BOOK No. 101/A1. 3B
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MAINTENANCE MANUAL AND INSTRUCTION BOOK

MOTOR CYCLE, SOLO

350 c.c. O.H.V.

ARIEL

MODEL W/NG

INDEX

DATA SHEET

Engine Number.

Stamped on drive side crankcase, **below** cylinder base ; the letters preceding the number must be quoted with the number, e.g., BH.1234.

Frame Number.

Stamped on saddle lug ; quote also the prefix letters, e.g., XG.12345.

Engine.

Capacity	349 c.c.
Bore	72 mm.
Stroke	85 mm.
Compression ratio	6·5 : 1

Gearbox.

Ratios : First gear ratio	18·1
Second „ „	12·0
Third „ „	8·7
Top „ „	5·7

Transmission.

Primary chain,	$\frac{1}{2}''$ x ·305 x 80 pitches.
Secondary chain,	$\frac{5}{8}''$ x $\frac{3}{8}''$ x 92 pitches.
Engine Sprocket	20T.
Clutch „	44T.
Gearbox „	18T.
Wheel „	47T.

Speed.

Run-in a new or overhauled engine for approximately 500 miles, not exceeding the following speeds in each gear, in miles per hour :—

Top	35
Third	20
Second	15
First	10

Petrol Tank Capacity	$2\frac{1}{2}$ gallons.
Oil Tank Capacity	4 pints.
Primary Chain Case Capacity	$\frac{1}{2}$ pint.
Gearbox Capacity	$1\frac{1}{2}$ pints.
Weight	354 lbs. approx.

THE ENGINE

Removal as Complete Assembly from Frame.

1. Release carburetter, ignition and exhaust lifter control cables at handlebar end. Disconnect battery and dynamo leads.
2. Remove battery, exhaust pipe and petrol pipe. Drain oil tank and remove complete with oil feed pipes.
3. Remove footrests and rod complete (note distance tube between engine plates). Release rear brake rod wing nut and allow brake pedal to fall below primary chain case.
4. Remove clutch dome, dismantle clutch (see p. D1) and remove clutch centre and clutch case. Take off outer half of chain case.
5. Remove two locking nuts on end of engine shaft and withdraw shock absorber assembly. Engine sprocket and clutch sprocket complete with chain can now be drawn off their shafts. Take care not to lose the needle rollers in the bronze cage carrying the clutch sprocket.
6. Remove back of chain case. Undo two $\frac{1}{4}$" bolts securing battery carrier to the engine plate and remove the carrier. Undo the $\frac{1}{4}$" bolt securing the rear mudguard bracket to the nearside engine plate.
7. Remove the gearbox clamp bolt (top, $\frac{1}{2}$" dia.) towards the offside and slacken the gearbox adjuster Slacken the tie bolts through the engine plates and crankcase lugs and take out the four bolts (two in front, two in rear plates) holding the engine plates to the frame. Hold the engine whilst the two last bolts are removed or it may fall and be damaged. Now lift clear of the frame.
8. If the engine is being returned to a workshop or depot for overhaul, replace the engine sprocket and shock absorber assembly as this is part of the complete unit.
9. If the engine is to be dismantled, support it in a convenient position by closing the vice tightly on one of the front lugs of the crankcase, arranging suitable support from the bench for the rear of the engine.

1. Rocker Assembly (See Figs. B2 & 4).

To remove rocker assembly without removing engine complete, it is necessary to remove the petrol tank. See page F5.

Rotate the engine until both valves are closed.

Take off the two rocker boxes complete by removing the four bolts through each box.

To take out the rocker, undo the flat large-headed screw from the end of the spindle nearest the sparking plug. The spindle is then pressed or tapped out towards the same end.

The rockers bear directly on the hardened steel rocker spindles, no bushes being used. If excessive wear has occurred the worn spindle and/or rocker must be replaced.

