuts and washers (a small tray with a gauze bottom is useful, and can be submerged in petrol or paraffin with the parts in the tray). A supply of jointing compound such as Wellseal, which does not become "flaky", is recommended. *All* working parts *must* be oiled before refitting. Proceed by forcing oil under pressure through oil drillings in crankshaft, repeat this operation several times to make sure all traces of foreign matter are excluded.

Refitting Connecting-rods and Centre Web

Apply clean oil to all bearings, apply also a film of graphite to the split bearings. Ensure connecting-rod caps are refitted in the same position as before removal.

Torque spanners are used in factory service, set to 22 lb.ft. for the connecting-rod nuts, 11 lb.ft. for the centre-web studs. Without such tools, centre-web and connecting-rod nuts should be firmly tightened without using undue force. Place the roller bearings on the crankshaft, with washers first, if fitted; apply oil either with a clean brush or oil can. Oil should never be applied with the fingers, on account of abrasive being included. If there is an interval between the installation of the crankshaft assembly to the crankcase, cover with clean rag or paper, most particularly if paraffin, which can collect dust and dirt, is used for washing.

Installing Crankshaft Assembly in Crankcase

A clean wooden box on the bench to hold the driving-side crankcase will help in this assembly; alternatively, bore a hole

in the bench so that the driving side of crankshaft can enter it when fitted to the crankcase. Oil the inner race and rollers, fit the crankshaft into the driving-side half crankcase, with both connecting-rods at the bottom of the stroke.

Locate centre web and bolt it to the driving-side crankcase (six bolts and washers). If a careful note of cam-follower distance pieces was made during dismantling, it is a simple matter to refit these parts. Proceed by fitting two cam-followers, with distance pieces, the two tunnels for camshaft housing and the two camshafts, make sure location is correct. Fit the remaining two cam-followers, then short spacers for cam-followers.

Use a thin film of jointing compound on face for timing-side half crankcase, place aside to allow compound to become tacky. Apply jointing compound round the filter aperture in driving-side half crankcase, locate paper gasket used to seal this joint. Offer up timing-side half crankcase after oiling camshaft bushes and roller bearings. Fit the bottom crankcase bolt also three bolts on driving-side crankcase to pinch crankcase together.

Crankcase assembly can now be held in a vice as shown in Fig. 14. Refit the piston, cylinder, etc. If a vice for the crankcase is not available, instal crankcase assembly into the frame, which will serve as a fixture, when pistons, barrels, etc., can then be refitted, provided throat of crankcase is filled with clean rag during this operation.

Clean or replace filter in crankcase, ensure metal seat is inserted in filter tunnel, before fitting filter. Replace oil-distributor bush release-valve, if fitted in crankcase. Remove oil tank, wash interior with benzole or mixture, clean or replace filter. Clean out both oil pipes, renew banjo fibre washers if damaged. Fill tank with fresh oil, after fitting oil pipes to crankcase.

Refer to details on dynamo and magneto before refitting these instruments to the crankcase. Before fitting carburetter read Chapter II. As the work on the engine is nearing completion, it is only natural, on the part of the private owner, to experience a mild form of excitement, with the desire to get the engine running as quickly as possible, with gratification as

to the ultimate result. Nevertheless, some restraint is necessary to continue methodically to complete the final assembly, if a sound job is to be carried out.

Installing Engine in Frame

Clean all engine-fixing bolts, using a brush on threads, to facilitate replacement. Check bolts for stretch, if they are held up to the light deformation on threads, by a change in diameter where thread terminates, can readily be seen. Replace any bolts affected, so that they can be firmly tightened, which will minimise engine vibration through the frame, also bolt breakage. Should it be necessary to completely dismantle the gearbox, defer installing the engine until the gearbox has been dealt with as described in Chapter III. Assuming the gearbox has been dealt with, or needs no attention to reinstal, reverse the procedure described to remove engine from frame.

Clean face on inner portion of front chaincase, apply jointing compound where it is bolted to the crankcase. Apply some grease to shock absorber and sprocket before assembly. A simple tool, which can be used to prevent the gearbox mainshaft from rotating whilst tightening the shock-absorber nut, also the clutch hub nut, is shown in Fig. 17, and consists of an old clutch steel plate, with a bar welded to it. Bleed oil-feed pipe to allow oil to drain away until air bubbles cease, to prevent an air lock.

Retighten union on crankcase for feed pipe. Before refitting rocker covers run engine, using test tank. Let engine cool down, reset rockers if required, retighten cylinder-head bolts, when rocker covers can be refitted. Check oil pressure as described on page 13.

Crankshaft Balance

The twin-cylinder crankshaft is balanced dynamically by the makers, who also weigh each piston and connecting-rod, which are paired to ensure that the balance factor is correct. This engine has a vibration period which occurs at about 60–65 m.p.h. in top gear. As the duration is short, discomfort

should not occur, but if the period is at the road speed regularly used by any particular owner, the solution is to use an engine sprocket with twenty-one teeth, to move the period away from the normal driving speed.

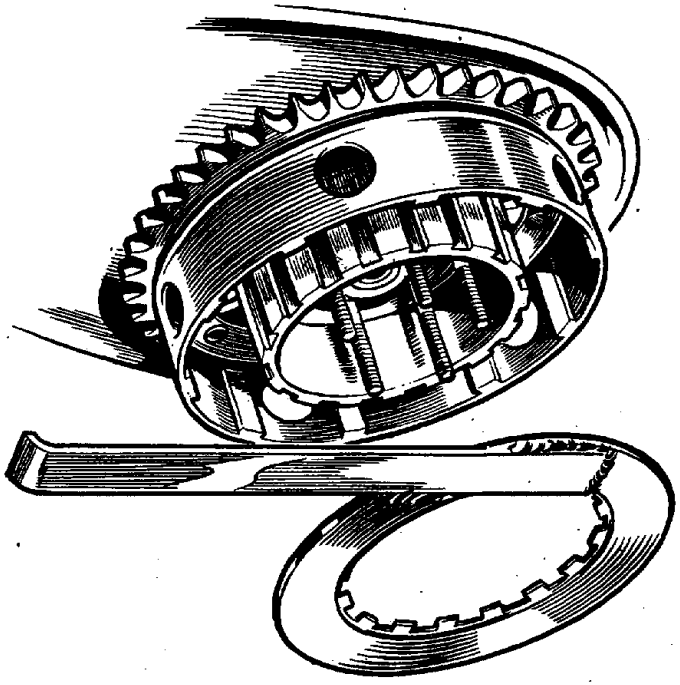

FIG. 17.—TOOL FOR PREVENTING THE GEARBOX MAINSHAFT TURNING WHILST THE CRANKSHAFT SHOCK ABSORBER AND CLUTCH HUB NUTS ARE TIGHTENED.

Where the vibration is of a prolonged or violent nature, this can be due to:

(*a*) Loose engine or gearbox bolts.
(*b*) Play in steering-head bearing.
(*c*) Loose cylinder-head steady-stay.
(*d*) Air leak on one cylinder-head causing bad carburation, which affects vibration.

In the case of old machines which have covered considerable mileage without overhaul, excessive movement in main bearings will have the same effect.

Note

Petrol-tank securing-bolts should be central in the frame-lug holes, as contact between these bolts and frame will amplify an engine period.

Balance Factor

The balance factor is 50 per cent of reciprocating masses plus the whole rotating mass.

Piston assembly	=	357·4 gm. × 2
Connecting-rod small-end	=	100 gm. × 2
Connecting-rod big-end	=	367 gm. × 2
∴ Reciprocating masses	=	457·4 gm. × 2
Rotating mass	=	367 gm. × 2

50 per cent balance factor = (50 per cent of 457·4 + 367) × 2
= (228·7 + 367) × 2
= 595·7 gm. × 2

∴ 2 balancing rings (one on each crank journal) of 595·7 gm. each should produce a static balance condition on the crankshaft for a 50 per cent balance factor with connecting-rods and pistons of the above weights.

Crankshaft Modification

Engines after No. 7000 were fitted with a modified crankshaft, with increased rotating weight, thus necessitating a narrower centre bearing. Earlier type engines can use the later type crankshaft, providing the centre web and bearing are exchanged also.

CHAPTER II

CARBURATION

THREE types of Amal carburetters have been used on the Model 20. Between 1950 and the end of the 1953 season, Type 76 AG/1AU was fitted; for the 1954 season, a modified carburetter, Type 76 AT/1EF, was introduced. This differed in that the mixing-chamber casting was redesigned to prevent distortion caused by faulty tightening of the carburetter to the manifold studs. An entirely different carburetter was used for the 1955 season; this was the Monobloc, Type 376/6, which featured combined mixing and float chambers, a detachable pilot jet and no exposed air passages when used with an air filter.

To obviate air leakage between the manifold and carburetter, a Hycar ring was fitted to a groove machined in the carburetter face of the manifold on machines produced during the 1953–55 seasons. The manufacturers will supply a modified manifold, complete with Hycar ring, on receipt of an early-type manifold together with 5*s*. plus postage.

No useful purpose is served by deviating from the recommended settings, unless the machine is operated at altitudes above 3,000 ft., when a 5 per cent reduction in main-jet size is usually necessary. If a machine is raced with an open exhaust-pipe system, then an increase in main-jet size is necessary to offset the removed restriction of the silencers. Usually, an increase of 10–20 c.c. (from size 180 to 190–200 jets, 250 to 260 on Monobloc carburetters) is sufficient. The use of megaphones will entail the need for even larger jets.

When investigating acute vibration, check the needle position and the slide cut-away, for incorrect setting; these faults, or a bad air leak on one cylinder, will affect engine vibration.

Carburetter Function

The petrol level is maintained by a float and a needle valve and in no circumstances should any alteration be made to this.

In the event of a leaky float, or a worn needle valve, the part should be renewed. Do not attempt to grind a needle to its seat.

The petrol supply to the engine is controlled, firstly, by the main jet and, secondly, by a taper needle which is attached to the throttle slide and operates in a tubular extension of the main jet, called the needle jet.

The main jet controls the mixture from three-quarters to full throttle, the adjustable taper needle from three-quarters down to one-quarter throttle, the cut-away portion of the intake side of the throttle slide from one-quarter down to about one-eighth throttle, and a pilot jet, having an independently adjusted air supply, takes care of the idling from one-eighth throttle down to almost closed position. These various stages of control must be kept in mind when any adjustment is contemplated. The pilot jet consists of a small hole drilled in the choke, or jet block.

Types 76 AG/1AU and 76 AT/1EF

Faults

If the engine fails to idle, with a weak spot at small throttle openings, the pilot jet may be at fault. Before altering the pilot setting check the following:

(*a*) Contact-breaker gap (0·010–0·012 in.).
(*b*) Sparking-plug gaps (0·020–0·022 in.).
(*c*) Rocker clearances (0·006 in. all valves, cold).
(*d*) Manifold joints for air leakage.
(*e*) Carburetter flange joint, for buckle, if Hycar ring is not fitted.

Even and positive slow running cannot be obtained with the ignition-control lever in the fully advanced position. Obviously, if the fully-advanced ignition setting is correct for 7,000 r.p.m. it cannot be suitable for very slow engine speeds, particularly when light crankshaft weights are used.

If screwing home the pilot-air-adjustment screw fails to make the engine idle, then either the pilot-jet drilling in the jet block is partially or totally obstructed, or the inlet valves and

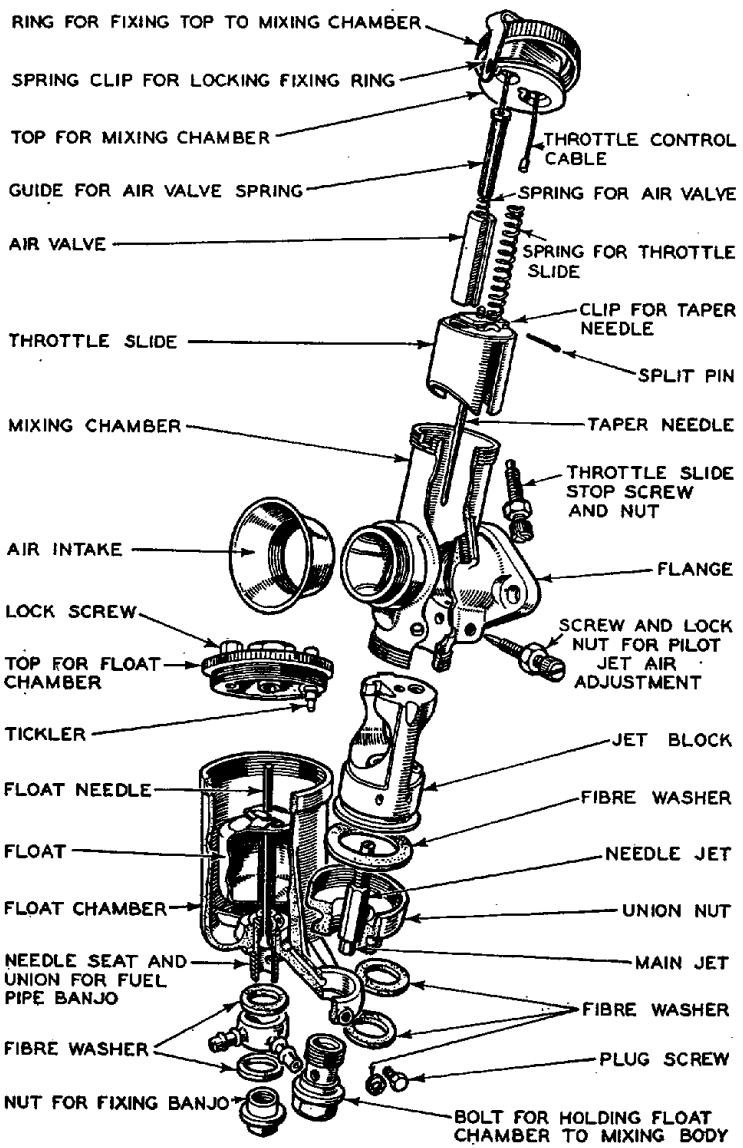

FIG. 18.—EXPLODED VIEW OF AMAL TYPE 76 CARBURETTER.

guides are badly worn. An obstruction in the pilot outlet, which is the hole drilled diagonally across the mixing chamber, can also have an adverse effect on slow running.

If the inlet valves and guides are known to be in good condition, disconnect the petrol pipes from the carburetter. Unscrew the float-chamber-holding bolt at the base of the mixing chamber, and remove the union nut and the two nuts securing the carburetter to the manifold. Ease the carburetter off the studs and unscrew the top ring; lower the carburetter away from the slide. Insert a piece of wood into the top of the mixing chamber and gently tap it to dislodge the jet block. Do not use more force than is necessary.

The pilot jet is a small hole drilled in the centre of the recess in the jet block, in the position arrowed in Fig. 18, for choke or jet block. A strand of Bowden wire or, preferably, compressed air can be used to clear the pilot drilling.

Pilot-jet Modification

A modification was introduced in the late part of the 1954 season to give better control over the pilot jet, by increasing the volume of the mixture and not the quality, which would affect petrol consumption. This modification can be carried out to earlier models, if extreme care is exercised, by increasing the diameter of the diagonal drilled hole in the mixing chamber leading into the inlet tract, which can be seen in Fig. 18, centre of cut-away portion, in line with the hole for pilot adjusting screw. Originally the diameter of this hole was 0·025 in., which should be increased to 0·029 in. To manipulate the drill used for this purpose, an Eclipse pin vice (watchmaker's hand chuck) No. 121 is required, together with a No. 69 drill. Introduce the drill into the counter-bored end of the drilled hole, taking care to avoid forcing the drill, which should be rotated slowly and withdrawn from time to time to clean the flutes, until the end of the drill emerges into the inlet tract. It will now be possible to have full control over the pilot jet, with the air screw unscrewed 1½ to 2 turns. Refit the carburetter in the reverse order to that given for dismantling; if the union nut and float-chamber holding bolt are tightened before the carburetter is securely fixed to the manifold, then distortion

of the carburetter flange face is almost certain to occur. After modification, when setting the pilot air screw after carrying out routine checks, start the engine, run for a few seconds, retard the ignition lever about $\frac{1}{8}$–$\frac{3}{16}$ in. and adjust the pilot air screw to give positive slow running. When the engine is warm, it should idle very slowly when the ignition is fully retarded, if it does not, the pilot setting is weak. Endeavour to set the pilot air screw as quickly as possible to avoid the engine overheating, giving a false pilot setting, which will be weak when the machine is on the road.

Excessive Petrol Consumption

Assuming that the engine is in good order, with the carburetter set as recommended, the only part of the carburetter that can wear and affect petrol consumption is the needle jet. If ovality takes place, due to the needle movement, the fact of altering the needle position will have no beneficial effect. In view of the small cost of replacement, a new needle jet should be tried. A rich pilot setting can account for an increase of fuel consumption, to the extent of 9 m.p.g. up to 30 m.p.h. Check also the frame seat tube for surface stains caused by fuel blown back after flooding. As the main jet comes into effect from three-quarters to full throttle only, a smaller main jet is not necessary in dealing with a fault of this kind. The use of a slide with a smaller cut-away will also have an adverse effect on fuel consumption. Conversely, a slide with a larger cut-away will weaken the mixture up to half throttle opening by causing a weak spot as the throttle comes off the pilot, because the cut-away acts to some extent as bridging jet from pilot to the main jet.

Mixture Bias

First check the inlet-manifold paper gaskets, which can, if incorrectly positioned, mask the inlet ports. If the bias is serious, try the effect of reversing the manifold; this should transfer the weak or rich mixture, whichever the case may be, to the opposite cylinder. To remedy, change the manifold. An air leak on one manifold joint will create a mixture bias.

Monobloc Carburetter (1955 Models)

The small holes drilled in the needle jet provide a head of fuel for snap acceleration. Tuning details are similar to those used on the earlier type carburetters, with the exception of the pilot adjustment, which is much more critical. The pilot air-adjusting screw should be moved a minute amount at a time to arrive at the correct slow-running setting (*see* details for earlier-type carburetters).

Engine Fails to Idle

First check the settings as previously described on this subject.

Remove the pilot-jet cap and unscrew the pilot jet. Remove any obstruction by blowing through the jet, in preference to probing with wire. On refitting the pilot jet, ensure that the jet is seated correctly, otherwise the fuel consumption will be impaired. Overtightening of this jet will distort the seating in the mixing chamber. Follow details already described for setting slow running.

Heavy Fuel Consumption

The average fuel consumption is in the region of 65–70 m.p.g. at speeds between 40 and 45 m.p.h. When the carburetter fails to respond to the usual treatment and it is known that the engine is in good order, refer to Fig. 19, when it will be observed that two holes of different diameter are drilled in the bottom of the carburetter intake. Two similar holes are drilled in the jet block. The larger of the two holes in the intake should be in exact register with the larger hole in the jet block. The taper needle can be used to feel if the register is incomplete, in which case the partial restriction must be removed either by changing the jet block or by carefully blending the hole in the jet block.

Carburetter Flooding

This fault is associated with heavy fuel consumption. Usually there is a marking on the frame seat tube as a witness that fuel has been blown back from the carburetter. To

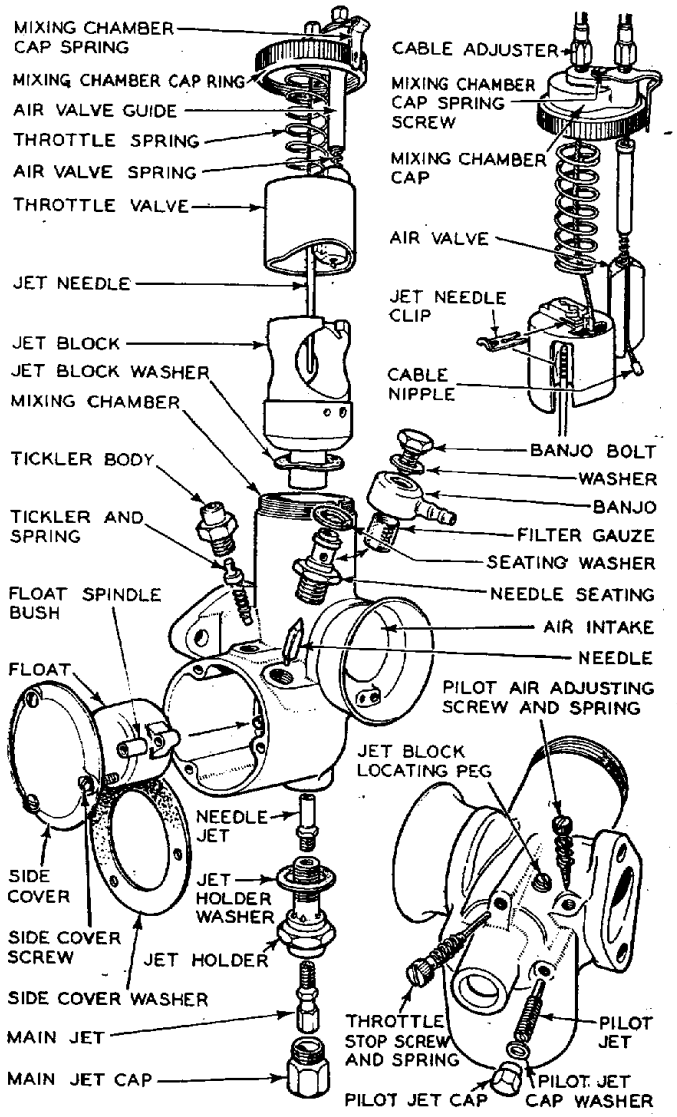

FIG. 19.—EXPLODED VIEW OF AMAL MONOBLOC TYPE 376/6 CARBURETTER.

remedy this condition, check for foreign matter on the float needle seat. If after cleaning the trouble prevails, the needle may be sticking or sluggish, in which case a new nylon needle will be required. The possibility of a distorted pilot-jet seat should be investigated. Take out the pilot jet and hold the tapered end over a lighted candle to form a coat of soot on the taper portion. Refit the jet, screw home lightly, take out the jet and note if the marking on the taper by contact with the seat is uniform. If not, the mixing chamber must be exchanged. A damaged jet-block washer will allow fuel to leak across the face, causing erratic running with heavy consumption.

CHAPTER III

TRANSMISSION

Chain Adjustment

FRONT-CHAIN adjustment is effected by moving the gearbox. It must be emphasised that when this chain is adjusted, the gearbox must be pulled back until the chain is tight, then the gearbox moved forward until correct adjustment is reached. This is to prevent the gearbox moving and tightening the chain after adjustment.

Tightening Front Chain

(1) Remove the chaincase inspection cap.
(2) Slacken the top gearbox bolt, on the right-hand side.
(3) Slacken the nut on the forward end of the gearbox adjuster bolt until the chain is tight, which can be felt if a finger is inserted in the inspection-cap orifice.
(4) Slack off the nut at the rear end of the adjusting bolt, then tighten slowly, a trifle at a time, the nut on the front end of the adjusting bolt, until correct adjustment is reached ($\frac{3}{8}$ in. whip in the tightest place).
(5) Retighten the rear nut on the chain adjuster.
(6) Retighten the top gearbox bolt nut firmly.
(7) Replace inspection cap.

Rear Chain Adjustment—1950–54

Wheel alignment is checked at the factory by adjusting the position of a small bolt screwed into the right-hand side of the swinging arm; the position of this bolt should not be altered. The rear wheel is moved to adjust the rear chain by turning the two cams, which move together, mounted on the rear-wheel spindle.

The adjustment is as follows:

(1) With the machine on the centre stand, slacken the nut on the right-hand side of the speedometer gearbox.

(2) Slacken the nuts at the ends of the rear-wheel axle.
(3) Push the wheel forward so both cams are in contact with the projections on the swinging arm.
(4) Apply a spanner to the hexagonal body of the chain-side cam, turn the spanner until correct adjustment is obtained ($1\frac{1}{8}$ in. whip in centre run of chain).
(5) Check the adjustment in several places by rotating the wheel, as chains do not always stretch evenly.
(6) Fully tighten the axle-nuts, position the speedometer gearbox and tighten the fixing nut, to avoid strain on the drive-cable.

Rear Chain Adjustment—1955

To obtain rear chain adjustment the rear wheel is bodily moved in the rear frame fork ends, which are slotted for the purpose. Adjusting screws with lock nuts are provided on the forward side of each slotted end.

Note

Any alteration to front-chain adjustment will affect the rear-chain adjustment. Therefore, check the front chain before adjusting the rear chain. Altering the rear-wheel position for chain adjustment will also affect adjustment of the rear brake.

Chain Inspection, Alteration and Repairs

The chains should be carefully inspected during overhaul to see that all the rollers are present. Breakage of primary-chain rollers will cause very rough running and also rapid wear on the sprocket teeth. Maximum permissible stretch is 3 per cent of the length.

If the chains have been correctly serviced very few repairs should be necessary. But should the occasion arise to repair, lengthen or shorten a chain, a rivet extractor and a few spare parts will cover all requirements. To shorten a chain containing an even number of pitches remove the dark parts shown in " A ", and replace by cranked double link and single connecting link as " B ", Fig. 20.

To shorten a chain containing an odd number of pitches remove the dark patches shown in " C " and replace by a single connecting link and inner link as " D ". To repair a chain with a broken roller or inside link, remove the dark parts in " E " and replace by two single connecting links and one inner link as " F ".

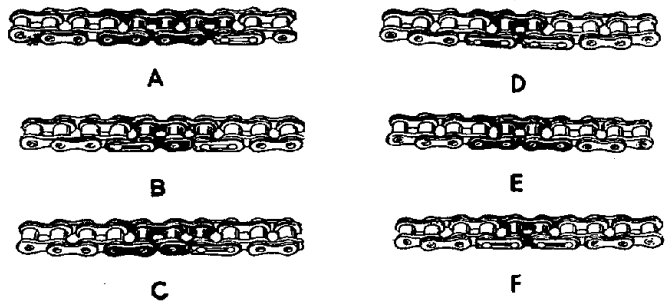

FIG. 20.—CHAIN ALTERATION AND REPAIRS.

The rivet extractor can be used on all motor-cycle chains up to $\frac{3}{4}$ in. pitch. When using the extractor:

(1) Turn screw anti-clockwise to permit the punch end to clear the chain rivet.
(2) Open the jaws.
(3) Pass jaws over chain and rest on a chain roller, free of chain-link plates (*see* Fig. 21).
(4) Turn screw clockwise until punch contacts with and pushes out rivet end through chain outer link plate. Unscrew punch, withdraw extractor and repeat complete operation on the adjacent rivet in the same chain outer link plate. The outer plate is then free and the two rivets can be withdrawn from the opposite side with the opposite plate in position. *Do not use the removed part again.*

Rear Chain Lubrication

To lubricate the rear chain effectively, with a lasting effect, remove the chain, clean it with paraffin. Obtain a small quantity of anti-centrifuge grease (*see* list of recommended

lubricants). Slowly heat the grease in a flat tin until it is fluid, immerse the chain, then reheat the grease, which will have cooled off when the chain was immersed, until the grease is again fluid. Leave the chain to soak; wipe off the surplus grease, then refit the chain. After a few miles, the grease having been squeezed out of the links and rollers, it may be necessary to readjust the chain. The time devoted to such process will be amply repaid, particularly during inclement weather, by prolonging the life of the chain.

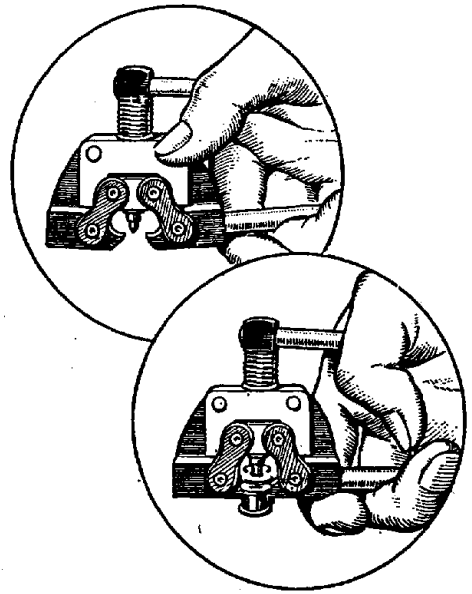

FIG. 21.—METHOD OF USING THE RIVET EXTRACTOR.

Gearboxes

Two types of gearboxes have been used on the twin-cylinder models. Type C.P. was used for the 1949–51 seasons and Type B.52 for 1952–55. Both types are oil-lubricated, with an oil content of 1 pint. Close-ratio gears, normally used with race kits, can be fitted to gearboxes made from 1952 onwards. The internal ratios for these gears are given in Technical Data on page 147. Gears of this kind can also be used on touring

models, with additional pleasure in driving. It is possible to change gear without touching the clutch once the machine is on the move, by regulating the engine speed with the throttle. The only disadvantage is the somewhat high first-gear ratio if the machine is used on steep gradients, continental touring or with a sidecar attached.

The B.52 gearbox is a great improvement over the early type, the foot-change operation is delightfully smooth, and can be improved further if all the operating parts used for gear selection are highly polished.

The C.P. gearbox remained unaltered basically for several years, and although it was superseded for 1952, this is no indication that it was unreliable or unsatisfactory.

Gearbox Faults—C.P. Type

Gearbox Noise

A noisy third gear is usually associated with wear on the layshaft fixed pinion and possibly the main driving gear, which engages with the layshaft fixed pinion. Wear on the layshaft bushes can also create a similar noise.

Top Gear Disengages Under Load

Check the striker forks for wear. If these are in order, the main driving-gear bush may have moved towards the kick-starter side of the gearbox, preventing full-tooth engagement of the gears.

To remedy, replace the bush and ensure that it is a good fit in the main driving gear. Two bushes are used for the main-shaft in this gear. A weak gear-indexing mechanism will have a similar effect.

Faulty Gear Selection

If this is present with more than one gear, check the foot-change assembly, which is " timed ". Remove the foot-change pedal and take away the nuts securing the kick-starter case cover. Remove the foot-change assembly. The small pinion on the camshaft is marked with a letter " O ". Using pliers, turn the shaft until letter " O " is at nine o'clock. Take out the foot-change mechanism for examination. The

toothed sector engages with the camshaft pinion and is also marked with a letter " O ". Fit the assembly with both marks in register, then refit the kick-starter cover and the foot-change pedal, when the gears should be indexed correctly. Should the trouble still prevail, take out the gears and examine the striker forks for wear.

Noisy Gear Engagement

This usually occurs when starting out, when first gear is engaged. Generally, this is due to torque on the gearbox mainshaft, by clutch " drag ". This can be proved by holding out the clutch, with the lever against the handlebar, then depressing the kick-starter crank several times. If after this operation the gear engages without noise, clutch drag is the cause of the trouble. The fault can be due to :

(1) Excessive lost motion in clutch-operating mechanism.
(2) Gumminess of clutch friction plates, due to oil.
(3) Buckled steel clutch-driven plates.
(4) Clutch-spring pressure plate not running true.

To remedy (1) refer to *clutch adjustment* on page 85; (2) and (3) can be dealt with by dismantling the clutch, and wash all parts in paraffin. Put the steel plates together, and hold up to the light, when distorted or buckled plates will be observed. To check (4) remove the outer portion of the front chaincase. pull out the clutch lever on the handlebars, depress kick-starter and observe if the pressure plates are running out of truth. Balancing the clutch-adjusting screws, within reasonable limits, should correct this fault.

Check also the rim of the pressure plate for uneven machining. Insufficient clutch-plate separation, due to wear on operating mechanism, will also create clutch drag and noisy gear operation. Should the clutch suddenly fail to disengage, check the nut retaining the kick-starter ratchet pinion, and check the thrust stud in the clutch-pressure plate. If these are not at fault check the clutch hub-retaining nut. Should this trouble develop gradually, check the push-rod ball for wear, together with the operating lever in the kick-starter case.

Kick-starter Fails to Engage, or Jams

Check the quadrant on the kick-starter crank for damage to the first tooth. This tooth can be ground off to restore operation to normal, with slight loss of leverage. A disintegrated stop rubber will have the same effect.

Kick-starter Fails to Operate

Remove the kick-starter cover and check the ratchet pinion and spring for security. The pinion may be sluggish on the mainshaft, if the spring is in order.

Side Movement, or Rock, on Clutch Sprocket

This may be due to wear on the clutch-hub rollers or sleeve. If the bearing surfaces are in order, reduce the overall width of the bearing sleeve of the gearbox mainshaft, and fit new rollers. Use an anti-centrifuge grease to lubricate the rollers before reassembly.

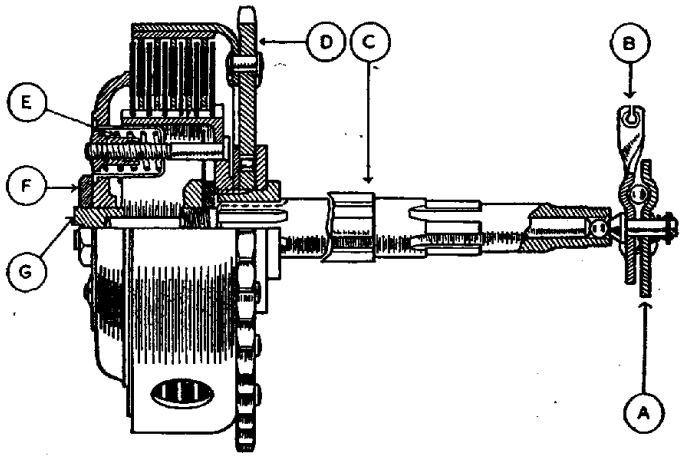

FIG. 22.—SECTION THROUGH CLUTCH FITTED TO B.52 GEARBOX.

A. Fixed clutch internal actuating plate.
B. Clutch internal operating lever.
C. Gearbox mainshaft.
D. Clutch sprocket.
E. Clutch spring.
F. Lock nut for clutch rod thrust cup.
G. Thrust cup (in clutch pressure plate) for clutch rod.

Endplay on Gearbox Mainshaft

If the kick-starter pinion-retaining nut is tight, the small bearing accommodating the mainshaft in the kick-starter case may be worn. The use of shim washers between this bearing and its housing will absorb slight movement.

Broken Teeth on Gears

If a gear has to be replaced for this reason, have the mainshaft and the layshaft checked between centres for bending before reassembling the gearbox. These shafts can be straightened, between V blocks, provided that the bow is within reasonable limits.

Clutch Rattle with Engine Idling

This is due to backlash between the tongues on the clutch friction plates and the slots for the clutch driver. This can be proved by pulling back the clutch lever on the handlebar, when the noise should cease. To remedy, the metal or tongues on the friction plates can be drawn out. Place the tongues of the friction plates on a flat vice or block of steel, and tap the tongues lightly with a light hammer to draw out the metal, thus reducing the clearance between the tongues and the slots in the clutch driver.

Gearbox Faults—B.52 Type

As the clutch arrangement on this type of gearbox is basically the same as the C.P. type (excluding the withdrawal mechanism), refer to previous instructions on this part of the gearbox.

Faulty Gear Selection

Invariably due to the small plunger which engages with depressions in the cam barrel sticking or sluggish in its housing. Cleaning the outside diameter of the plunger with emery cloth is usually sufficient to restore the gear selection to normal.

Top Gear Disengages Under Load

This is not a common fault, but a number of gearboxes were dispatched with the housing for the main bearing machined too deeply. This causes partial engagement only between the main driving gear and the mainshaft sliding gear. To create deeper dog engagement, a steel washer must be made to fit over the shaft between the main driving gear and the main bearing. The washer should be approximately $\frac{1}{16}$ in. thick. Evidence of shallow dog engagement can be seen on the two pinions concerned.

Gears Disengage Under Load

Usually due to a weak V-shaped foot-change centralising spring mounted in the kick-starter case; stretch this spring slightly to increase pressure. A weak foot-change quadrant coil spring will display the same symptoms.

Noisy Gear Selection

When a grating noise ensues as first gear is engaged, check the clutch-withdrawal mechanism. To fully understand the working of the clutch-operating mechanism, a study of the arrangement shown in Fig. 22 should be made. From this it will be seen that any reduction in leverage brought about by shortening the clutch cable (unscrewing the cable adjuster) will reduce the movement of the clutch push-rod. This usually creates a clicking noise when the handlebar lever is operated.

To remedy, run down the clutch-cable-adjuster as far as it will go. Next, turn to the opposite side of the gearbox. Remove the chaincase outer portion or clutch cover, whichever is fitted. With a sparking-plug box key, release the nut locking the thrust cap or stud, mounted in the centre of the clutch-spring pressure plate. Place a screwdriver in the thrust-stud slot and screw in the stud exactly half a turn, and retighten the lock-nut, taking care that the stud does not move during this process. Now go back to the clutch-cable adjuster, and unscrew until there is $\frac{1}{8}$–$\frac{3}{16}$ in. free movement in the outer casing for the clutch cable; retighten the cable-adjuster lock-nut. Should the trouble still prevail, check for " clutch drag " as described for the C.P. type gearbox.

Clutch Rattle

The details given for the C.P. type clutch are applicable also to this clutch.

Foot-change Lever Sticks

The most likely cause of this defect is friction between the foot-change shaft and its bearing in the kick-starter-case cover. First try the effect of squirting a little paraffin, or penetrating oil, around the shaft, and lean the machine over to the left to assist oil penetration. If this does not effect a cure, take off the kick-starter-case cover, ease down the shaft with emery cloth, oil and refit. It should be noted that a weak centralising spring can have the same effect.

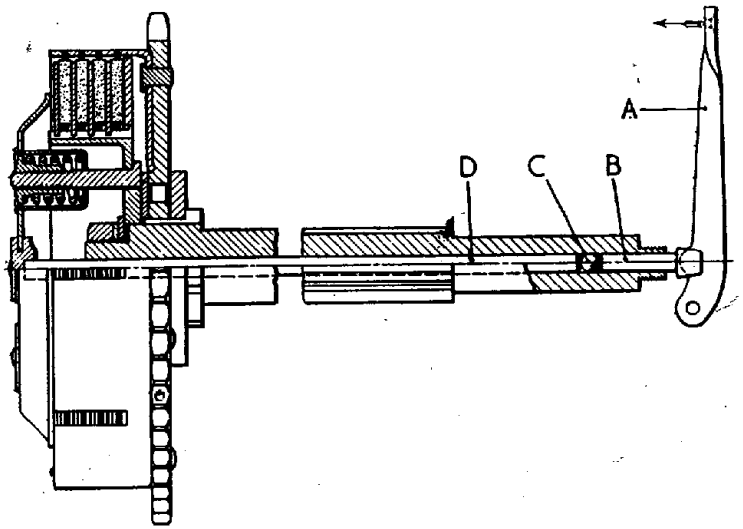

FIG. 23.—SECTION THROUGH C.P. CLUTCH.

A. Lever
B. Short Push-rod
C. Ball
D. Long Push-rod

Kick-starter Crank Sticks After Use

Release the screws fixing the kick-starter-case cover; operate the kick-starter crank. If the crank does not return to its normal position, the return spring is probably broken. *See* details for dismantling gearbox. If the kick-starter returns, with the cover screws loose, it is quite possible that the kick-starter axle bearings, in the case and the cover, are not in line, due to movement of the cover. To correct, lightly tighten the cover-fixing screws, then with a mallet, tap the cover *upwards* from underneath. Retighten the cover-fixing screws firmly, but do not overtighten; the crank should then operate normally. A formation of rust on the kick-starter axle will have the same effect.

Note

It is dangerous to drive with the kick-starter trailing, or with the quadrant in engagement with the ratchet pinion. The ratchet pinion will seize on the mainshaft if the machine is used in this condition for any length of time.

Oil Leakage from Gearbox—Driving Side

The Super oil seal fitted to the gearbox shell will be satisfactory until the machine has covered a considerable mileage. Endeavour to determine where the oil leakage takes place. Wash the gearbox shell with petrol. Check that the oil level is correct, by draining and refilling with exactly 1 pint of oil (SAE 50). Make a short road test, stop the machine and check the gearbox shell exterior for the position of the oil leakage.

This can take place from the two metal plugs sealing the shaft holes or from the main bearing. Should the leaks come from the two metal plugs, wash again with petrol, and apply jointing compound copiously around the plugs; leave the machine stationary until the jointing compound has "set". In the case of leakage from the main bearing, the oil seal must be replaced.

Oil Leakage from Kick-starter-case Cover

This is usually due to a broken or deformed gasket, fitted between the case and cover. A new gasket stuck to the case with jointing compound will have the desired effect.

Dismantling and Reassembling the C.P. Type Gearbox in the Frame

Have available a stout box key or ring spanner for the large nut securing the gearbox sprocket and the nut securing the clutch hub to the mainshaft. These nuts are $2\frac{1}{16}$ in. across the flats and $1\frac{5}{16}$ in. across the flats respectively. New gaskets for the kick-starter case and cover and a new oil seal for main driving-gear will be required.

Remove the left side exhaust pipe and silencer in one piece. Do not unduly rock the exhaust pipe sideways in the port, apply a little paraffin if difficult to extract. Remove the nut on the left side footrest rod, also on machines where the footrest is inside the frame, the nut for the centre-stand spindle, together with the lower front frame uniting bolt. The footrest can now be moved forward.