Spindle dia.	...	·498—·499 in.
Rocker hole dia.	...	·500—·501 in.
Clearance (new)	...	·001—·003 in.

When assembling the rockers into their boxes, see that the small distance washer is fitted against the shoulder on the spindle, thus coming between the rocker and the box itself. This washer prevents the rocker rubbing the soft aluminium and also forms an abutment against which the spindle is pulled when the outer oil union retaining nuts are screwed up. The flat headed screw at the other end—in conjunction with the fibre washer—is nothing but an oil seal and must be tightened *after* the oil union nuts have been done up.

To fit the boxes to the head, see that the joint faces are clean, and place the joint washers in position. Drop the boxes squarely down on to the washers, making sure that the ball ends on the rockers locate in the push rod cups and then bolt down firmly. **The long bolt passes through the push rod end of the box.**

2. Cylinder Head, Push Rods and Enclosing Tubes (See Fig. B4).

Undo the four bolts holding the head to the barrel. If the head sticks a sharp blow with the hand on the induction flange will loosen it. Remove the push rods and enclosing tubes.

Before starting to remove the valves or carbon from the combustion space a tool should be made from a 5" length of ·705" hexagon bar threaded (14 mm. dia. x 1·25 mm. pitch) at one end to screw into the plug hole. The hexagonal end can then be gripped in a vice while any work is carried out on the head.

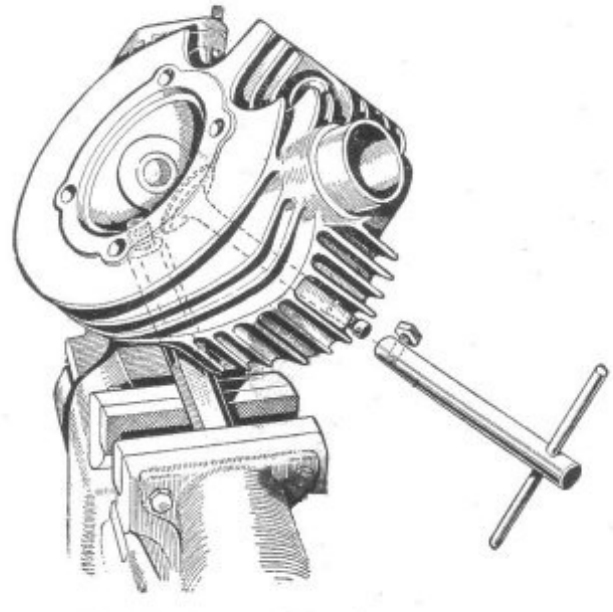

Fig. B1. Tools for holding Head and Valves.

17. Sprocket and Shock Absorber (See Fig. B4).

The assembly is held on the engine shaft by the two lock-nuts on the end of the shaft.

Note the correct order of assembly :—

Sprocket distance piece,
Sprocket,
Sliding member,
Spring,
Spring plate,
Locknut, tab washer, lock nut.

Be sure the spring plate is forced right up to the shoulder on the shaft. The assembly is *not* adjustable for spring tension. On early models the sliding member is carried in a cup and the spring plate fits on the splined part of the shaft ; in this case be sure that the plate is *not* trapped against the shoulder.

18. Refitting Engine to Frame.

Refitting the engine to the frame is simply a matter of reversing the removal instructions. The following points should, however, be specially noted.

1. All engine plate and crankcase bolts must be dead tight.

2. Primary chain to have $\frac{3}{8}$" up and down movement in the middle, at the tightest point.

3. Fit small round paper joint washer at foot-rest boss, between two halves of chaincase, to prevent oil leakage.

4. Gearbox pivot and clamp bolts must be dead-tight. The clamp bolt (top) must be fitted with the flat in the D shaped hole in the near side engine plate.

5. Remember to fit the footrest rod distance tube between the engine plates.

6. Note carefully the correct clutch assembly instructions on page D1.

Carefully scrape all carbon from the cylinder head and valve ports using an old knife or screwdriver, etc. Finish off by polishing with emery cloth. Take care not to damage the valve seats.