Place a tray to catch oil when outer portion of chaincase is taken away, with rubber band, if fitted, between the chaincase halves. Fully open the throttle, turn the engine against compression. Using a suitable ring spanner on the engine shock-absorber fixing nut, apply a series of light blows on the end of the spanner with a light hammer, in preference to a levering motion, when the nut will release. Disconnect front chain. Take away the clutch-adjusting screws, springs, cups and pressure plate. Turn back the tab washer behind clutch-hub fixing nut.

Engage top gear, press hard on the rear-brake pedal and unscrew the hub nut. Place one hand on the back of the clutch assembly, the other against the washer covering the clutch rollers, then the complete assembly will come away without losing the rollers (twenty-four in number). Remove the long hexagon bolt uniting the rear chain-guard to the back portion of the chaincase. Unscrew three bolts ($\frac{5}{16}$ in. A/F) retaining chaincase to crankcase, after turning back the tab washer, also nut on bolt in centre of case, which can now be removed.

Work on the gearbox can now commence by removing the drain plug in the bottom of the gearbox shell and catching the oil drained in a suitable receptacle. Remove:

(1) Clutch cable.
(2) Four nuts fixing kick-starter case cover and withdraw, leaving the kick-starter crank and foot-change pedal in position. Fit a rubber band between the kick-starter crank and foot-change pedal to prevent kick-starter spring unwinding.
(3) Clutch lever in kick-starter case cover, also short push-rod, watch for the $\frac{1}{4}$-in. steel ball used between the short and long push-rod.
(4) Kick-starter pinion nut; pull off the pinion and spring.
(5) Four nuts fixing kick-starter case to gearbox shell.
(6) The kick-starter case, watch for the twelve rollers on camshaft.
(7) Slotted bolt at bottom of gearbox shell, with its spring which operates the pawl.
(8) The whole of the gears and layshaft, except the main driving gear, with camshafts.

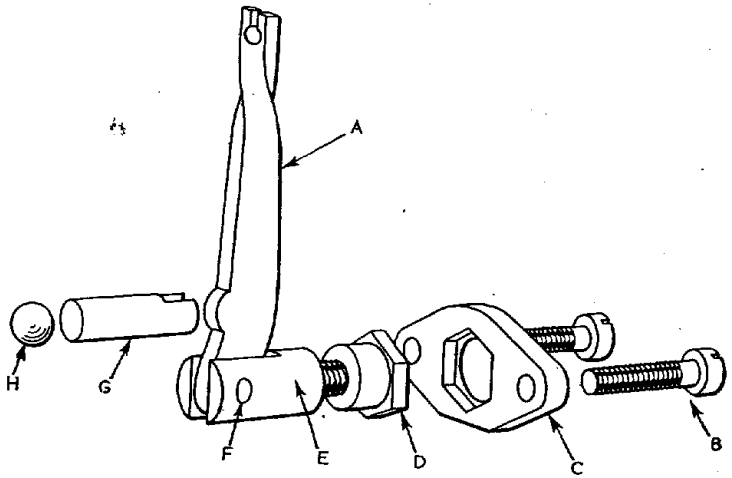

FIG. 24.—COMPONENTS OF THE CLUTCH RELEASE MECHANISM.

A. Clutch operating lever.
B. Screw, fixing cap to kick-starter case cover.
C. Cap, covering sleeve D.
D. Sleeve nut for E.
E. Operating lever fork.
F. Pin for A.
G. Operating plunger.
H. Steel ball for G.

(9) Rear chain, the mainshaft can now be withdrawn from the clutch end of the gearbox. Using a chain bar, which is simple to make (Fig. 25), with a short length of $\frac{5}{8}$ in. $\times$ $\frac{3}{8}$ in. chain attached, drape the chain round the sprocket, with the bar propped against the frame. Should it be inconvenient to make a tool of this kind, leave the chain attached and apply pressure on the brake pedal to release the sprocket-fixing nut after turning up the tab washer. This nut is usually very tight, as it must be, and for this reason the use of a chain bar is desirable.
(10) The sprocket spacing collars, recording the position in which they are fitted.
(11) The main driving gear, which can be tapped into the gearbox shell.
(12) The main bearing after extracting the circlip, washer and oil seal.
(13) The mainshaft ball-bearing in the kick-starter case, which is also retained by a circlip.

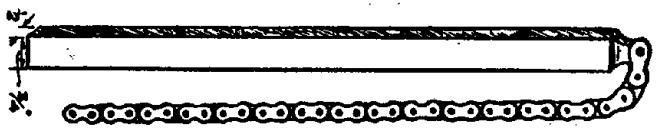

FIG. 25.—CHAINBAR FOR USE WHEN REMOVING GEARBOX SPROCKET NUT.

The gearbox is now completely dismantled, with the exception of the layshaft bushes. These bushes, a force fit in both the gearbox shell and kick-starter case, are made from self-lubricating bronze and are somewhat brittle, so care should be taken when new bushes are fitted, which do not require reaming for size. To extract the layshaft bush in the gearbox shell, tap out the steel " glut " or disc, then the bush can be pressed into the interior of the gearbox shell. The bush in the kick-starter case can be pushed out by supporting the case with tubing or a box key of suitable size.

There is very little load, or turning movement on the camshaft bush in the gearbox shell. To remove, use method

described for extracting layshaft bush in shell. Details of camshaft assembly are shown in Fig. 26.

Two inexpensive self-lubricating bushes are fitted in the main-gear pinion. Insert the mainshaft and check for wear. These bushes are a force fit and can be pressed out without difficulty. They must be a tight fit in the pinion, for a loose bush will affect top-gear engagement. The pinion on the layshaft which engages with the main gear should also be a tight fit on splines for layshaft. If the shaft is chipped, or pinion loose, fit replacements. Examine carefully the striker forks on camshaft for wear, as a badly worn fork can allow two gears to engage simultaneously, with disastrous results.

Reassembling Gearbox

Wash and oil *all* parts before reassembly.

Replace in the following order:

(1) The main driving bearing, oil seal, retaining washers and circlip.

(2) The main gear, with spacing collars, washers, chain-sprocket and tab-washer, with fixing nut. Apply chain-bar firmly, tighten sprocket nut, turn down the tab washer.

(3) The mainshaft, through main gear.

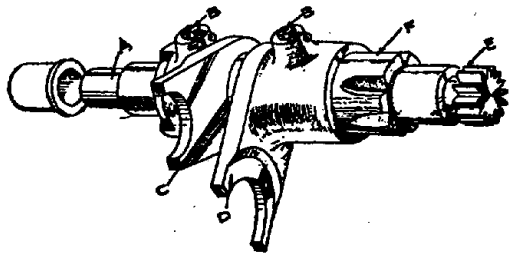

FIG. 26.—GEARBOX CAMSHAFT AND SELECTOR FORKS.

A. Camshaft.
B. Operating fork peg.
C. Mainshaft sliding gear operating fork.
D. Layshaft sliding clutch operating fork.
E. Pinion.
F. Grooves for engagement with locking pawl.

(4) Gears on layshaft in the order shown in Fig. 27, the fixed pinion is fitted to the short end of the layshaft.

(5) Hold the layshaft assembly in hand, with the fixed pinion on the left. Take up the camshaft (small pinion to the right), engage the larger of the two striker-forks in groove for sliding clutch.

(6) Hold the mainshaft sliding gear, large pinion to the left, along the camshaft assembly, so that the smaller striker-fork engages with its central groove.

(7) Insert the entire assembly into the gearbox shell, sliding the mainshaft gear along the mainshaft, and push home, locating the camshaft and layshaft into respective bushes.

(8) Slide the remaining free pinion on mainshaft.

(9) Pawl, spring and slotted screw, locating gears.

(10) The twelve rollers, with grease to hold in position.

(11) The mainshaft ball bearing for kick-starter case, locate with circlip.

(12) Paper washer for gearbox shell, with grease applied on gearbox face.

(13) The kick-starter case, ensure rollers enter housing in kick-starter case, the four nuts for case, and firmly tighten.

(14) The ratchet-pinion bush and spring on mainshaft ratchet pinion (teeth outwards), the ratchet driver, fully tighten fixing nut.

(15) Paper washer for kick-starter case, with grease on face of case, carefully passing the washer over studs to avoid damage.

Replacing Foot-change Assembly

To ensure gears are correctly indexed, particular care is needed for this operation. The small pinion on the camshaft is marked with a letter " O ". The sector engaging with the pinion is marked likewise. Proceed:

(1) Turn the camshaft till the " O " is at nine o'clock.

(2) Fit the sector, with the " O " stamped on it to mesh with " O " on the small pinion.

(3) Apply graphite grease on the length, and both ends of the long push-rod and insert it into the mainshaft from clutch end, with 2 in. protruding.
(4) From kick-starter end of mainshaft insert ¼-in. steel ball, short push-rod, with the slot nearly vertical.
(5) Take up the spring box, see that the springs are not broken and that the four small steel plates are in position.
(6) Place metal cover on spring box, fit the quadrant with its peg engaged between the two small springs.
(7) Fit rocking pawl. The complete assembly can now be inserted in the kick-starter case, locating the peg in case between the two large springs.

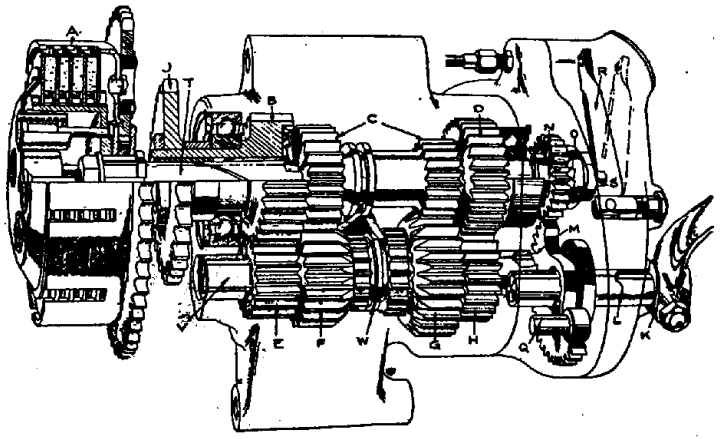

FIG. 27.—CUTAWAY VIEW OF THE C.P. GEARBOX FITTED TO 1950–51 MODELS.

A. Clutch assembly.
B. Main gear wheel.
C. Mainshaft sliding gear (has a pinion at each end).
D. Mainshaft third gear.
E. Layshaft small gear.
F. Layshaft second gear.
G. Layshaft first gear.
H. Layshaft third gear.
J. Final drive sprocket.
K. Kickstarter crank.
L. Kick-starter axle.
M. Kick-starter quadrant.
N. Kick-starter ratchet pinion.
O. Kick-starter ratchet driver.
P. Kick-starter return spring.
Q. Kick-starter stop.
R. Clutch operating lever.
S. Clutch thrust rod.
T. Gearbox mainshaft.
V. Layshaft.
W. Layshaft sliding clutch.

(8) Place gasket in position, put back the case cover, after discarding the rubber band, holding the kick-starter crank in its normal position, then push the cover firmly home. If the cover does not go fully home this may be due to the rocking pawl being out of position (work the gear pedal up and down) or the slot in the short push-rod engaging with clutch operating lever.
(9) Fit gear-change indicator and the clutch cable.
(10) Put 1 pint of engine oil SAE 50 into the gearbox.
(11) Reassemble clutch in reverse order.

Dismantling and Reassembling the B.52 Type Gearbox in the Frame

The general arrangement is shown in Fig. 28, illustrating the internal gearbox layout, together with the foot-change mechanism and kick-starter. To remove the kick-starter-case cover, to inspect gear change, clutch-operating mechanism and kick-starter:

(1) Drain gearbox after removing drain plug in bottom of gear case.
(2) Unscrew filler cap on kick-starter-case cover.
(3) Screw down clutch-cable adjuster, to permit clutch-cable wire to be disconnected.
(4) Unscrew clutch-cable adjuster, remove the cable.
(5) Remove nut securing gear-position disc, with its spring.
(6) Take out five cheese-headed screws securing case cover.
(7) Pull off the case cover about ½ in., turn kick-starter crank so it can be tied to foot-change lever with a rubber band, preventing the kick-starter from unwinding.
(8) Case cover can now be taken off.

Parts subject to wear are the plunger, which engages with "dimples" in cam barrel, and the clutch push-rod. Wear of this kind is caused by continual pressure on these two parts—*see* clutch-cable adjustment. After refitting parts in reverse

order, ensure fixing screws are correctly positioned as detailed. Fill with 1 pint of engine oil, SAE 50.

Top screw, $3\frac{1}{8}$ in. under head.
Bottom screw, $2\frac{7}{8}$ in. under head.
Rear screw, $\frac{7}{8}$ in. under head.
Front screws, $1\frac{3}{8}$ in. under head.

Removing the Gears

Remove kick-starter case as previously described. Remove split pin securing striker-shaft pins, withdraw both pins, cam barrel, spring and short plunger, which engages with cam barrel. Unscrew mainshaft nut, take off kick-starter ratchet, ratchet driver, bush and spring. Upon removing three screws in the kick-starter case, the case, complete with the cluster of gears *in situ*, will be exposed when case is pulled away. If the mainshaft has to be removed, release nut on clutch end.

Removing Main Driving Gear and Bearing

The nut securing rear-chain sprocket is firmly tightened, as it must be, therefore some difficulty may exist in holding the sprocket during this process. The chain bar (Fig. 25) is the tool for this job, fitted on the sprocket, with the bar propped against the frame after disconnecting the rear chain.

Proceed by turning down the lock-washer behind the sprocket nut. Remove the sprocket nut, lock-washer, two distance-pieces and then the sprocket, which can be pulled off easily without an extractor. Take away the distance piece, the circlip and the oil seal, when the main gear can be tapped into the gearbox shell.

When the case is removed, the two striker-shafts and layshaft with gear pinions assembled, will come away in a cluster. The position of gears should be carefully noted.

To Refit the Gears

With the mainshaft in the gearbox, fit parts in the following order:

(*a*) Take up layshaft, fit over splined end.
(*b*) Second gear-pinion, 24 teeth; layshaft fixed-pinion, 18 teeth.

(*c*) Fit mainshaft second gear, 22 teeth, into mainshaft striker forks.
(*d*) Fit mainshaft third gear, 25 teeth, into layshaft striker forks.
(*e*) Fit third gear on layshaft, 21 teeth.
(*f*) Low gear on mainshaft, 17 teeth, with spigot end towards kick-starter.
(*g*) Low gear on layshaft, 29 teeth.

With striker-fork shafts mounted in the case, the complete assembly can go into the gearbox shell. Reassemble clutch and foot-change assembly.

Clutches

Clutch Operation

When the handlebar control lever is operated, the clutch lever A (Fig. 23) is moved in the direction of the arrow, thus separating the clutch friction plates. This action compresses the clutch springs, which must be evenly adjusted, otherwise clutch drag or slip will take place. It will be observed that if wear takes place on the operating lever A, the short push-rod B or the push-rod D, the withdrawal movement of the clutch will be curtailed by contact between the slotted end of the short push-rod B and the end of the mainshaft.

Clutch-spring Adjustment

A cheap screwdriver with a slot $\frac{1}{4}$ in. deep cut in the end, to clear the clutch-spring studs, is a suitable tool for this purpose. After assembling the clutch springs and cups, screw on the spring-adjusting nuts, but do not fully tighten. Ensure that the spring-pressure plate, which houses the springs, is correctly located, then screw home diagonally the adjusting screws until they are fully compressing the springs. Unscrew each adjusting screw four complete turns to provide the recommended setting.

Clutch Adjustment

Minor adjustment of the withdrawal mechanism is obtained by screwing the clutch-cable adjuster in or out; the adjuster is mounted in the top of the kick-starter case. Free movement

of the handlebar lever, before resistance of clutch springs occurs, should be to the extent of $\frac{1}{8}$–$\frac{3}{16}$ in. only. Should this free movement of the operating lever suddenly increase, refer to *Noisy Gear Engagement*, which will inevitably occur when the withdrawal movement is restricted by lost motion. Major adjustment of the operating mechanism is effected by altering the position of the operating-lever fulcrum pin inside the kick-starter case. The lever and the pin are shown in Fig. 24. The position of the fulcrum pin is controlled by the position of the sleeve nut, E. The cap on the kick-starter case, held by two screws, locates the sleeve nut.

In the event of wear in the clutch-plate friction inserts, these plates will tend to close up to each other, which has the effect of increasing the effective length of the clutch push-rod. Conversely, the clutch inner-cable will tend to stretch, when the wear on the inserts and cable stretch should neutralise these

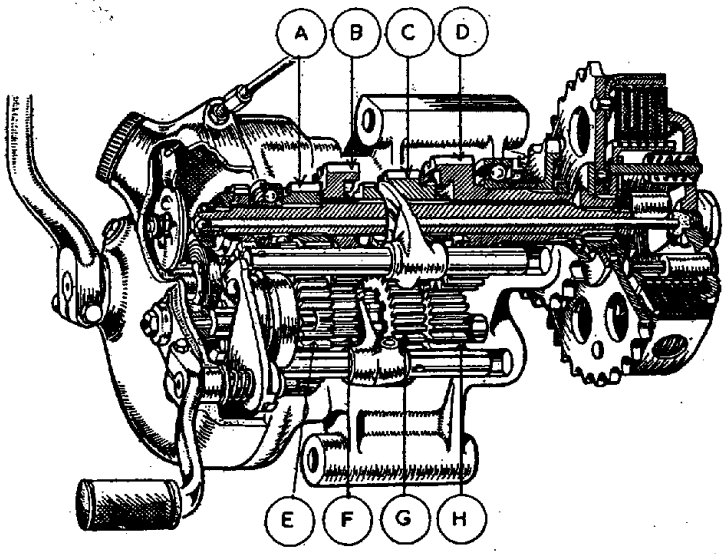

FIG. 28.—CUTAWAY VIEW OF THE B.52 GEARBOX.

A. Mainshaft low gear.
B. Mainshaft third gear.
C. Mainshaft second gear.
D. Mainshaft driving gear.
E. Layshaft low gear.
F. Layshaft third gear.
G. Layshaft second gear.
H. Layshaft small pinion.

two actions. Nevertheless, in all probability clutch push-rod adjustment will be necessary, by an allowance of $\frac{1}{32}$ in. free movement between the operating lever, A, and the operating plunger, G. To do this, remove the two screws, B, take off the plate and remove the oil-filler plug on the kick-starter case.

To increase the movement, turn the sleeve nut clockwise (usually half to one turn will suffice). Replace the cap and check the movement of the lever with a finger inserted in the oil-filler plug orifice. To decrease the movement, rotate the sleeve nut anti-clockwise.

Removing the Clutch Cable

(*a*) Remove the oil-filler plug.
(*b*) Screw home the clutch-cable adjuster.
(*c*) Press in the lever with a screwdriver to disengage the clutch-cable inner wire.
(*d*) Unscrew the clutch-cable adjuster completely.
(*e*) Disconnect inner wire from the handlebar lever.
(*f*) If numerous cable clips or insulating tape are used to secure the outer cable to the frame tube, it may be necessary to remove the petrol tank.

Replacing the Clutch Cable

Reverse the removal procedure; ensure that sharp bends do not occur in this cable.

Lubricating the Clutch Cable

The benefit of a well-lubricated clutch cable has to be experienced to be appreciated. With the cable removed, shape a small funnel made from plasticine moulded on the end of the outer cable. Hold the cable vertical and fill the funnel with paraffin to assist oil penetration; when the paraffin has drained down the cable fill the funnel with light oil. Suspend the cable to allow the oil to percolate down the inner wire.

Clutch Slip

This can be the result of:

(*a*) Insufficient clearance ($\frac{1}{32}$ in.) between the clutch lever, A, and the plunger, G, in Fig. 24.

(*b*) Insufficient free movement ($\frac{1}{8}$–$\frac{3}{16}$ in.) of clutch handlebar operating lever.

(*c*) The top of the operating lever, A, may be fouling the oil-filler plug. If these points are not at fault, then there may be oil on the clutch-plate friction discs, or the clutch springs may be weak (normal free length $1\frac{3}{4}$ in.).

Should the fault be due to oil-impregnated friction inserts, the effect of washing all the friction plates in petrol and then dusting them copiously with fullers' earth should be tried. If it proves ineffective, replace the inserts with the type, now available, that are impervious to oil. If the clutch slip has prevailed for any length of time, the heat generated will probably have weakened the clutch springs; to avoid subsequent attention, fit a new set.

Note

On the C.P. type gearboxes a large nut was used to retain the clutch hub on the mainshaft, and it is possible for the clutch-spring cups to foul this nut and cause clutch slip. To correct, use the slightly smaller B.52 type clutch hub nut.

Removing Clutch Complete

Remove :

(1) Outer portion of chaincase.
(2) Five screws for clutch, with pressure plate, springs and cups.
(3) Lock-washer under clutch hub nut.
(4) Engage top gear, fit box key to clutch hub nut, press on rear-brake pedal and unscrew nut. Disconnect front chain.
(5) As clutch hub is on splines, a tool is not needed to remove it. Take away the clutch assembly complete, watch for clutch rollers (24), which will drop out when assembly is removed.
(6) Gearbox mainshaft.

To reassemble, use anti-centrifuge grease to stick rollers in position, reverse dismantling order.

CHAPTER IV

FRAME AND FORKS

MAINTENANCE of the frame and cycle parts is confined generally to regular greasing and occasional adjustment of the steering-head bearings. The forks and rear suspension legs require virtually no attention for many thousands of miles; when, however, it is necessary to dismantle and inspect for wear, the job is well within the capability of any enthusiastic owner equipped with a reasonable number of workshop tools, plus the few special tools that are essential.

Steering-head Adjustment

Self-aligning ball-races are fitted to both ends of the frame head-lug, which must be kept in close adjustment, for movement, which will occur when the front brake is applied, will damage both the races if the correct adjustment is not maintained. This adjustment must be made with the front wheel clear of the ground, using a box under the crankcase. To tighten the bearing, release slightly the two nuts, or Allen screws, whichever are fitted, situated under the headlamp, that clamp the fork inner-tubes. Slacken off the top nut on the fork stem, which passes through the handlebar lug. Screw down the lower nut on the fork stem half a turn. Place the fingers of the left hand on the handlebar lug and the end of the frame head-lug. Lift up the front-wheel assembly, with right hand on the mudguard, when movement will be felt by the left hand (Fig. 29). Retighten the lower nut if necessary, until movement is taken up. Bearings should be free from friction, and not overtightened.

It is of vital importance to ensure the nuts, or Allen screws, clamping the fork tubes are firmly retightened when adjustment is completed, for if movement between the fork tubes and the fork crown occurs " fretting " will take place, which can result in a fracture of the fork inner tube.

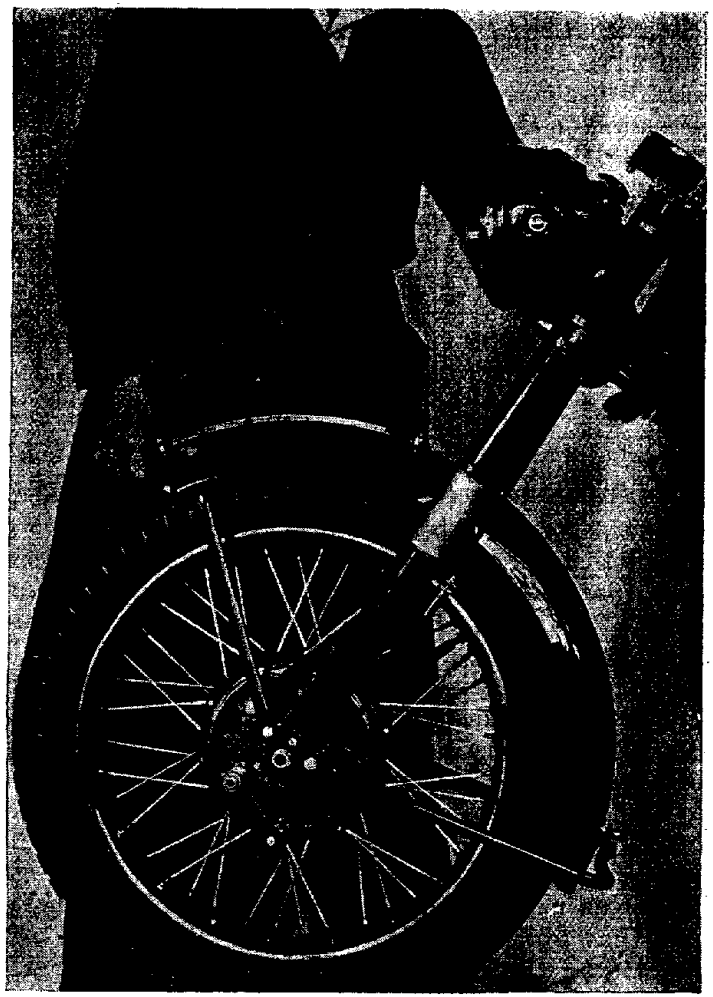

FIG. 29—CHECKING STEERING-HEAD ADJUSTMENT.

To check adjustment, grasp machine as shown and raise front wheel clear of ground. If the bearing is loose, movement will be detected by the left hand.

Steering Troubles

If the machine has been run for any length of time with a loosely adjusted steering-head bearing, pitting in the ball-races will create a rolling motion in steering, which can only be rectified by replacing the damaged ball-races. This can be proved by jacking up the front wheel as previously described, when, if the handlebars are moved sideways slowly, the " pitting " in the ball-races can be felt.

If a steering-damper is fitted, the same effect will result if unwanted friction in the damper takes place. Removing the bolt anchoring the damper steel plate to the head-lug will prove after road test if the fault lies with the steering-damper. Swollen friction discs, or bent damper plates, are associated with this fault. Both damper steel plates should be parallel to each other; the use of a steel washer between the damper plate and the head-lug will have the desired result.

Handlebars Wobble at Slow Road Speeds (Solo)

Usually occurs after tyres have been removed, or replacements fitted, and is entirely due to one or both tyres running out of true with the wheel rim. This can easily be proved, in the case of the rear wheel, by raising the rear wheel clear of the ground. Start the engine, engage the top gear. With the rear wheel spinning, watch the rear wheel as it revolves, when a " wobbly " motion of the rear tyre will indicate if the fault lies with this part of the machine.

In the case of the front wheel, which is the most probable cause of the fault, the wheel must be rotated by hand as fast as possible to observe if the tyre is true with the rim. Usually, over-inflating the tyre to 40 lb./sq. in. will cause the tyre to make up its proper position, if not, deflate the tyre and strike it carefully with a mallet until it is even with the wheel rim.

Handlebar Wobble (Sidecar)

A steering damper is not necessary when the machine is used as a solo, as the steering is perfectly safe without it.

When a sidecar is fitted the handlebars will wobble violently at low road speeds due to the drag caused by the third wheel

attached. This can only be controlled by fitting a steering damper, obtainable from the makers; this is essential, independent of the type or weight of the sidecar used.

The position of the sidecar wheel in relation to the rear wheel has some bearing on the extent of the wobble, but, as a spring frame is used, the chassis position cannot be varied.

All sidecar makers have knowledge of the frame layout and will know what type of chassis to supply if the model of the machine is specified.

Fitting a Steering Damper

The steering damper is supplied assembled. To avoid removing front wheel and guard, take off the damper knob and washers, then unscrew the long draw bolt from the damper base. Remove dome nut on fork stem, pass the long draw bolt up the fork stem from the base of fork crown, screw on damper knob to retain the bolt.

Refit draw bolt to damper base, fully tighten its lock nut. Attach flat steel plate to the fork crown, then the cranked plate to the boss on the frame, it may be necessary to use a $\frac{1}{4}$ in. washer on the bolt locating plate to frame. If this bolt is difficult to screw home, use a $\frac{1}{4}$ in. $\times$ 26 T.P.I. tap to remove enamel in bolt hole.

To complete the damper assembly,

(*a*) Fit plain stem nut to replace dome nut.
(*b*) Fit cap washer.
(*c*) Fit spring washer.
(*d*) Fit serrated washer.
(*e*) Fit damper knob.

Checking Wheel Alignment

This is best accomplished by obtaining a long wooden batten with a straight edge, placed along both edges of the rear tyre. The front end of the track stick, as it is called, should be parallel with both edges of the front tyre. As the section of the rear tyre is larger than the front tyre, the space between the batten, taken on the front tyre each side, must be equal.

Once the correct wheel alignment has been established, a measurement should be taken, from the rim of the rear wheel

and the centre of the tubing for the swinging arm. When this is recorded it is only necessary to position the rear wheel to the same measurement to ensure that the wheel alignment is correct. A strip of steel, suitably marked after adjustment, will serve as a guide for subsequent adjustment.

Steering Uncertain on Bends

Test for wheel alignment, then check wheel bearings for loose spindle or bearings. Remove one rear-suspension unit at a time and check each unit for equal damping. Any variation can be due to damaged oil seal, low oil content or broken damper tubes. Check the swinging arm for side movement, which is likely only on machines that have been in commission for several years. The replacement of worn bushes is a major operation that should be carried out by the makers of the machine.

"Teledraulic" Suspension

The three types of front forks used on twin-cylinder models are basically the same, with the exceptions of the shuttle damping arrangement used on the 1950 model, and large-diameter fork inner tubes for 1955 models. The shuttle-type damping was discarded through a " clacking noise " on violent impact, or on application of the front brake violently. The noise is caused by shuttle movement, and has no adverse effect on reliability. In some cases, improvement is made by increasing oil content by $\frac{1}{2}$ oz. to each fork tube ($10\frac{1}{2}$ oz.).

Faults in the Front Forks

Forks sticking is caused by Bakelite bushes swelling, creating friction between bushes and fork inner tubes. This is on the assumption that fork tubes are not bent. Sometimes this fault will cause a " creaking noise " when handlebars are turned slowly with the machine stationary, often confused with a cracked ball-race in the steering-head. To remedy, dismantle the forks, ease down with emery cloth inside the diameter of both bushes for a free fit on tubes; oil and refit. Should the forks become stiff after refitting the front wheel, loosen the four nuts clamping the front-wheel spindle, work the forks

violently up and down, retighten the four nuts. This will permit the fork tubes to be relieved of the side thrust. On 1955 models similarly affected, take off the two nuts fixing the front guard to the fork slider, and test. If the forks work freely in this condition, set stays on the front guard, which are under tension.

Grating Noise with Fork Movement

This noise is due to one or both springs in contact with the cover tubes. Grease applied on the outside diameter of the springs will have a lasting effect. Buckled springs can be cured by grinding the ends square with the axis of the spring.

Rattle in the Front Forks

This will occur if the oil content is nil or very low, noise comes from the damper tubes or rods. The damper rod disconnected from the fork top bolt can also cause this noise.

Lateral Play in the Forks

Caused by worn Bakelite bushes or, in the case of a very old machine, wear between the bottom steel bush and the slider.

Dismantling the Forks

To facilitate dismantling and reassembly, a draw bolt is most desirable, details and dimensions are shown in Fig. 30. This tool is used to drive out the fork tubes without damage, and in particular to pull back the tubes against the resistance of the fork springs on assembly. Without this tool, dismantling the forks from the bottom end is necessary.

Changing or Servicing the Fork springs

A quick and easy method of exposing fork springs is shown in Fig. 31. With draw bolt available, disconnect the front-brake cable, slacken the nuts or Allen screws, whichever are fitted and situated below the headlamp, for clamping the fork tubes. Remove the large nuts on the handlebar lug, disconnect the damper rod. Screw the draw bolt into one fork

tube, tap the tube downwards a slight amount, unscrew the draw bolt, insert it into the other tube, tap the tube down a similar amount, repeat this process, so that the tubes are moved an equal amount, until they are clear of the lower fork crown.

To refit the forks, enter the tubes into the fork crown, pass draw bolt through the handlebar lug, screw it into the tube. Run down the nut on the draw bolt to pull back the tube a slight amount, then deal with the other tube in a similar manner, changing over the tool until the tubes are fully home. A loop of copper wire can be used to " fish " up the damper rod, or a length of rod, screwed $\frac{5}{16}$ in. × 26 T.P.I., with a nut partially screwed on, it can be connected with the damper rod to pull it up. Refit both the damper rods, firmly tighten the large nuts for tubes, retighten the clamping bolts or screws, and connect the brake cable.

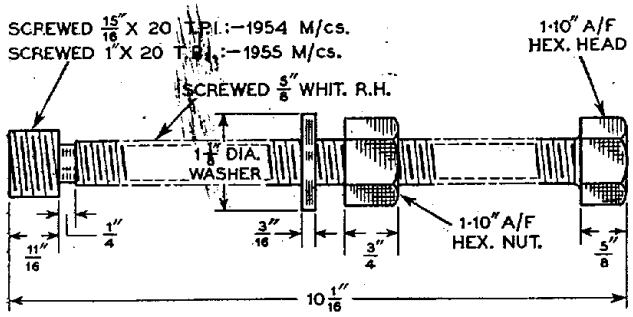

FIG. 30.—DRAW BOLT FOR FACILITATING DISMANTLING AND REASSEMBLY OF FORKS.

Removing the Fork Slider

Raise the front wheel clear of the ground, disconnect the damper rod. Unscrew the fork-slider extension, screwed into the fork slider. Remove the front-brake cable, wheel, stand and the mudguard. The oil seal fitted in the top enlarged end of the slider is a close fit, to make a satisfactory seal.

The application of heat to this part of the slider will cause it to expand, when with a sharp jerk downwards, the slider will come away. The reassembly is carried out in reverse order.

FIG. 31.—CHANGING FORK SPRINGS.
Check the length of the springs before refitting.

Alternatively, the fork tube with the slider and springs can be driven out as detailed for exposing the fork springs. If the fork tube is held in a vice, use soft clamps to avoid bruising the tube.

Replacing the Oil Seal

On the front forks fitted to the 1950 models, the oil seal must be fitted from the top or screwed end of the tube. The seal will receive damage, and become ineffective, unless care is taken. Using a piece of sheet foil (4 in. × 3 in.) wrapped round the top of the tube, slide the seal down the sheet foil

with a rotary motion, with the exposed spring in the seal facing downwards, the metal backing abutting against the screwed extension.

Check Oil Content—1950

Normal oil content with dry forks is 10 oz. (284 c.c.) SAE 20. This type of fork should be serviced with the front wheel clear of the ground. A graduated glass measure of not less than 10 oz. should be available. Remove both nuts on handlebar lug securing the fork tubes. Turning the front wheel to the right against steering stop, when dealing with the right slider, and to the left when this slider is serviced, will facilitate draining. Remove the drain plug from one slider, oil drained, usually 8–8½ oz. Refit drain plug, work the forks up and down violently several times with the wheel on the ground, to pump residue of oil into the slider. Again remove the drain plug, catch the residue of oil, usually making a total of 9½ fluid oz. If the oil content is low, measure and pour back exactly 9½ oz. A rubber grommet, which must be undamaged, is fitted around large nuts for the tubes. These nuts must be firmly tightened before the wheel is placed on the ground.

Checking the Oil Content—1951–55

Normal oil content with dry forks is 6½ oz. (184 c.c.) SAE 20. Machine must be vertical on both road wheels, boxes under the footrests is the best method. Unscrew the large nuts on the handlebar lug. Use the graduated measure and turn the wheel to the right, then remove drain plug in the right slider. Catch the oil in the measure, watch oil does not spurt out when the drain plug is removed. Refit the drain plug, work the damper rod attached to the large nuts up and down several times, wait a few minutes before removing the drain plug, catch the residue of oil in the measure, which should total 6 fluid oz. (170·4 c.c.). If the oil content is low, refill with 6 fluid oz., replace the large nut on the handlebar. The reason for the difference of 6½ oz. and 6 oz. is due to the presence of unexpelled oil.

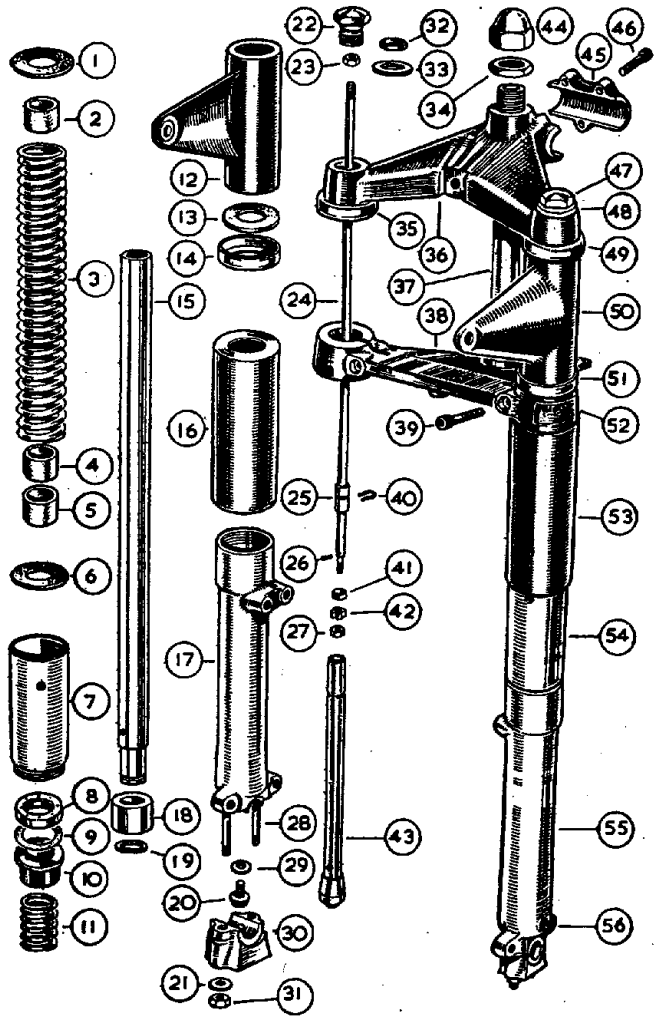

FIG. 32.—EXPLODED VIEW OF FRONT FORKS FITTED TO 1953–54 MODELS.

Removing the Front-fork Assembly

Support the machine on two suitable wood boxes under each footrest to raise the rear wheel clear of the ground. Remove front wheel by disconnecting front-brake cable at the wheel end. Release the front-brake anchorage and slacken the nut on the left side of the wheel spindle. Remove the four nuts fixing the caps to the fork sliders, mark them for correct position for reassembly. Take off the front mudguard and stand. Disconnect the steel plate for steering-damper, if fitted. Remove the headlamp and speedometer. Take out the two large bolts that secure the fork tubes in the handlebar lug. Disconnect the damper rods attached to these bolts (damper rods are not used on 1950 models). Place an old coat on the petrol tank to avoid damage to the enamel when the

KEY TO FIG. 32.

1. Leather washer.
2. Rubber buffer.
3. Main spring.
4. Rubber buffer.
5. Rubber buffer.
6. Leather washer.
7. Fork slider extension.
8. Oil seal.
9. Paper washer.
10. Plastic bush.
11. Buffer spring.
12. Fork top cover tube.
13. Rubber washer.
14. Fork top cover tube bottom cap.
15. Inner fork tube.
16. Fork bottom cover tube.
17. Fork slider.
18. Steel bush.
19. Circlip.
20. Damper tube bolt.
21. Plain washer.
22. Fork inner tube top bolt.
23. Lock nut.
24. Fork damper rod.
25. Plunger sleeve.
26. Damper valve stop pin.
27. Lock nut.
28. Stud.
29. Fibre washer.
30. Fork slider cap.
31. Nut.
32. Rubber sealing ring.
33. Plain washer.
34. Adjusting nut.
35. Fork top cover tube cap.
36. Handlebar and steering head lug.
37. Fork crown stem.
38. Fork crown.
39. Pinch screw.
40. Clip.
41. Fork damper valve.
42. Fork damper valve seat.
43. Fork damper tube.
44. Domed lock nut.
45. Handlebar lug half-clip.
46. Pinch screw.
47. Fork inner tube top bolt.
48. Plain washer.
49. Fork top cover tube top cap.
50. Fork cover top tube.
51. Fork top cover tube bottom cap.
52. Fork crown.
53. Fork cover bottom tube.
54. Fork slider extension.
55. Fork slider.
56. Plug screw with fibre washer.