Refit the valves after making any replacements or doing any necessary service work.

The head is now ready to be refitted to the cylinder.

Rotate the engine until neither cam lever is on the lift, *i.e.*, valves closed. **Fit new rubbers to the push rod enclosing tubes—it is very important to fit the correct genuine replacements if oil leakage is to be avoided. Top and bottom rubbers may look the same but the top rubbers are made of a special synthetic oil and heat resisting compound. If bottom rubbers are used at the top of the enclosing tubes, trouble with oil leakage will soon be experienced.** Place the push rod enclosing tubes in position. Make sure that the joint faces of the head and barrel are clean, smooth, and have no carbon particles or old jointing compound on them, or a tight joint will not be obtained (no jointing gasket is used). Smear the joint face with jointing compound and drop the head into position, seeing that the push rod enclosing tubes register with the spigots under the head. Insert the four head bolts and tighten down evenly and firmly. Insert the two push rods.

3. Valves (See Figs. B1, 2 and 4).

The valves are held by taper cotters and collars and the springs are easily removed by means of a valve spring compressing tool of the type illustrated (Fig. B2). The method of use is to place the forked end on the valve spring collar, and the pointed end of the screw in the centre of the valve head. Then screw up until the spring is compressed sufficiently to enable the split cotters to be removed.

For grinding the valves another tool for gripping the valve stems is essential. A number of proprietary brands are available but a simple edition can be made from a 4″ length of mild steel bar. This bar is drilled at one end to a depth of about ·75″ with a ·375″ hole to slip over the end of the valve stems. The side of the rod is then drilled and tapped for a $\frac{1}{4}$″ B.S.F. bolt at a point ·375″ from the same end. The far end is drilled diametrically to accommodate a $\frac{3}{16}$″ tommy bar which enables the valve to be twisted after the stem has been nipped by the $\frac{1}{4}$″ B.S.F. bolt.

Scrape all carbon from the valves, taking care not to damage the valve faces. Get the carbon away from the underside of the head where it blends into the stem. Finally, polish up with emery cloth and then grind in the valves on their seats.