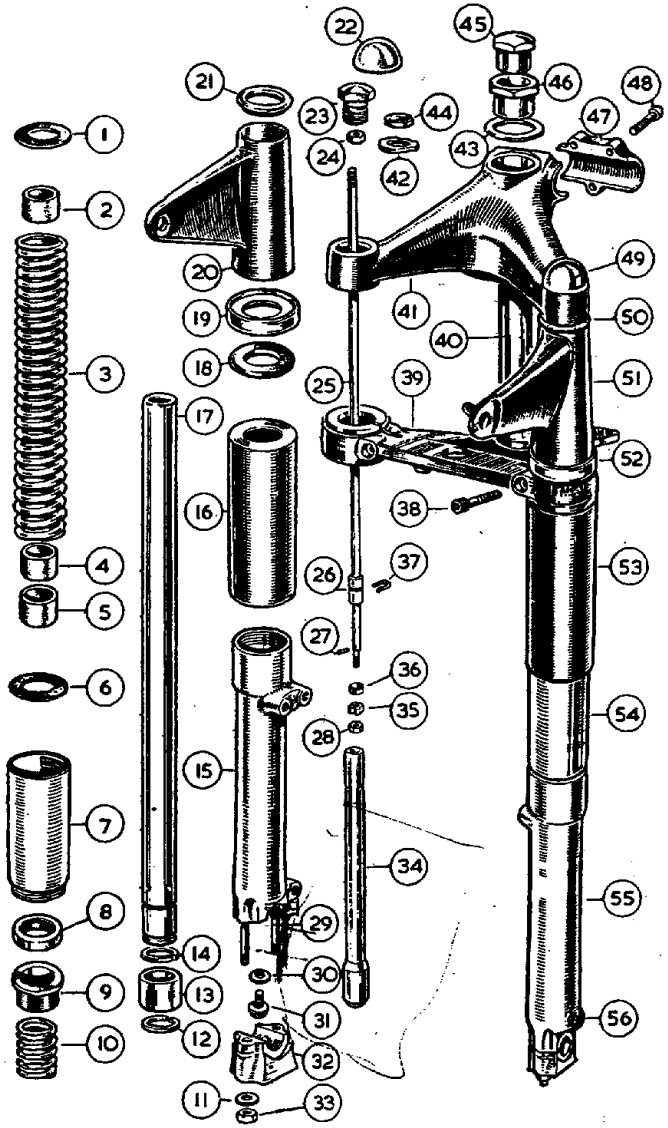

FIG. 33.—EXPLODED VIEW OF FRONT FORKS FITTED TO 1955 MODELS.

handlebars are placed on it. Take off the handlebar clamp, lay the bars on the petrol tank. Remove both nuts on the steering-column, then, using a soft mallet, tap the handlebar lug upwards until it clears the fork column. Steady the forks during this process, as they will drop down when the handlebar lug is free. Watch for the steel balls in the head-race bearings, fifty-six in number.

Refitting the Front-fork Assembly

Fill the ball-race on top of the frame head lug with grease. Fill the ball-race on the fork crown with grease. Place twenty-eight steel balls in each of these races, then reverse the instructions given for removal, but make sure the damper rods are fully tightened before the two large bolts are finally tightened.

KEY TO FIG. 33.

1. Leather washer.
2. Rubber buffer.
3. Main spring.
4. Rubber buffer.
5. Rubber buffer.
6. Leather washer.
7. Fork slider extension.
8. Oil seal.
9. Plastic bush.
10. Buffer spring.
11. Plain washer.
12. Circlip.
13. Steel bush.
14. Circlip.
15. Fork slider.
16. Fork bottom cover tube.
17. Inner fork tube.
18. Rubber ring.
19. Top cover tube housing ring.
20. Fork top cover tube.
21. Top cover tube spigot ring.
22. Snap-on dome cap.
23. Bolt.
24. Lock nut.
25. Fork damper rod.
26. Plunger sleeve.
27. Damper valve stop pin.
28. Lock nut.
29. Stud.
30. Fibre washer.
31. Bolt.
32. Fork slider cap.
33. Nut.
34. Damper tube.
35. Damper valve seat.
36. Damper valve.
37. Clip.
38. Fork crown pinch screw.
39. Fork crown.
40. Fork crown stem.
41. Handlebar and steering head lug.
42. Washer.
43. Washer.
44. Rubber sealing ring.
45. Fork stem lock nut.
46. Fork stem adjusting nut.
47. Handlebar lug half-clip.
48. Pinch screw.
49. Snap-on dome cap.
50. Top cover tube spigot ring.
51. Fork top cover tube.
52. Top cover tube housing ring.
53. Fork bottom cover tube.
54. Fork slider extension.
55. Fork slider.
56. Oil drain plug and fibre washer.

Removing a Fork Inner Tube

Remove the front mudguard and stand. Unscrew the slider extension, which screws into the top end of the fork slider, then remove the front wheel as previously described. Take out the top bolt passing through the handlebar lug. Disconnect the damper tube if fitted. Slacken the bolt or screw, whichever is fitted, situated in the fork crown below the headlamp. The fork can now be removed. If the tube is a tight fit in the fork crown, the fork draw bolt should be screwed into the tube and hammered to drive the tube out of position. Without this tool the large bolt securing the fork tube can be used; this will move the tube a limited amount only, because of its short length.

To Completely Dismantle Inner-tube Assembly

Remove the fork slider and the bolt in the bottom of the slider; take out the damper assembly. Remove the circlip on the end of the fork tube carefully, to avoid distortion. Gently tap off the steel bush.

Remove the buffer spring, Bakelite bush, the washer and oil seal, the main spring, three buffer rubbers, used to prevent spring rattle.

Note

The surface of the fork tube, particularly where the oil seal operates, must be perfectly smooth and undamaged, otherwise the seal will become ineffective.

Reassembling the Fork Inner Tube

Refit the bare fork tube into position, which will facilitate assembly, when the tube can be tapped home before components are reassembled. Graphite painted on the tube and the steel bush is of benefit for free movement.

Rear-suspension Service

Details of this part of the machine are confined to two types, the early type used up to 1950, and the "jam-pot" type used from 1951 to 1955. Fig. 34 shows the early arrangement, which gave a nice soft ride, but was inclined to "bottom"

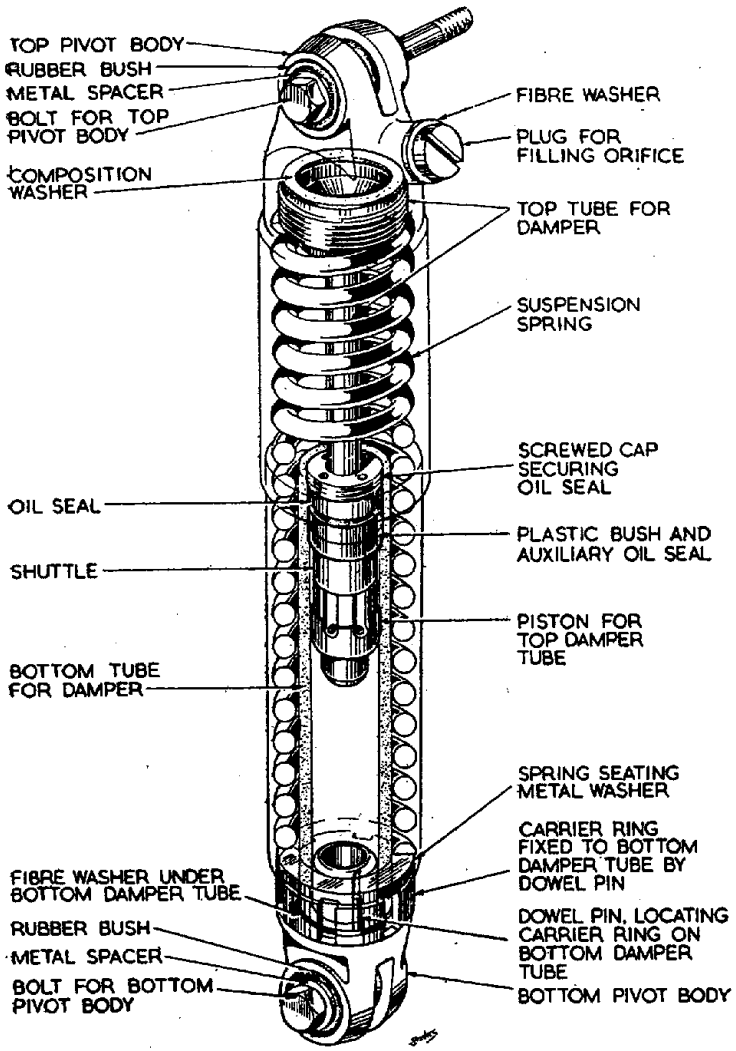

FIG. 34.—THE REAR DAMPER FITTED TO 1950 MODELS.

when a heavy pillion passenger was carried. The oil content is most critical, and should not exceed 1¾ fluid oz. (50 c.c.) SAE 20; an excess can burst the oil seal. Stronger springs are now available which will not cause discomfort, even without a passenger.

Checking Oil Content

Remove one suspension unit at a time. Remove the top pivot bolt and the spacing washer. Remove the bottom pivot bolt, take away the unit. Hold the unit vertical in the vice, gripping the bottom pivot (use a spanner or similar object) in slot for pivot, to avoid bending, when the vice is closed. Slacken serrated carrier ring, with a C-spanner. Reverse position of the unit in the vice grip. Unscrew the bottom pivot (now uppermost). Carefully take off serrated carrier ring and dowel pin, locking ring, to the damper tube. Take off the cover and the spring. Oil content is poured into a graduated glass or measure. When the oil stops draining, take off the filler plug, pump the assembly, by holding the damper tube, several times, to expel residue of oil. Reassemble parts in reverse order. Hold the unit vertical and refill with 1¾ oz. (50 c.c.) SAE 20 oil exactly. Move the unit slowly up and down to expel air.

Completely Dismantling the Unit

Proceed as detailed "To check oil content". The following tools will be needed:

(*a*) Clamp to hold the smooth surfaced damper tube.
(*b*) Peg spanner for removing the screwed cap in the tube, securing the oil seal.

Rear Suspension—1951–54

Suspension units of an improved design were introduced for the 1951 season and continued without any material alteration up to 1955. Two types of springs are available, i.e., for solo or sidecar use. When camping equipment, panniers, etc., are carried, the sidecar-type springs should be used, to accommodate the additional weight. Drain plugs were used on the

bottom pivot for the 1951 models; these plugs served no useful purpose, and were discarded in 1952.

Checking the Oil Content

Normal contents 3 fluid oz. (85 c.c.) SAE 20. To service these units, a clamp, such as an old connecting-rod, is desirable to clamp the tube close to the bottom pivot. With the clamp in a vice, adjacent to the bottom pivot, loosen the bottom pivot. Holding the unit vertical, bottom and uppermost, remove the pivot lug. Hold the exposed end of the damper tube, use a pumping action to eject the oil under the damper, allow the oil to drain into the measure for several minutes. If the content is correct 2⅝ oz. (75 c.c.) will drain out, if content is low refill with 2⅝ oz., using care in pouring fluid back into the tube, to avoid spilling; assemble in reverse order.

To Dismantle and Reassemble Rear-suspension Units—1951–54

To dismantle these units the following tools are necessary:

(1) Clamp (suitable scrap connecting-rod) for the 1⅞-in.-diameter outer tube, 016407.
(2) Clamp (suitable scrap connecting-rod) for the 1⅛-in.-diameter inner tube, 016406.
(3) Peg spanner for the ring nut, 016424, supporting the spring and cover tubes.
(4) Peg spanner for the screwed collar in the outer tube, 016078, also a receptacle or graduated glass for oil content.

Remove one unit at a time from the frame, holding the bottom pivot in a vice, with a packing piece in the pivot fork to avoid bending. Remove the collar nut, 016424, supporting the spring, when both cover tubes and the spring will be released, exposing the inner tube, 016406. Fit the smallest of the two clamps to the inner tube close to the top pivot, which can then be unscrewed and removed. Take away the small clamp, also the rubber buffer, 016251, fit the largest clamp to the outer tube, 016407, to unscrew the bottom pivot. The oil content can now be poured into a suitable container or

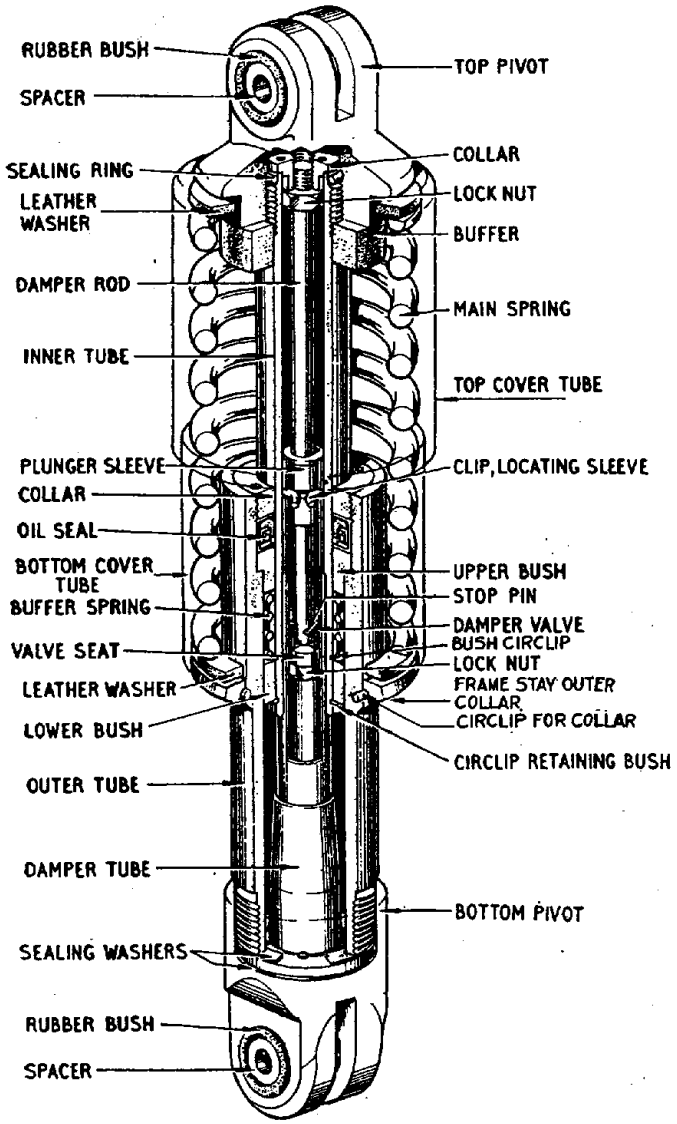

FIG. 35.—REAR DAMPER FITTED TO 1955 MODELS.

graduated glass. The cover tubes and spring can now be removed.

Lift up the damper rod, 016342, as far as it will go, so that the lock-nut can be released to take off the screwed collar, 016343. Now the damper tube, 016349, can be withdrawn from the bottom end of the outer tube. Next, turn to the screwed collar fitted to the top end of the outer tube, using the peg spanner mentioned previously, which when unscrewed will allow the black bush and oil seal to be pushed out of the outer tube, and note the way the oil seal is fitted (metal side up).

Note

To avoid damage to the oil seal, it is essential to replace the inner tube into the outer tube before the black bush and oil seal are replaced. Examine the rubber sealing-ring in the top pivot, 016291, and renew if damaged. Ensure sealing washers are fitted, 016349, each side of the damper tube. Reverse the above procedure to reassemble and fill 3 fluid oz. SAE 20 oil (85 c.c.) before replacing the top pivot.

Dismantling Rear-suspension Units—1955

Hold the unit firmly in a vice, compress the spring either by the use of an adjustable clamp or by hand with the help of a second person to extract the circlip for collar 021655 (Fig. 35). Instruction given for the 1954 models apply after the spring pressure has been released.

Removing the Oil Tank and Battery Carrier—1950–54

The oil tank, also battery carrier, are secured by two studs brazed on the frame down-tube. Removing these two parts is a lengthy process, simplified on the 1955 models by using two easily withdrawn bolts. Drain the oil tank, disconnect the battery cables and take off the battery. Remove the oil-feed pipe, vent pipe at rear of oil tank, bolt fixing oil-tank stay to rear mudguard, screw in the base of the battery carrier, and the two nuts and washers on the frame studs. The brackets spot-welded to the battery carrier are slotted, but it may be necessary to lever up these brackets to clear studs, avoiding damage to the stud threads. Replace parts in reverse order.

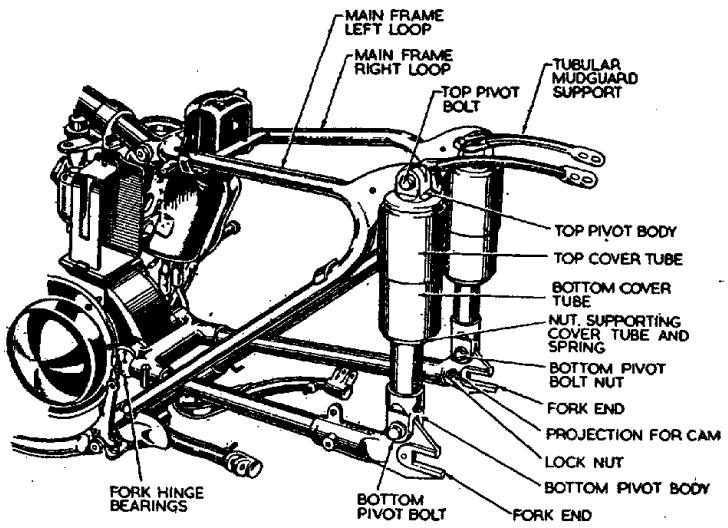

FIG. 36.—THE REAR SUSPENSION.

Removing the Oil Tank and Battery Carrier—1955

Drain oil tank, disconnect wires from the battery terminals and remove battery. Disconnect oil-feed pipe and the oil-return pipe from the bottom of the oil tank. Disconnect vent pipe from the back of the oil tank. Remove the bolt retaining the oil-tank stay to the frame. Remove screw in the base of the battery carrier, retaining the carrier to stay from front chaincase. Remove the two nuts and washers retaining the battery-carrier to the two mounting studs and remove the carrier. Oil tank with supporting studs can then be withdrawn. To refit, reverse the above instructions.

CHAPTER V

WHEELS AND BRAKES

ADJUSTABLE taper roller bearings are used for both wheels, the arrangement of which is shown in Fig. 37. The rollers run on bearing sleeves at each end of the hub; the sleeves are a close fit in the hub. The bearing sleeve at the adjusting end can be moved, to either increase or decrease the amount of end play, by altering the position of the adjusting ring. If this type of bearing is pre-loaded, or tightly adjusted, a crushing action on the rollers will take place, causing overheating, with serious damage. A little end play in the bearing is therefore of vital importance.

Wheels

A light-alloy full-width front-wheel hub was introduced for the 1954 season; this was followed, for 1955, by a similar design for the rear wheel, improving the appearance of the machine.

Adjusting Front-wheel Bearings

Whilst it is possible to adjust the bearing with the wheel in position, it is preferable to place the machine on the centre stand and remove the wheel for this adjustment.

Disconnect the brake cables from the expander lever. Remove the brake anchor stay. Remove the four nuts fixing the caps to fork sliders. Remove both caps, noting location for reassembly, which must be as originally fitted. Remove the front wheel; it may be necessary to flatten the tyre to permit the wheel spindle to clear the slider studs.

For correct adjustment, slacken the lock-ring and tighten the adjusting ring to take up all slackness. Unscrew the adjusting ring half a turn, and retighten the lock-ring, making sure that the adjusting ring does not move. With a rawhide mallet, or hammer, with a piece of wood against the left end of spindle, deliver a light blow to move bearing sleeve towards the adjusting ring, to create a little end play.

This method applies also to machines fitted with full-width hubs, when the metal disc for access to the grease nipple must be located before the lock-ring is finally tightened.

Dismantling Front-wheel Bearings

First refer to Fig. 37 for assembly arrangement, which will also indicate the order in which parts should be removed. Remove the front wheel and the cover plate, together with the brake shoes. Slacken the lock-ring (11). Completely unscrew the adjusting ring (10) with the lock-ring attached. The bearing sleeves are a close fit in the hub, pressure must be applied on the threaded end of the spindle to force out, from adjusting side of the hub, the oil-seal cup (9), oil seal (8), metal washer (7), together with the spindle bearings and sleeve. With left side of hub uppermost, press down on the washer behind the circlip to remove the circlip. Turn the wheel over, apply pressure on the inside end of the bearing sleeve (6), to force out the oil-seal washer (2), oil seal (3), spacer collar (4) and plain washer (5). To reassemble, reverse dismantling procedure, remembering to leave space between the bearing sleeve and slot for the circlip. When the circlip is fitted, press the bearing sleeve up against the circlip. Adjust the bearing as previously described.

Dismantling Rear-wheel Bearings—1950–54

First refer to Fig. 37 for assembly arrangement, which will indicate also the order in which parts are removed. Remove the rear wheel, cover-plate with shoes, spindle with cams and all parts external to the hub. From the brake-drum end of the hub, slacken the lock-ring (26), and unscrew the adjusting ring (25). Now follow the procedure described for dismantling the front-wheel bearing.

Removing Rear Wheel—1950–54

With the machine on the centre stand, loosen the bolts on tubular members to which the detachable portion of the rear mudguard is attached. Slacken the two bolts at the mudguard joint, and take away detachable portion of the mud-

guard. Disconnect the rear-lamp cable, and the stop-light cable, if fitted. Remove the rear-brake-rod adjusting nut. Engage a gear to prevent the gearbox sprocket turning, and remove the rear-chain connecting link. Unscrew the speedometer cable from the rear-wheel gearbox. Slacken the nut fixing the speedometer gearbox on the spindle. Slacken both the spindle-end nuts. Use a spanner on the hexagonal body

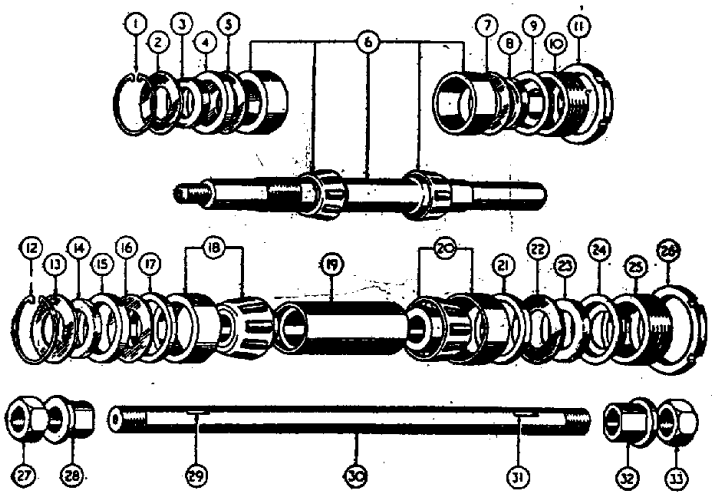

FIG. 37.—EXPLODED 1950–54 FRONT AND REAR HUB BEARINGS.

Front Bearings

1. Circlip.
2. Washer, metal, outside oil seal.
3. Oil seal.
4. Spacing collar, encircling oil seal.
5. Washer, metal, between oil seal and taper bearing.
6. Outer races (2 off) centre spindle. Rollers in cages (2 sets).
7. Washer, metal, between oil seal and taper bearing.
8. Oil seal.
9. Cup, housing, for oil seal.
10. Adjusting ring.
11. Lock nut, for adjusting ring.

Rear Bearings

12. Circlip.
13. Washer, metal, outside oil seal.
14. Oil seal.
15. Spacing collar, encircling oil seal.
16. Washer, metal, between oil seal and spacer.
17. Spacer, between oil seal washer and taper bearing.
18. Taper bearing (outer cup, cage for rollers and rollers).
19. Spacer, between bearings.
20. Taper bearing (outer cup, cage for rollers and rollers).
21. Spacer, between oil seal washer and taper bearings.
22. Washer, metal, between oil seal and spacer.
23. Oil seal.
24. Cup, housing, for oil seal.
25. Adjusting ring.
26. Lock nut, for adjusting ring.
27. Nut, external, for rear wheel spindle.
28. Bush, for rear wheel spindle (fits in fork end).
29. Keyway, to accommodate key locking cam to rear wheel spindle.
30. Rear wheel solid centre spindle.
31. Keyway, to accommodate key locking cam to rear wheel spindle.
32. Bush, for rear wheel spindle (fits in fork end).
33. Nut, external, for rear wheel spindle.

on the left-hand adjusting cam, turn the adjusting cam to push the wheel forward. Cock the wheel to the right to clear the brake plate from the anchor stud; pull the wheel out of the fork ends.

Refitting Rear Wheel—1950–54

Reverse the above procedure, but ensure that the brake plate is located on the anchor stud (Fig. 40) and that the speedometer drive dogs are engaged with the slots in the hub. Connect the speedometer-drive cable and tighten the speedometer-drive fixing nut; retighten the axle nuts. Replace the rear mudguard and connect the rear-lamp cable.

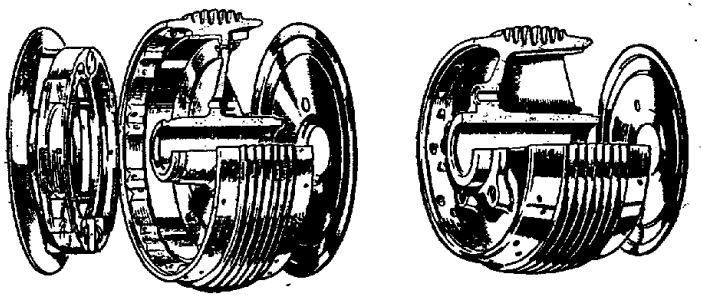

FIG. 38.—FULL-WIDTH WHEEL HUBS.

The front wheel hub and brake are shown on the left. On the right the bare rear wheel hub and cover plate are illustrated.

Removing Rear Wheel—1955

Follow instructions given for 1950–54 models up to disconnecting the speedometer-drive cable. Then remove the axle nut, pull out the spindle, pull the wheel off the drive studs; the spindle distance piece will fall as the spindle is withdrawn.

Refitting Rear Wheel—1955

Place the wheel into the swinging arm. Take up the wheel spindle, leave distance collar aside. Raise the wheel, and enter the spindle through the fork and hub. Position the wheel on the driving studs. Pull out the spindle, put the distance collar in position and reinsert the spindle. Position

the speedometer gearbox, tighten the axle nut and refit the speedometer cable. Ensure collar on spindle abuts against chain-adjuster bolt, for correct wheel alignment. Replace mudguard and electric cables.

Rear-brake Drum—1955

Brake drum runs on a ball-bearing separate from hub bearings. Method of bearing retention and assembly order can be seen in Fig. 39. To dismantle, after removing rear wheel, disconnect rear chain, take off nut and washer for dummy spindle (12), cock brake to the right to clear anchor-plate stud, remove the assembly complete. After removing the circlip, the bearing and the oil seal, etc., can be pressed out. Before reassembly, lubricate the bearing with anti-centrifuge grease sparingly.

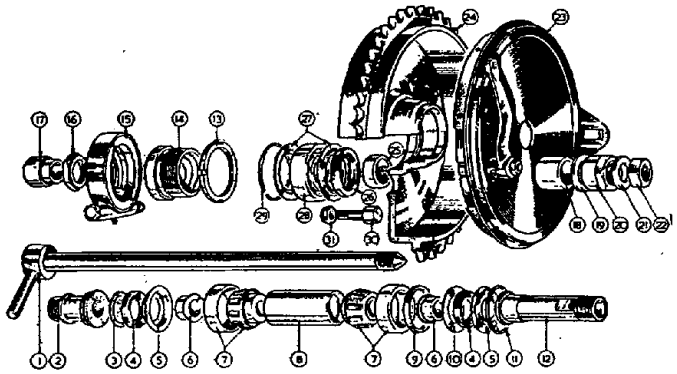

FIG. 39.—EXPLODED VIEW OF THE REAR WHEEL BEARING AND BRAKE DRUM FITTED TO 1955 MODELS.

1. Withdrawable wheel spindle.
2. Speedometer gearbox sleeve.
3. Ring retaining oil seal (small).
4. Oil seal.
5. Cup for oil seal.
6. Oil seal distance piece.
7. Taper roller bearing complete.
8. Spacer between bearings.
9. Bearing spacing collar (brake side).
10. Ring retaining oil seal (large).
11. Circlip.
12. Brake drum dummy spindle.
13. Lock nut for adjusting ring.
14. Adjusting ring.
15. Speedometer gearbox complete.
16. Speedometer gearbox fixing nut.
17. Spacer for withdrawable spindle.
18. Outer spacer for brake cover plate.
19. Washer for cover plate fixing nut.
20. Brake cover plate fixing nut.
21. Spindle end washer.
22. Spindle end nut.
23. Brake cover plate complete.
24. Rear brake drum.
25. Inner spacer for brake cover plate.
26. Brake drum bearing oil seal.
27. Brake drum oil seal washers.
28. Brake drum ball bearing.
29. Circlip retaining bearings.
30. Driving peg (5 off).
31. Nut securing driving peg (5 off).

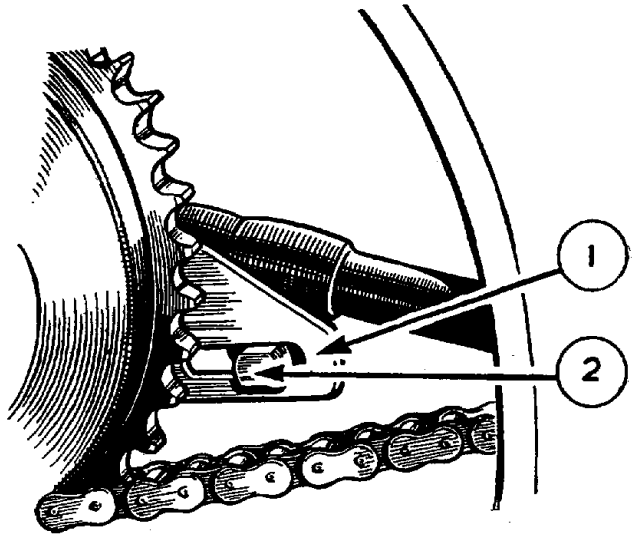

FIG. 40.—REAR BRAKE TORQUE STAY.

1. Rear Brake Cover Plate.
2. Bolt Anchoring Cover Plate to Rear Frame.

Backlash in the Driving Studs

If ovality in holes for driving studs in the rear-brake drum develops, enlarge the five holes with a $\frac{5}{8}$-in. fluted reamer, fit oversize studs obtainable from the makers.

Adjusting the Rear-wheel Bearings—1955

With the wheel in position, slacken the speedometer-gearbox fixing nut, disconnect the speedometer-drive cable and remove the wheel as previously described. Remove the speedometer-gearbox fixing nut, and take off nut (16) (Fig. 39) to remove speedometer gearbox, adjust the bearings as described on page 109.

Brakes

Removing and Replacing the Brake Liners in Wide Hubs

Liners for these hubs are not supplied as a separate item to stockists in Great Britain. Should severe wear take place,

hubs should be returned to the factory for service. When it is not possible to return the hub to the factory the following procedure should be carried out. Unspoke the wheel and remove the bearings. Remove self-locking nuts retaining liner, and discard. Heat the hub shell to 220–225° C. and soak at this temperature for 20 minutes, when a sharp tap on the bench, whilst the hub is still hot, will dislodge the liner.

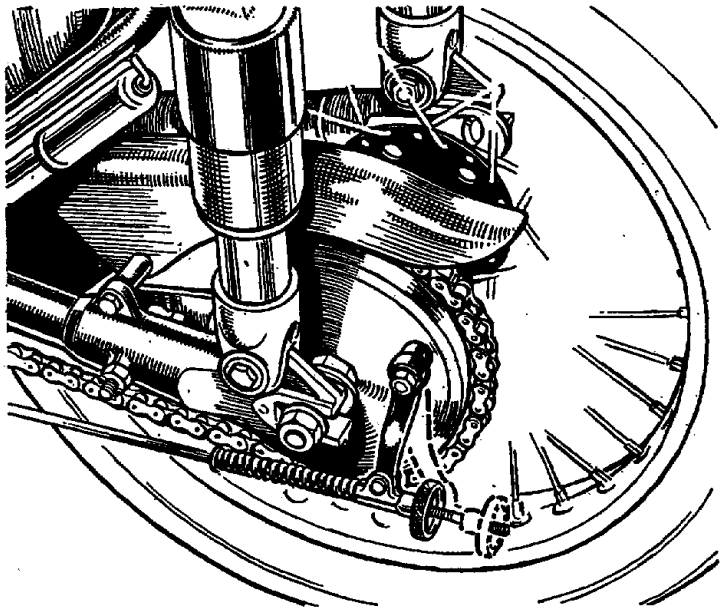

FIG. 41.—REAR BRAKE ADJUSTMENT.

The dotted outline shows the most effective position. In the position shown, either new linings or packing under the thrust pins (Fig. 42) are required.

Fitting New Liner

Heat the hub shell to 210–215° C. for 10 minutes and, with the liner clean and free from burrs, slide the liner into position whilst the shell is still hot, making sure that the liner is square on its seating before the shell cools off. When the shell is cold reassemble the spindle and the wheel bearings, and respoke the

wheel. Mount the wheel on a lathe, using the centres in the spindle for location, and bore the liner to 7·025–7·030 in. Remove the sharp corner from edge of liner. It is essential that the liner be machined to size after the wheel is laced.

Brake-shoe Adjustment

Minor adjustment is effected by altering the position of the front-brake cable adjuster and finger adjuster on rear-brake rod. Major adjustment, to compensate lining wear, is achieved by packing washers (2) under the thrust pins (1), Fig. 42.

Ineffective Brakes

Assuming that the brake linings are not badly worn, and that the cam is in the normal position, the brake shoes may not be

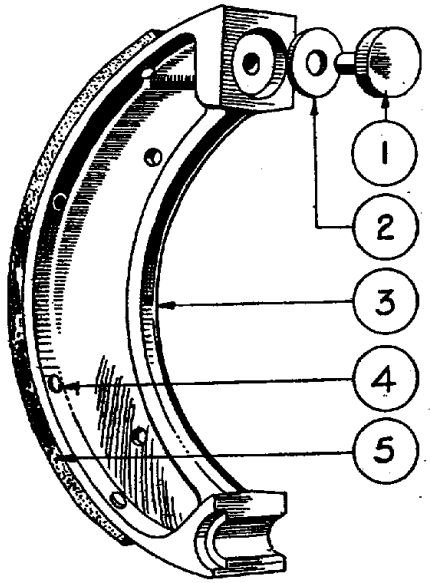

FIG. 42.—BRAKE SHOE AND THRUST PIN WITH PACKING WASHER.

1. Brake shoe thrust pin.
2. Thrust pin packing washer.
3. Brake shoe.
4. Brake shoe lining rivet.
5. Brake shoe lining.

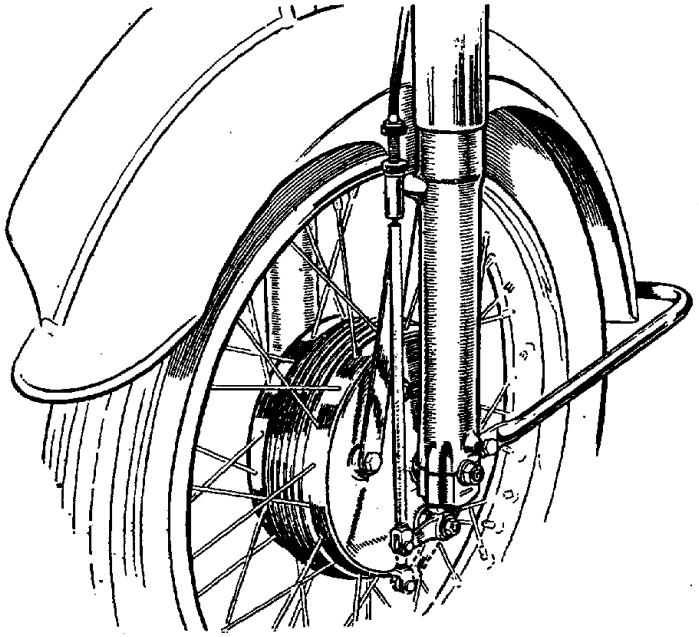

FIG. 43.—FRONT BRAKE ADJUSTMENT.

The dotted outline shows the most effective position. New linings or packing washers under the thrust pin (Fig. 42) are necessary when the arm takes up the position shown.

concentric with the drum. The front-brake shoes can be centralised by releasing the nut securing the brake-cover plate, and the shoe fulcrum nut at the top of the cover plate. To centralise the shoes, pressure is applied on the expander lever either by pulling hard on the hand-operated lever or by disconnecting the brake cable from the expander lever, with pressure applied by a box key to obtain more leverage. Retighten the brake-cover-platenut and the shoe-fulcrum nut, *whilst the pressure is maintained.* If this fails to work, take out the wheel, remove the cover-plate fixing nut and see if there is clearance between the hole in brake-cover plate and the spindle, if not, enlargen the hole in the cover plate to give concentric clearance, $\frac{1}{32}$ in. will do, and repeat the same process. The object of this is to allow the brake-cover plate to move and

make the shoes concentric with the brake drum when pressure is applied on the expander. Deal with the rear brake in same manner, using brake pedal to apply pressure.

Brake Squeal

Check both brake shoes for lack of chamfer on the ends of the linings and centralise as previously described.

Note

If difficulty exists in removing the nut securing the brake plate on the front wheel, clamp the right-side end of the wheel spindle into the fork slider, which will act as a vice to prevent the spindle turning.

CHAPTER VI

ELECTRICAL AND IGNITION EQUIPMENT

LUCAS electrical and ignition equipment is used on the Model 20, in conjunction with K.L.G. F.E. 80 sparking-plugs. A hand-control magneto, driven by the inlet-camshaft wheel, supplies the high-tension current for the sparking-plugs. The exhaust-camshaft wheel drives the E3L-L1-0 60-watt dynamo anti-clockwise. 1950 models used a negative-earth system; since 1951, a positive-earth arrangement has been used. When fitting a service replacement dynamo, or if the dynamo polarity has been reversed inadvertently, fit the dynamo and make all connections, then press the regulator cut-out points together for a few seconds; this will render the dynamo suitable for use with whichever system is employed on the machine.

The two exterior terminals on the dynamo are marked " D " and " F "; they are connected to similarly marked terminals on the regulator. Reversal of these leads will burn out the dynamo, so ensure that the connections are made correctly; remember that the *field is green*.

Magneto

Lubrication and adjustment is required every 3,000 miles, cleaning is required every 5,000 miles. Every 10,000 miles the complete unit should be handed to a Lucas Service Station for dismantling, replacement of worn parts, cleaning and lubrication.

Lubrication Every 3,000 miles

The cam is supplied with lubricant from a felt pad contained in a pocket in the contact-breaker housing. A small hole, located in the bottom of the cam, is fitted with a wick to enable the oil to find its way on to the surface of the cam. Remove the contact-breaker cover and turn over the engine until the hole in the cam can be clearly seen, and then carefully add a

few drops of thin machine oil. Do not allow any oil to get on to the contact points.

The contact-breaker rocker arm also requires lubrication, and the complete contact-breaker must be removed for this purpose. Take out the hexagon-headed screw from the centre of the contact-breaker, pull the contact-breaker off the tapered shaft on which it fits, then push aside the rocker-arm retaining spring, prise the rocker arm off its bearing and lightly smear the bearing with clean engine oil. When replacing the contact-breaker, take care to ensure that the projecting key, on the tapered portion of the contact-breaker base, engages with the key-way cut in the magneto spindle, otherwise the timing of the magneto will be upset. Tighten the hexagon-headed screw with care; it must not be too slack, nor must undue force be used.

Adjustment Every 3,000 miles

Remove the contact-breaker cover and turn the engine until the contact points are fully opened. Check the gap with a gauge having a thickness of 0·012 in. (spanner 015023 has a gauge of this thickness as an integral part of it). If the setting is correct the gauge should be a sliding fit, but if the gap varies appreciably from the gauge it should be adjusted. Keep the engine in the position to give maximum opening of the contact points, slacken the lock-nut on the fixed contact point and turn the contact screw until the gap is set to the gauge. Finally, tighten the lock-nut and recheck the setting.

Cleaning Every 5,000–6,000 miles

Take off the contact-breaker cover and remove the contact-breaker. If the contact points are burned or blackened, clean them with a fine carborundum stone or with very fine emery cloth, and afterwards wipe away any dust or dirt with a petrol-moistened cloth. After replacing the contact-breaker, check the point gap and, if necessary, reset it. Remove the high-tension pick-ups (held by swinging spring clips), wipe clean and polish with a fine dry cloth. The high-tension pick-up brush must move freely in the holders. If dirty, clean with a

cloth moistened with petrol. If the brushes are worn within $\frac{1}{8}$ in. of the shoulder they must be renewed. While the pick-ups are removed, clean the slip-ring track and flanges by holding a soft cloth on the ring with a suitably shaped piece of wood while the engine is slowly turned. If, on inspection, the high-tension cables show signs of perishing or cracking, they must be replaced by a suitable length of 7-mm. rubber-covered ignition wire. When replacing high-tension cables in brush holder, ensure that cable nuts are firmly tightened, so making contact between the high-tension leads and the brass contacts in the brush holders.

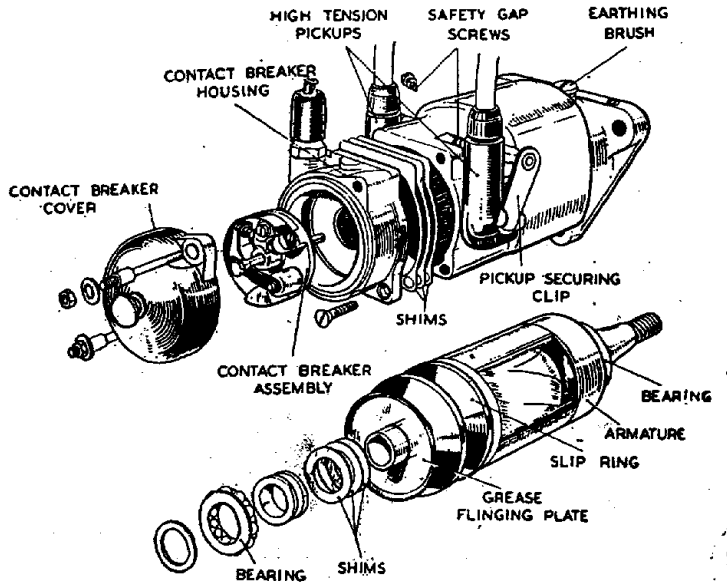

FIG. 44.—EXPLODED VIEW OF THE LUCAS K2F MAGNETO.