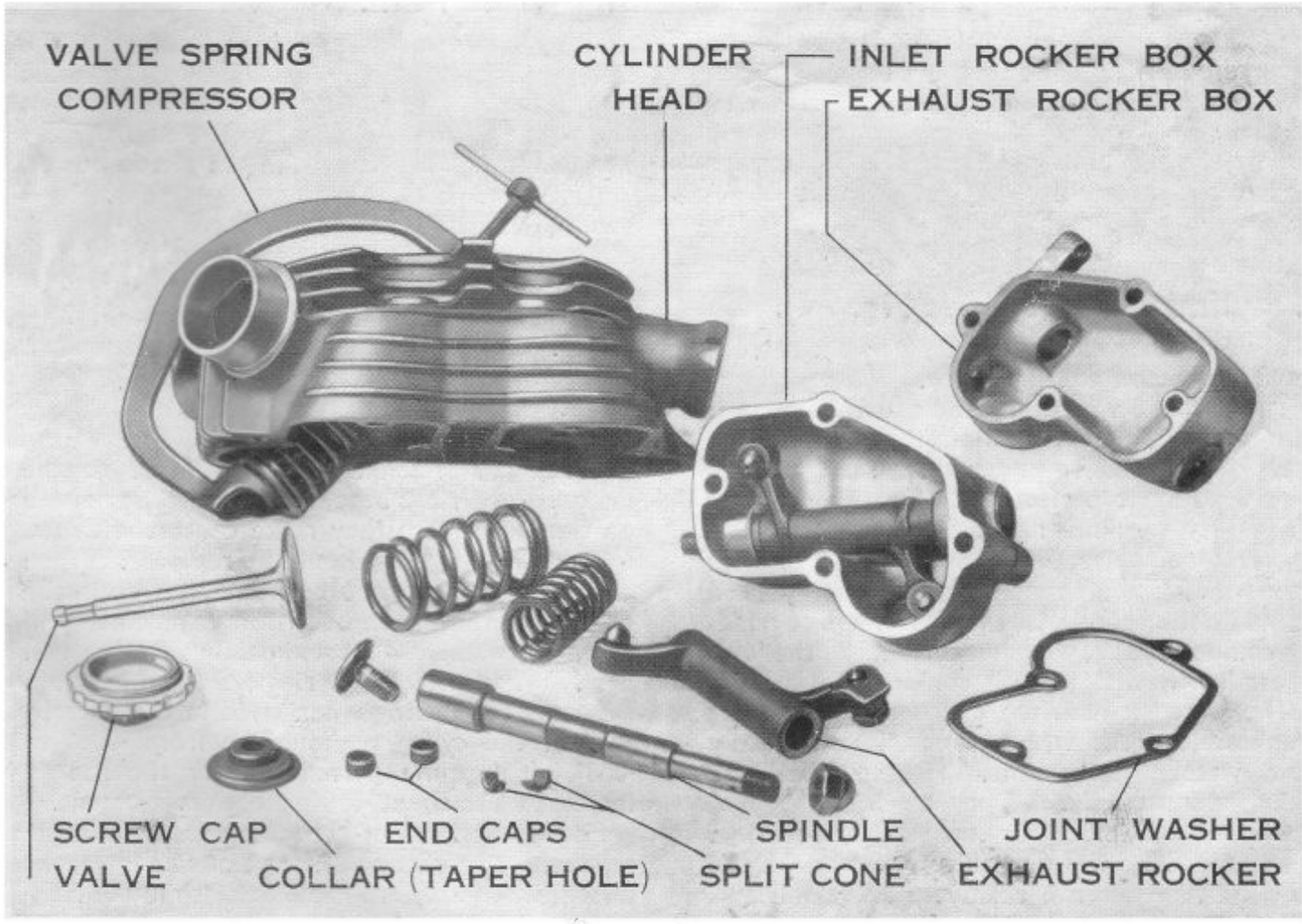

Fig. B2. Method of Removing Valves and view of Rocker Box.

It should not normally be necessary to recut the valve seats and recutting should be avoided so far as possible. If, however, a new valve guide is fitted it may be necessary to cut the seat in order to correct a slight variation in alignment between the new and the old guide. First, however, give the seat a light grinding-in with the valve. If the seating is cleaning up all the way round, do not re-cut. If, however, the seat is only cleaning up on one side, use the seating cutter just enough to give the valve a seating the whole way round ; then grind in the valve in the normal manner.

The valve seat has an angle of 45°.

	Inlet	Exhaust
Valve stem dia. ...	·311—·312in.	·340—·341in.
Valve guide bore dia.	·313—·314in.	·344—·345in.
Clearance ...	·001—·003in.	·003—·005in.

When re-assembling *do not interchange the valves* ; these are stamped IN on the inlet and EX on the exhaust.

Note also that the inner valve spring has a larger diameter at one end which should be fitted over the valve guide thus coming nearest to the cylinder head.

4. Valve Guides.

The valve guides are shouldered and are pressed into the head up to the shoulder. If available, use a press for inserting or removing the guides. If a press is not available a shouldered drift may be used but be very careful to drive-in the guides squarely as they are very brittle, being made of chilled cast iron, and will readily break if strained sideways. The smaller diameter of the drift should have about ·002—·003in. clearance in the guide.

5. Cylinder Barrel (See Fig. B4).

Undo the four base nuts and lift up the barrel ; catch the piston as it falls free.

The joint between the head and the barrel is direct metal to metal, no jointing washer being used. It is therefore necessary to see that both joint faces are in perfect condition. If either one is damaged the joint may be "ground in," like grinding-in a valve, by smearing the face with fine grinding compound and rubbing the head round on the barrel. Clean off all traces of grinding compound and, when ready to make the joint smear lightly with jointing compound.

The joint between the cylinder base and the crankcase is made with a paper washer ; use a new washer each time. Tighten the base fixing nuts securely.

Check the cylinder bore for wear and scoring. A shallow ridge will probably appear at the top of the barrel after a relatively short mileage. This is the upper limit of piston-ring travel. Ignore this ridge unless there are symptoms of engine trouble such as serious loss of compression, heavy piston slap, broken piston rings or high oil consumption.

The cylinder bore (new) is 2·834″—2·835″.

6. Piston Assembly (See Fig. B4).

The piston is secured by a fully floating gudgeon pin which is held in position by spring circlips in grooves in the piston bosses. Remove the circlips by inserting a pointed tool in the slot under the clip and prising out.

Take off the rings and clean the piston by scraping the carbon from the head with an old knife. Burnt oil may also be scraped from the skirt but be careful not to scrape off any metal. Clean carbon from the ring grooves. Do not use emery cloth on the piston. Carefully inspect the piston for damage, *i.e.*, scoring, and cracks ; cracks are most likely to occur on the head and near the gudgeon pin bosses.

The piston is taper and oval. As a guide for fitting purposes the clearances allowed when new, measured on the thrust faces (*i.e.*, *not* the sides of the piston) are as follows :—

In the ring land	·020″—·023″
Immediately below the bottom ring	·010″—·012″
At the bottom of the skirt ...	·003″—·005″

There is only one standard oversize piston, namely, ·020″ oversize.

7. Gudgeon Pin.

The gudgeon pin should be quite free in the small end bush but may be slightly tight in the piston bosses ; it will become free as soon as the piston expands with heat. The circlips must fit firmly into the grooves in the piston bosses. Do not use bent or damaged circlips. It is generally desirable to fit new circlips when the old ones are removed, in order to avoid any possibility of trouble.

The gudgeon pin diameter (new) is ·8110″—·8115″. Oversize pins are not normally supplied.

8. Piston Rings.

Three compression rings are fitted to the piston. If the rings become seriously discoloured on the face where they make contact with the cylinder barrel, they should be replaced. When clean, the rings should be perfectly free in the grooves in the piston but without much up and down movement—approximately ·003″ when new. When fitting new rings, the gap between the ends of the ring when tried in the unworn part of the cylinder should be from ·006″ to ·008″. It is quite permissible for the gap to increase up to about ·030″ before replacement.

Piston rings must be handled with care, especially when fitting to, or removing from, the piston, when they are liable to catch in the ring-grooves. With a little practice, however, they can readily be removed or fitted using an old penknife to ease them out of the ring grooves.

9. Connecting Rod (See Fig. B4).

Test for up and down play in the big end bearing ; there is slight slack when new, but oil in the bearing will probably prevent this being felt. When direct up and down movement becomes very perceptible it is probable that the bearing requires replacement.

The small end of the rod is bushed and the bush must be tight. If a new bush is fitted see that the oil way in the bush is in line with the oil hole in the rod. Ream the bush, after fitting, to ·8120″—·8125″ dia.

It is generally desirable to test the alignment of the small and big end bearings after fitting a new small end bush or if the flywheel assembly has been dismantled. This is most readily done by placing a close fitting mandrel through the small end bush and measuring to the crankcase face. The most accurate results are obtained by placing a pair of parallel ground steel " slips " (rectangular bars) across the mouth of the crankcase, one bar on either side of the connecting rod, and rotating the flywheels until the mandrel rests on the bars. It should touch each bar. If it touches one but not the other the connecting rod should be " set " until the mandrel bears equally on each bar.

The outer race of the big end bearing is replaceable and is a parallel press fit in the rod. When fitting a new race take every care to see that it is pressed-in squarely and not tipped. Use a proper press ; do not squeeze-in between the jaws of a vice.