Magneto Removal

The magneto is located by a spigot on the magneto body, and is retained to the crankcase by two studs and one bolt, a paper gasket being used at the joint to prevent oil leakage. To remove the magneto, proceed as follows: take off the timing cover. Remove the magneto pinion with special tool 015273.

Disconnect the high-tension cables and the ignition-control cable. Remove the three nuts securing the magneto, which can now be taken from its mounting. After considerable mileage, or during engine overhaul, the magneto should be serviced by a Lucas Service Depot.

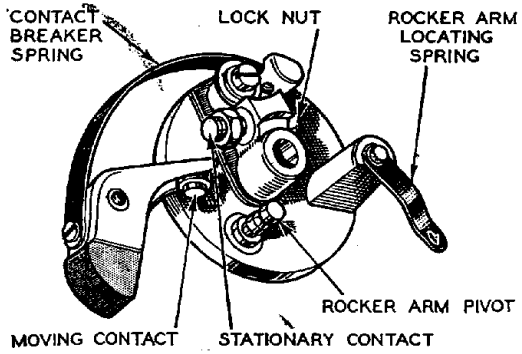

FIG. 45.—CONTACT BREAKER MECHANISM.

Dynamo

The makers of the dynamo recommend inspection of commutator and the brush gear every 5,000–6,000 miles, also a service check of the dynamo complete by a Lucas Service Station every 10,000 miles.

Testing Dynamo in Position

(*a*) Remove the " D " and " F " leads from the dynamo terminals and connect the two terminals with a short length of wire.

(*b*) Start the engine and set to run at normal idling speed.

(*c*) Connect the negative lead of a moving-coil voltmeter (calibrated not less than 0–10 volts) to either of the two dynamo terminals and connect the positive lead to the engine. For 1950 models, the voltmeter leads should be reversed for these and other tests.

(*d*) Gradually increase the engine speed, when the voltmeter reading should rise rapidly and without fluctuation.

Do not allow the voltmeter reading to rise above 10 volts or race the engine in an attempt to increase the voltage; it is sufficient to run the engine up to a speed of 1,000 r.p.m. If the above reading is obtained the dynamo is in order. If there is no reading, check the brush gear, ensuring that the cover-band securing screw is not shorting the " D " brush housing. If there is a reading of approximately 1½–2 volts the armature winding may be at fault. If the tests mentioned above clearly indicate that the dynamo is not charging it is then desirable to remove the dynamo from the machine in order to make further tests and repairs or replacements.

Dynamo Removal

The dynamo is retained to the crankcase by an adjustable band and also by a stud located in the end of the dynamo. Early models use a short stud, with its nut inside the timing cover. Later models use a long stud, with the nut outside the timing cover. By slackening the clamp, removing the locating-stud nut and detaching the " D " and " F " leads the instrument can be taken away, leaving the drive pinion on the armature shaft. The " D " and " F " leads are retained by a kidney-shaped insulator screwed into the dynamo end cover.

Note

The cork washer used between the dynamo and crankcase must be undamaged if oil leakage is to be avoided. A persistent oil leak can be rectified by using two cork washers, lightly smeared with " Wellseal ".

Regulator

This unit houses the dynamo voltage regulator and the cut-out. Both are accurately set and the cover should be removed for cleaning and adjustment only in the event of trouble with the charging circuit being experienced.

Testing Regulator Unit in Position

(1) Before checking the regulator unit, make sure that the wiring between the regulator and the battery is in order. To do this, disconnect the wire from the (*A*) terminal of the

regulator unit and connect the lead from the positive terminal of the voltmeter to the end of the wire. If a voltmeter reading is given, the wiring is in order and the regulator should be examined. If there is no reading examine the wiring for broken cables or loose connections.

(2) Remove the cable from the terminal on the regulator marked (*A*). Connect the positive terminal of the moving coil voltmeter to the (*D*) terminal on the regulator and connect the other lead of the voltmeter to an earthing point on the engine.

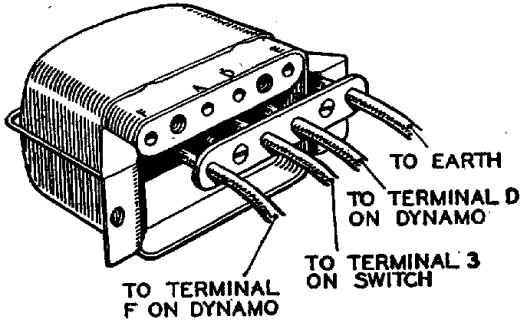

FIG. 46.—REGULATOR CONNECTIONS.

(3) Start the engine and slowly increase the speed until the voltmeter needle " flicks " and then steadies ; this should occur at a voltmeter reading between the limits given for the particular atmospheric temperature :

Atmospheric Temperature.	Regulator Setting.
30° F.	7·9–8·3 volts
60° F.	7·8–8·2 volts
90° F.	7·7–8·1 volts

If the voltage at which the reading becomes steady is outside these limits, the regulator must be adjusted. Shut off the engine, release the lock-nut on the regulator adjusting screw and turn the screw in a clockwise direction to raise the setting, or in an anti-clockwise direction to lower the setting. Turn the screw a fraction of a turn at a time and then tighten the lock-nut.

When adjusting, do not run the engine up to more than 1,000 r.p.m., as while the dynamo is on open-circuit it will build up to a high voltage if run at a high speed, and so a false voltmeter reading would be obtained.

Cleaning Regulator Contacts

After long periods of service it may be found necessary to clean the vibrating contacts of the regulator. These are accessible if the top screw securing the fixed contact is turned back and the bottom screw slackened to permit the fixed contact to be swung outwards. The contacts can then be polished with fine emery cloth.

Cut-out—Testing and Adjustment

(1) If the regulator setting is within the correct limits, but the battery is still not receiving current from the dynamo, the cut-out may be out of adjustment, or there may be an open-circuit in the wiring of the voltage-regulator unit.

(2) Remove the voltmeter lead from the (*D*) terminal of the regulator unit and connect it to terminal (*A*). Run the engine as before : the reading on the voltmeter should be the same as that obtained when the voltmeter was connected to terminal (*D*). If there is no reading, the setting of the cut-out may be badly out of adjustment and the contacts are not closing.

(3) To check the voltage at which the cut-out operates, the voltmeter should be connected between the (*D*) terminal and earth. Slacken the lock-nut on the cut-out adjustment screw and turn the screw in an anti-clockwise direction until the cut-out contacts are seen to close. Check the voltage at which the cut-out operates and if necessary adjust by turning the screw in a clockwise direction to raise the setting or anti-clockwise direction to lower it. Set the cut-out so that it operates at 6·2–6·6 volts. Tighten the lock-nut after making the adjustment.

Cut-out—Contacts Burnt or Dirty

To clean the cut-out contacts, place a strip of fine glass-paper between the contacts, then, with the contacts closed by

hand, draw the paper through. This should be done two or three times with the rough side towards each contact.

Other Equipment

Sparking-plugs

Sports-type sparking-plugs, type K.L.G. FE 80 (14 mm.), are available with either single- or three-point electrodes. The use of the three-point type is recommended to balance positive-electrode erosion. When single-point plugs are used, change the plugs round from one cylinder to the other from time to time, as one plug will be affected by electrode erosion caused by the alternating polarity of the magneto impulses. The normal plug gap is 0·020–0·022 in., which is obtained by either closing or widening the electrode attached to the body of the plug; the gap should be checked every 3,000 miles, or earlier if slow running or starting is impaired.

Ammeter—Testing in Position

With the engine stationary, check the voltage between each terminal of the ammeter and earth. Both readings should be the same. If there is a reading at one terminal, Fig. 47, but not at the other, there is a broken connection in the ammeter and a replacement must be fitted.

To remove the ammeter, unscrew the ammeter terminal screws and lift out the cable ends. Bend back the four metal tags securing the ammeter and remove it from the panel. The procedure must be reversed when fitting the replacement ammeter.

The Battery

The battery is a 6-volt lead-acid type, of 12 ampere hours capacity, containing electrolyte in free liquid form. This part of the electrical equipment is often neglected, and owners are advised to check the electrolyte level at frequent intervals, and to top up with distilled water to the top of the separators, using a glass funnel. Filling instructions are moulded inside the battery lid on all models, but on those produced since 1953,

batteries have a built-in automatic-level device that accepts just as much distilled water as is required. After topping up, wipe metal parts with a rag soaked with ammonia, to neutralise acid on battery top. If frequent, or excessive, topping up is necessary, the reason should be investigated, which may be due to overcharging, in which case the voltage-control regulator should be readjusted, preferably by a Lucas Service Depot. The regulator and cut-out are carefully set during manufacture, and it is a skilled job to reset this part of the electrical equipment.

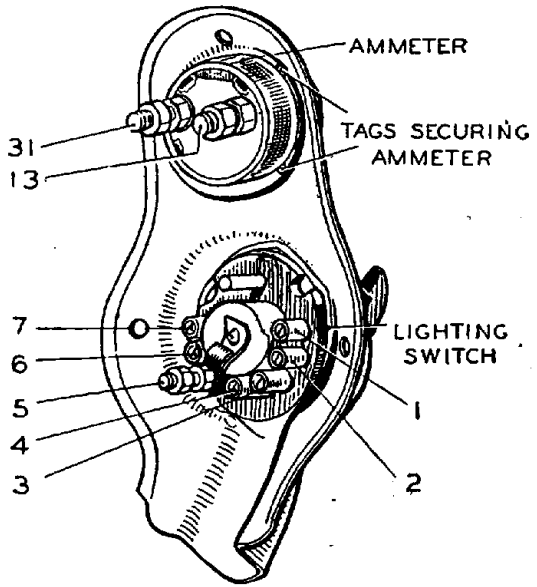

FIG. 47.—AMMETER AND SWITCH PANEL ON HEADLAMP.

Lamp Bulbs Blowing

This fault is usually due to a bad earth connection, particularly on machines where the earth connection is made to the frame seat-lug bolt. Take out this bolt, file away any enamel in the frame holes and clean the bolt. A dry battery will have the same effect.

Removing the Headlamp—1950–53

Take out the three screws securing the switch panel, and remove the two bolts screwed into the lamp body, supporting the lamp with one hand as the second bolt is taken out.

To Remove the Headlamp Front and Interior

Slacken the screw on the top of the lamp body at the front, pull the rim outwards from the top and, as the front comes away, raise slightly to disengage the bottom tag from the lamp shell. The cap that carries the bulbs is secured to the reflector by two spring plungers. To remove the cap, depress one plunger and tilt the cap bodily. The reflector and front glass unit is secured to the rim by five spring clips. These can be disengaged from the turned-up inner edge of the rim by pressing with a screwdriver blade and, at the same time, working away from the edge.

To Replace the Headlamp Front and Interior

Lay reflector and glass unit in the rim so that the block on the reflector back engages with the forked bracket on the rim. Spring in the five clips so that they are evenly spaced around the rim. Offer up the assembly to the lamp shell, engaging the bulb-carrier cap in the position in which the pilot bulb is against the small window of the reflector. Engage the bottom tag on the lamp rim with the small slit in the shell and gently press the top of the rim back into the shell, then retighten the locking screw on the top of the lamp body.

Focusing the Main Driving Beam—1950–52

The main bulb is adjustable in its holder. It is secured by a clamp bound with one screw and, upon slackening the screw, the bulb may be pushed inwards, and outwards, as required, thereby providing movement to enable the light beam to be focused. It is best to make the focusing adjustment in the dark with the machine so positioned that the light falls on a wall some distance away. To focus the light beam, place the machine as suggested above, slacken the clamp screw and pull

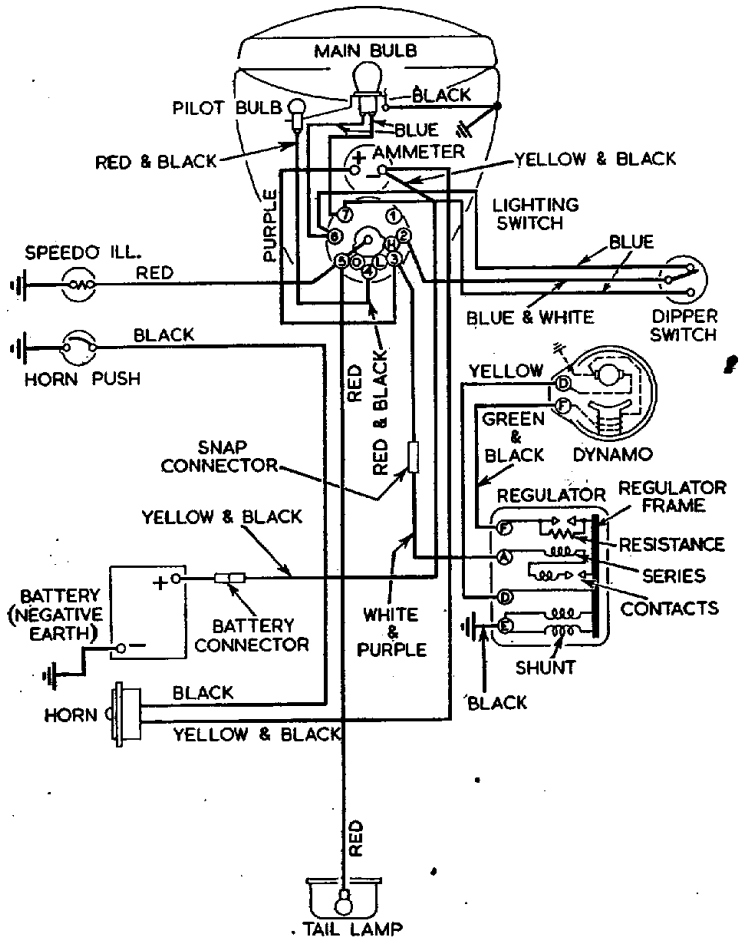

FIG. 48.—WIRING DIAGRAM FOR 1950 MODELS.

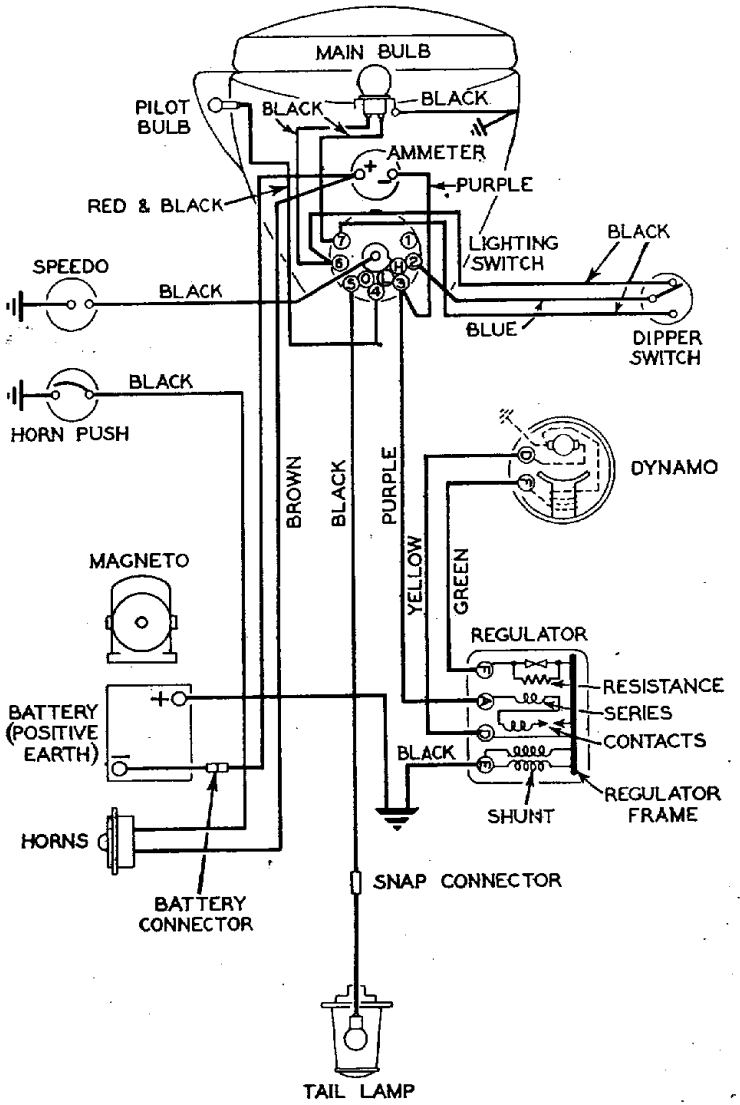

FIG. 49.—WIRING DIAGRAM FOR 1951–53 MODELS.

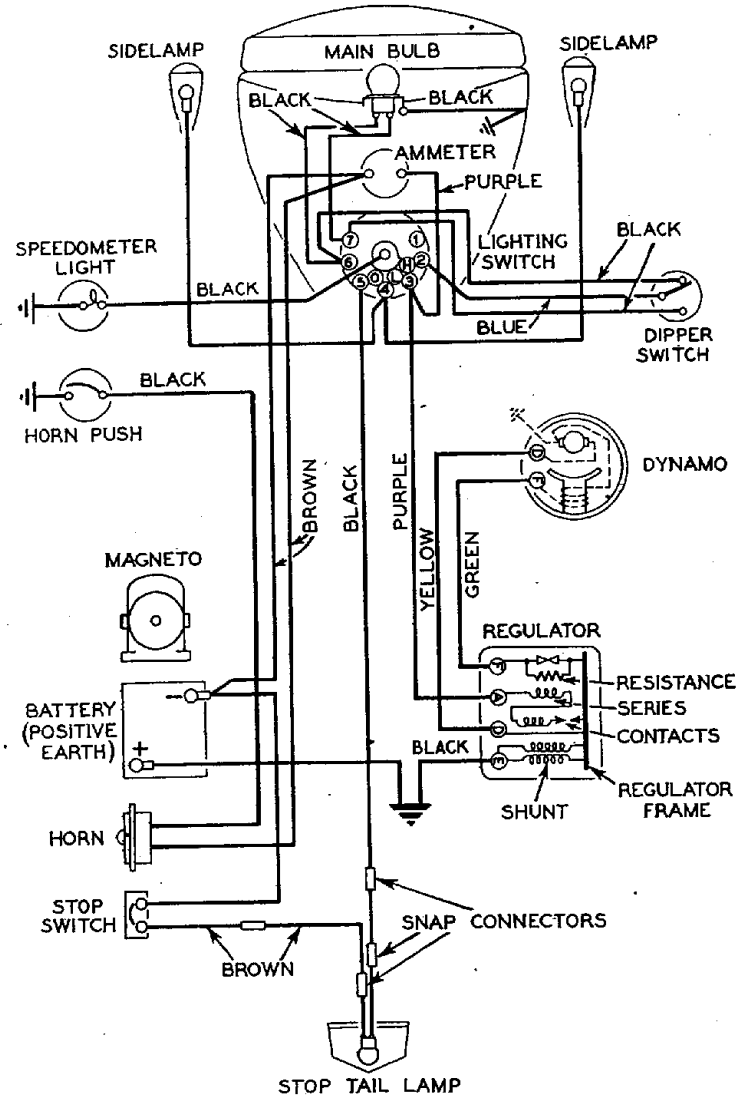

FIG. 50.—WIRING DIAGRAM FOR 1954 MODELS.