The big end of the rod should have approximately ·008″—·012″ side play. The amount of play is not adjustable, being controlled by the fact that the flywheels are pulled up to shoulders on the crankpin.

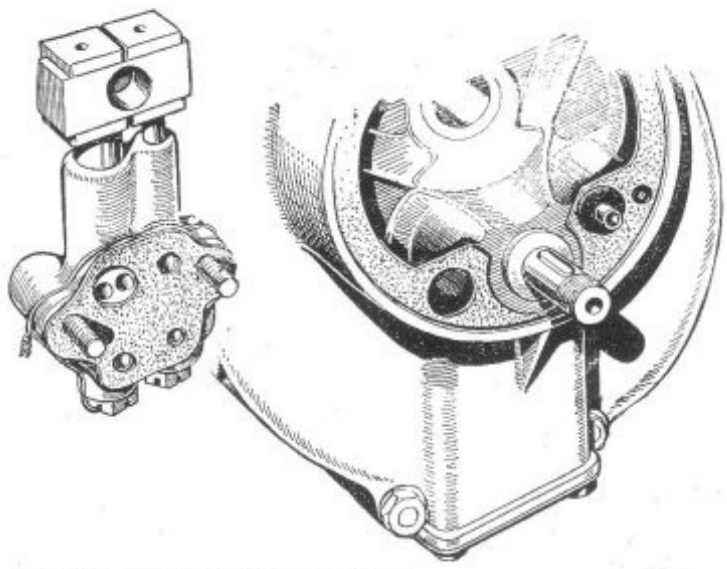

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Fig. B3. The Oil Pump with Joint Washer and extra ·005 washer at return oil pipe joint.

10. Oil Pump (See Figs. B3 and 4).

Bolted on to the outside of the timing case, but inside the magdyno chain cover, is the oil pump. To remove the pump, take off the chain cover and unscrew the two cheese-headed screws in the pump body. Pull away the pump and duralumin driving block.

The manner in which the pump works is described on page C1. Lubrication trouble is nearly always due to faulty oil circulation which, in turn, is mostly due to dirt or air leaks causing poor suction. To test the pump (removed from the engine) hold a finger tightly over the upper oil port in the pump face behind the plunger to be tested and pull up the plunger. Considerable resistance, due to the pump suction, should be felt. Now remove the finger and depress the plunger sharply. The air compressed below the plunger should escape past the spring loaded ball valve with a vigorous " plop " ; work the plunger up and down several times, seeing that a good " plop " is heard each time the plunger descends. These tests should be carried out with the pump oily. Weak suction will be due to either dirt on the ball valve seating or a worn plunger or pump body.

Delivery plunger dia.	·1870″—·1875″
Return ,, ,, ...	·3745″—·3750″
Delivery pump bore dia.	·1875″—·1880″
Return ,, ,, ,,	·3750″—·3755″

Take care when refitting that the paper joint washer is undamaged and replace properly in position so that the holes in the washer correspond with those in the pump body and tighten up the two securing screws evenly and firmly. Occasionally an additional washer, making two instead of one, will be beneficial in making a tight joint.

The duralumin block which operates the pump plungers is fitted so that the chamfered edge of the hole faces inwards towards the back of the crank.

See that the two cupped plugs carrying the 7/32in. ball valves in the bottom of the pump body are tight.

11. Rear Engine Plates.

To remove the plates from crankcase, remove small setbolt through magneto platform into magneto chain case and steady bolt from platform to nearside engine plate. Take out tie bolts through crankcase lugs.

12. Timing Gear (See Fig. B4).

First take off the magdyno as described on page H2. See also Fig. B5.

NAMES OF PARTS IN ENGINE ASSEMBLY, Fig. B4.