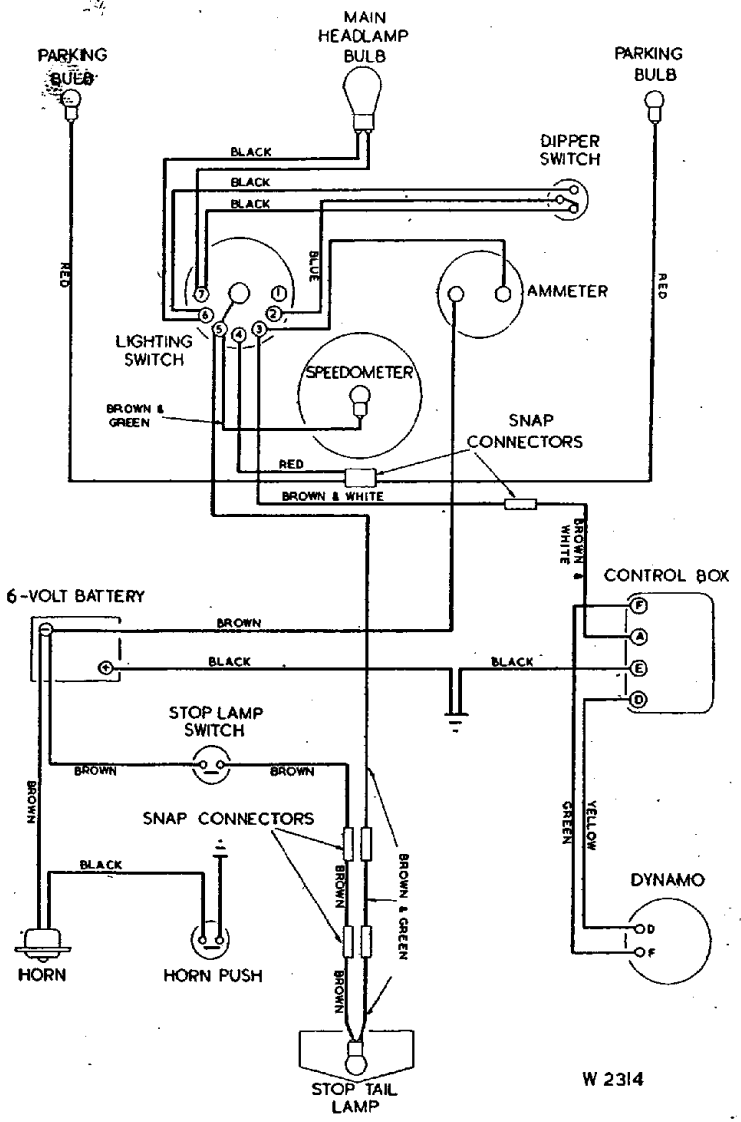

FIG. 51.—WIRING DIAGRAM FOR 1955 MODELS.

the bulbs inwards or outwards till, with the light switched on, the smallest circle of light is obtained. Tighten the clamp binding screw, then set the lamp, by slightly slackening the two fixing bolts, so that the light beam is projected slightly below the horizontal, after which tighten the two fixing bolts.

Removing Headlamp—1954–55

Slacken the screw on the headlamp top, gently prise out the rim and reflector assembly. Hold the light unit with the glass at the bottom, and with a rotary and lifting movement detach the bayonet cap to which the headlamp wires are attached and take away the rim and reflector assembly. Gently ease back the rubber sleeves covering the pilot-lamp wire snap connectors and pull the latter apart. Remove the three screws securing the switch panel and lift off with all wires attached. Remove the nuts on the tubular bolts through which the pilot-lamp wires pass, take away the pilot lamps and headlamp shell. Disconnect the driving cable from the speedometer head and detach the speedometer-lamp bulb with its holder.

Removing Headlamp Rim and Light Unit—1953–55

Slacken the screw on the top of the lamp body at the front, pull the rim outwards from the top and, as the front comes away, lower slightly to disengage the bottom tag from the slit in the lamp shell. Twist the bulb holder in an anti-clockwise direction and pull it off, the bulb can then be removed. The light unit is secured to the rim by spring clips. These can be disengaged from the turned-up inner edge of the rim by pressing with a screwdriver blade and, at the same time, working away from the edge.

Replacing Headlamp Rim and Light Unit

Lay the light unit in the rim so that the location block on the unit back engages with the forked bracket on the rim. Replace, by springing in, the spring clips so that they are evenly spaced around the rim. Hold the light unit with the glass facing downwards and replace the bulb. Engage the projections on the inside of the back shell with the slots in the bulb

holder, press on and secure by twisting it to the right. Engage the bottom tag on the lamp rim with the small slit in the shell and gently press the top of the rim back into the shell, then retighten the locking screw on the top of the lamp body. Access to the pilot lamp's (1954–55) interior for bulb removal is obtained by removing the screw at the rear end and gently pulling forward on the glass rim.

On the 1955-type headlamp the speedometer is incorporated in the lamp shell. Disconnect the speedometer cable before removing the headlamp.

Note

1951–55 models have a *positive earth* battery connection.

CHAPTER VII

TUNING FOR SPEED

ASSUMING the engine is in good order, the road performance of the twin-cylinder model is particularly good, if the weight of the complete machine is taken into account. The accepted b.h.p. is 29, the engine peaking just below 7,000 r.p.m. To obtain maximum performance, the engine should reach peak r.p.m. in third gear, which represents a road speed of 80–84 m.p.h.; under favourable conditions with the rider prone the maximum speed in top gear is approximately 90–92 m.p.h. Owners unaccustomed to this type of machine are often concerned at the high engine speed at full throttle, with apprehension as to a possible engine failure by breakage. There are no grounds for such thoughts, as the engine is designed to rotate at high speed, depending upon r.p.m. for power. It is for this reason that the engine should reach its peak if maximum speed is desired. The number of parts available to increase engine performance is limited, with the exception of the race kit marketed. The special camshafts supplied with this kit are designed for a straight-through exhaust-pipe system, and a serious loss of power will occur if silencers are used. See Fig. 52 for a comparison between the timing of touring and racing engines.

Without such special parts, the engine can be tuned by:

(1) Polishing ports and manifold, together with the sphere of the cylinder-head.

(2) Fitting pistons to give a compression ratio of 8 to 1.

(3) Using super-sports type sparking-plugs, such as the K.L.G. F.E. 100 or, preferably, F.E. 220.

When high-compression pistons are fitted, three-layer bearing shell Part No. 018564 should be used in the top half of the connecting-rod.

Valve Timing

Owners of 1950–53 models can improve the engine performance by fitting camshafts made for the 1954–55 engines. As these cams have a slightly higher lift, the valve-spring motion must be checked when the valve is at full lift to ensure that the valve springs do not become coil bound. Reducing the face of the valve-spring seat by 0·040 in. will provide sufficient extra clearance.

The best method of finding top dead centre accurately is to lay a rule across the top of the cylinder barrel and note the degree-plate reading as the piston crown touches it; carry on rotating the crankshaft until the rule is about to sit down on the top of the cylinder barrel again. Gently lower the piston and note the degree-plate reading as the rule touches the barrel; top dead centre is half-way between the two readings obtained.

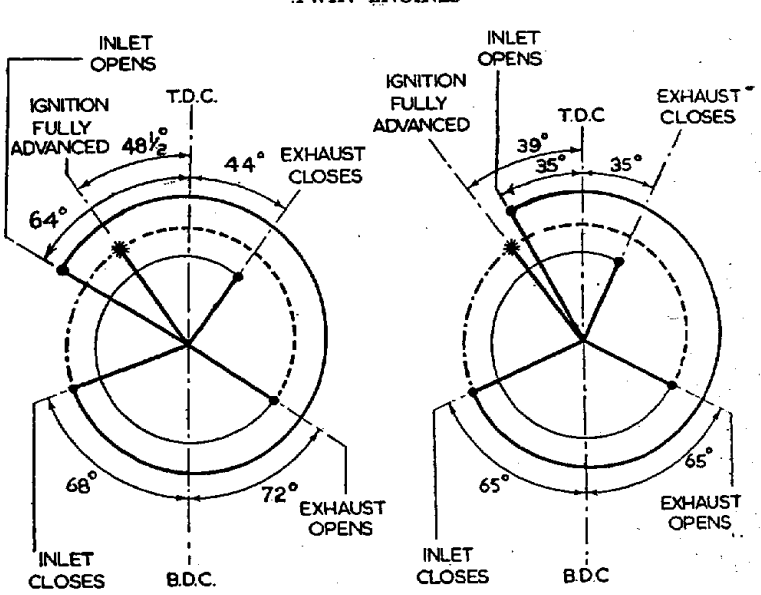

FIG. 52.—TIMING DIAGRAMS.

On the left is shown the timing diagram for tuned engines; touring engines are timed to the right-hand illustration.

This eliminates the errors of up to 10° that are common with the rough-and-ready timing-stick method. Fig. 12 shows the degree plate and adjustable top dead centre pointer mounted in position.

Valve Springs

During the process of tuning, check the valve-spring free length (*see* Technical Data), as maximum pressure is essential to maintain high engine speeds. Valve springs used in the race kit are identical to the standard type, with the exception of the feathered ends, which are cropped to prevent breakage at sustained high r.p.m. To convert the standard springs, file off the sharp ends.

Rocker Clearances

Correct rocker clearances are essential; ensure that the clamp nuts are securely tightened after adjustment.

Carburation

When the restriction caused by the silencer is removed, a larger main jet is necessary, i.e., increase from 180 to 200. The use of a second carburetter will also increase engine efficiency, and owners who have workshop facilities will be able to make up two special distance pieces which are needed when two carburetters are fitted. The additional carburetter can be obtained from the makers of the carburetter, together with a junction box for two throttle cables. Should flooding occur from the float chambers when two carburetters are used, fit two 6/3 throttle slides. The fitting of high-compression pistons will improve the acceleration of the machine, in its standard form, to a marked degree, the maximum speed being increased by 3–5 m.p.h. No alteration to the ignition timing is necessary when high-compression pistons are fitted, using premium grades of fuel.

Note: It is not possible to fit a second type 376/6 carburetter.

Exhaust System

If an open exhaust-pipe system is used, the best length is 34 in. measured on the inside bend. This measurement can be obtained by using a long, thin piece of copper wire with a weight, such as a large nut, attached to one end of the wire. Remove baffle tubes. Lower the weight and wire through the pipe from the port end, until the weight emerges from the pipe at the silencer end. Pull the wire tight against the inside of the bend and mark it at both ends of the pipe. Extract the wire, measure the marked length and adjust the pipe length accordingly.

Dismantling the Engine

If the engine is to be completely dismantled for tuning, obtain the correct tools for the work. Clean the exterior of the engine thoroughly before commencing operations, and remember that absolute cleanliness is of vital importance to success. During the stripping, observe the condition of the engine and measure the various components for wear. Polish all the moving parts, paying particular attention to the cam-follower contours, the cams and the rocker ends, and eliminate any steps in the induction tracts. Wash all parts in clean petrol before rebuilding the engine. Having gone to the trouble of cleaning everything thoroughly, do not leave partly-assembled components lying about to get dusty, and always cover the crankcase mouth with clean, non-fluffy rag to prevent the ingress of particles of dirt. Oil *all* parts before assembling and check for freedom of rotation frequently during rebuilding. Investigate the cause of any avoidable friction and eliminate it.

Frame Adjustments

The cycle parts of the machine are as equally as important as the engine; a very fast machine that steers badly is usually at a disadvantage when compared with a slower machine on which meticulous attention has been paid to all adjustments. To obtain the best from a machine requires much more time and patience than most people are prepared to give.

Wheels and Tyres

Balance the wheels statically with balance weights obtainable from the tyre manufacturers. Remember that as the tyres become worn so the balance will deteriorate.

Chains

Correctly lubricated and adjusted chains, running perfectly true, will make a considerable difference to the running of the machine.

APPENDIX 1

PERIODIC MAINTENANCE

Daily

Check oil level and circulation.

Weekly

Test tyre pressures.
Check battery electrolyte level.

Every 500 Miles

Check oil in front chaincase.
Check front- and rear-chain adjustments.
Check gearbox oil level.
Oil rear chain.

Every 1,000 Miles

Grease hub bearings.
Grease brake-expander lever bushes.
Grease steering-head bearings.
Oil small parts, control levers, clevis pins for brakes, brake pedal, etc.
Test steering-head bearings.
Check rocker clearance.

Every 3,000 Miles

During wet weather remove and soak rear chain in molten anti-centrifuge grease.
Clean and check contact points on magneto.
Clean and reset plug points to 0·020–0·022 in.

Every 5,000 Miles

Drain oil tank, fill with fresh oil. If the machine is used frequently for short journeys, change the oil every three months, whichever occurs first.
Clean oil filter.
Check front-fork oil content.
Check rear-suspension unit oil content.
Oil hinge-bearing for swinging arm.
Clean out carburetter float chamber.
Clean air-filter element and re-oil.

RECOMMENDED LUBRICANTS

	Shell.	Vacuum.	Price's.	Esso.	Wakefield.
Engine:					
Summer	X-100 (SAE 50)	Mobiloil D	Energol 50	Essolube 50	Castrol Grand Prix
Winter	X-100 (SAE 30)	Mobiloil A	Energol 30	Essolube 30	Castrol XL
Gearbox	X-100 (SAE 50)	Mobiloil D	Energol 50	Essolube 50	Castrol Grand Prix
Frame and Hubs	Retinax Grease CD or A	Mobilgrease No. 2	Energrease C_3	Esso Pressure Gun Grease	Castrolease Heavy
Front Forks and Rear Legs	X-100 (SAE 20)	Mobiloil Arctic	Energol 20	Essolube 20	Castrolite
Primary Chain	X-100 (SAE 20)	Mobiloil Arctic	Energol 20	Essolube 20	Castrolite
Rear Chain	Retinax Grease CD or A	Mobilgrease No. 2	Energol A.O.	Esso Fluid Grease	Castrolease Graphited

APPENDIX 2

TECHNICAL DATA

Engine

Bore, mm.	66
Stroke, mm.	72·8
Capacity, c.c.	498
B.H.P. at r.p.m.	29 at 6,800
Engine type	O.H.V. Twin
Maximum torque at r.p.m.	26·4 lb.ft. at 4,250
Compression ratio:	
normal	7 : 1
alternative	8 : 1
Lubrication	Dry-sump

Crankshaft

Crankpin dia.	1·62475–1·62575
Journal dia.	1·3747–1·3752
Centre journal dia.	1·62425–1·62625
Roller bearings	RLS–12½ 1⅜ × 3 × 11/16
Bearing-housing dia.	2·997–3·002

Connecting-rods

Big-end type	Vandervell
Clearance (dry)	0·0025 max.
Side-play	0·026–0·032
Big-end dia. (internal)	1·7710–1·7715
Distance between centres	5·750
Small-end dia.	0·750–0·7505

Camshafts

Bush dia. (*in situ*)	0·8125–0·8135
Camshaft dia.	0·81025–0·81325

Cam Followers

Spindle dia.	0·370–0·376
Spacer (wide)	1·296875–1·301875
Spacer (narrow)	0·156–0·159

Oil Pumps

Gear width:	
feed	0·250
scavenge	0·375

Intermediate gear

Bush dia. (*in situ*) (1950–54)	0·6223–0·6230
Bush dia. (*in situ*) (1955)	0·74950–0·75025

(All dimensions are in inches unless otherwise indicated.)

TECHNICAL DATA (*Continued*)

Intermediate Shaft

Diameter (1950–54)	0·6210–0·6215
Diameter (1955)	0·7485–0·7490

Inlet Valves

Stem dia.	0·27875–0·27975
Guide bore	0·28075–0·28175
Lift	0·3125

Exhaust Valves

Stem. dia.	0·309–0·310
Guide bore	0·312–0·313
Lift	0·3525

Valve Rockers

Bush bore	0·500–0·501
Spindle dia.	0·498–0·501

Rocker Clearances

Cold	0·006

Valve Timing*

I.V.O.	35° B.T.D.C.
I.V.C.	65° A.B.D.C.
E.V.O.	65° B.B.D.C.
E.V.C.	35° A.T.D.C.

Valve Seats

Angle	45°

Valve Springs

Pressure, full lift	140–145 lb.

Cylinder Barrels

Bore dia.	2·5975–2·5985

Pistons and Rings

Skirt dia., top	2·5969–2·5976
Skirt dia., bottom	2·5977–2·5984
Ring gap, normal	0·006
Ring gap, maximum	0·030
Ring, vertical clearance	0·002

(All dimensions are in inches unless otherwise indicated.)

*Rockers set to 0·012 in. clearance

TECHNICAL DATA (*Continued*)

Push-rods

Assembled length	8·07875–8·10875

Carburetter (1950–54)

Type	76AG/1AU*
Bore	1
Main jet	180†
Slide	6/4
Needle jet	0·1065
Needle position	Middle notch

Carburetter (1955)

Type	376/6
Bore	1
Main jet	240‡
Slide	376/4
Needle jet	0·1065
Needle position	Middle notch
Pilot jet	30

Ignition

Contact-breaker gap	0·012
Plug gaps	0·020–0·022
Timing, advanced	39° B.T.D.C. or $\frac{5}{8}$

Sparking-plugs

Normal	K.L.G. FE80
Hard driving	K.L.G. FE220

Torque-spanner Settings

Cylinder-head bolts	18 lb.ft.
Big-end nuts	22 lb.ft.
Centre-bearing nuts	11 lb.ft.

Steel Balls

Non-return valve dia.	0·375
Pump-plate dia.	0·250
Clutch-rod dia.	0·3125

(All dimensions are in inches unless otherwise indicated.)

* 1954 models, 76AT/1EF.
† 160 with air filter.
‡ Size 230 main jet with air filter.

TECHNICAL DATA (*Continued*)

Clutch Push-rod

Length, 1950–51 (CP Gearbox)	10·125
Length, 1952–55 (B52 Gearbox)	10·1875

Tyres

Front size	3·25 × 19
Rear size	3·50 × 19

Wheel Rims

Front and rear size	WM2 × 19

General Data

Weight, dry	394 lb.
Wheelbase	55·25
Seat Height	31·5
Ground clearance	5·5
Overall length	86·25
Overall height	41·5
Overall width	28
Tyre pressure—front	22 lb.
Tyre pressure—rear	25 lb.
Brakes	7 in. dia.

Tuned Engines

Compression ratio	8:1
Main jets	180–200, to be selected after trial runs
Sparking-plugs	K.L.G. FE220

Valve Timing*

I.V.O.	64° B.T.D.C.
I.V.C.	68° A.B.D.C.
E.V.O.	72° B.B.D.C.
E.V.C.	44° A.T.D.C.
Ignition timing (advanced)	48½° B.T.D.C.
Exhaust pipe length, open	34

(All dimensions are in inches unless otherwise indicated.)

* With inlet-rocker clearance of 0·003 in., and exhaust-rocker clearance of 0·010 in. These camshafts *must* be used with an open exhaust system and larger main jets. If megaphones are used, they should be 9 in. long and have an outlet dia. of 4 in.

SPRING DATA

Part No.	Year.	Description.	Free Length.	No. of Coils.	Imperial Wire Gauge.	Outside Diameter.
Lubrication System						
014241	1950–55	Felt filter relief valve	1½ in.	15	17	¾ in.
013564	1950–55	Non-return valve	⅞ in.	7	22	7/16 in.
016058	1951	Oil-relief valve, plunger type	⅞ in.	11	18	11/32 in.
000701	1950–55	Pump-bleed valve	9/16 in.	10	26	½ in.
016522	1952–55	Oil-relief valve, piston type	11/16 in.	7	18	11/32 in.
018282	1952–55	Release valve	11/16 in.	10	26	¾ in.
Front Forks						
015002	1950	Solo	12·09 in.	—	6	—
016526	1951–54	Solo	12¾ in.	—	6	—
016782	1951–54	Sidecar	12¾ in.	—	0·212 in. dia.	—
021784	1955	Solo	12¼ in.	—	5½	—
021789	1955	Sidecar	12¾ in.	—	0·222 in. dia.	—
Rear-Suspension Units						
011945	1950	Solo	8⅛ in.	—	9/32 in. dia.	—
016297	1951–55	Solo	5¾ in.	—	7/16 in. dia.	—
016061	1951–55	Sidecar	5¾ in.	—	11/32 in. dia.	—
Engine						
—	1950–54	Shock absorber	13/16–11/16 in.	—	—	—
016633	1955	Shock absorber	11/16–15/16 in.	—	—	—
011770	1950–55	Valve, inner	1⅛ in.	—	—	—
011769	1950–55	Valve, outer	1¼ in.	—	—	—
Clutch						
36–6–1	1950–55	Pressure springs	11/16 in.	—	—	—

GEARBOX AND CHAIN DATA

Front Chain Size	½ in. × 0·305 in. 66 links.
Rear Chain Size	⅜ in. × ⅜ in. 96 links.
Standard Engine Sprocket	20 Teeth
Clutch Sprocket	40 Teeth.
Gearbox Sprocket	16 Teeth.
Rear-wheel Sprocket	42 Teeth.

Gearbox Internal Ratios

	First Gear	Second Gear	Third Gear	Fourth Gear (Top)
Standard	2·65 to 1	1·70 to 1	1·308 to 1	1 to 1
Close Ratio	1·87 to 1	1·35 to 1	1·09 to 1	1 to 1

Gear Ratios (Standard)

Engine Sprocket	First Gear	Second Gear	Third Gear	Fourth Gear (Top)
19	14·55 to 1	9·33 to 1	7·18 to 1	5·49 to 1
20	13·91 to 1	8·91 to 1	6·86 to 1	5·25 to 1
21	13·25 to 1	8·50 to 1	6·54 to 1	5·0 to 1

C.P. TYPE (1950–51)

Gearbox-sprocket Nut, Part No. 176-X . 1 21/32 in. A/F
Mainshaft Nut (Clutch End), Part No. 11-7-11 1 5/16 in. A/F

B.52 TYPE (1952–55)

Gearbox-sprocket Nut, Part No. 11-11-1 . 1 21/32 in. A/F
Mainshaft Nut (Clutch End), Part No. 11-7-11 1 5/16 in. A/F

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