1. ROCKER BOX, INLET.
2. CYLINDER HEAD BOLT.
3. ROCKER BOX JOINT WASHER.
4. ROCKER BOX BOLT (LONG).
5. ROCKER BOX BOLT (SHORT).
6. ROCKER BOX (EXHAUST).
7. WASHER FOR LIFTER BUSH.
8. EXHAUST LIFTER COMPLETE.
9. SCREW CAP WASHER.
10. SCREW CAP FOR ROCKER ADJUSTMENT
11. ROCKER LEVER ADJUSTING SCREW.
12. ROCKER SPINDLE.
13. OIL SEAL SCREW WASHER.
14. OIL SEAL SCREW FOR ROCKER SPINDLE.
15. ROCKER LEVER AND FIXED END PIN INLET.
16. ROCKER LEVER AND FIXED END PIN, EXHAUST.
17. DOME NUT FOR ROCKER SPINDLE.
18. FIBRE WASHER FOR ROCKER SPINDLE CONN.
19. OIL FEED PIPE ASSY. TO ROCKERS.
20. WASHER (RUBBER) FOR PUSH ROD COVER (TOP).
21. CYLINDER HEAD.
22. HALLITE WASHER UNDER COLLAR.
23. COLLAR FOR SPRING (PRESSING).
24. VALVE GUIDE, INLET.
25. VALVE, INLET.
26. VALVE SPRING, OUTER.
27. SPLIT CONE (2 HALVES).
28. VALVE SPRING, INNER.
29. COLLAR FOR SPRING (TAPER HOLE).
30. VALVE STEM END CAP.
31. VALVE GUIDE, EXHAUST.
32. VALVE, EXHAUST.
33. PUSH ROD COVER.
34. WASHER (RUBBER) FOR PUSH ROD COVER (BOTTOM).
36. CIRCLIP.
37. GUDGEON PIN.
38. PISTON.
39. CYLINDER BASE WASHER, PAPER.
40. CYLINDER BARREL.
41. PISTON RINGS.
42. MAGDYNO CHAIN COVER.
43. MAGDYNO CHAIN COVER SPROCKET FOR CAMSHAFT.
44. MAGDYNO CHAIN.
45. MAGDYNO CHAIN SPROCKET FOR MAGDYNO
46. JOINT WASHER : GEAR COVER—CHAIN COVER.
47. GEAR COVER.
48. FELT WASHER.
49. STEEL RETAINING WASHER.
50. CAM LEVER.
51. CAM LEVER PIN.
52. CRANKCASE, GEAR SIDE.
53. OIL PURIFIER, CUPPED PLUG.
54. OIL PURIFIER, CENTRE TUBE.
55. CRANKPIN NUT.
56. FLYWHEEL, GEAR SIDE.
57. CONNECTING ROD.
58. CRANKPIN ROLLERS.
59. FLYWHEEL, DRIVE SIDE.
60. CRANKCASE, DRIVE SIDE.
61. DRIVE SIDE SPINDLE.
62. SPROCKET DISTANCE PIECE.
63. SPROCKET.
64. SLIDING MEMBER.
65. SPRING.
66. SPRING PLATE.
67. SPROCKET SECURING NUT.
68. LOCKWASHER.
69. ELBOW UNION, 90°.
70. OIL FEED PIPE TO MAINSHAFT.
71. TIMING PINION.
72. CAM ASSEMBLY.
73. OIL PRESSURE REGULATOR BODY.
74. REGULATOR BODY FIBRE WASHER.
75. OIL PUMP PLUNGER, RETURN.
76. OIL PUMP BODY WITH BALL VALVES.
77. OIL PUMP PLUNGER, DELIVER.
78. OIL PUMP JOINT WASHER, PAPER.
79. OIL PUMP DURALUMIN BLOCK.
80. JOINT WASHER BETWEEN CRANKCASE GEAR COVER.
81. OIL SUMP BASE JOINT WASHER.
82. OIL SUMP BASE.
83. GEAR SIDE SPINDLE.
84. GEAR SPINDLE NUT.
85. CRANKPIN.
86. DRIVE SPINDLE NUT.

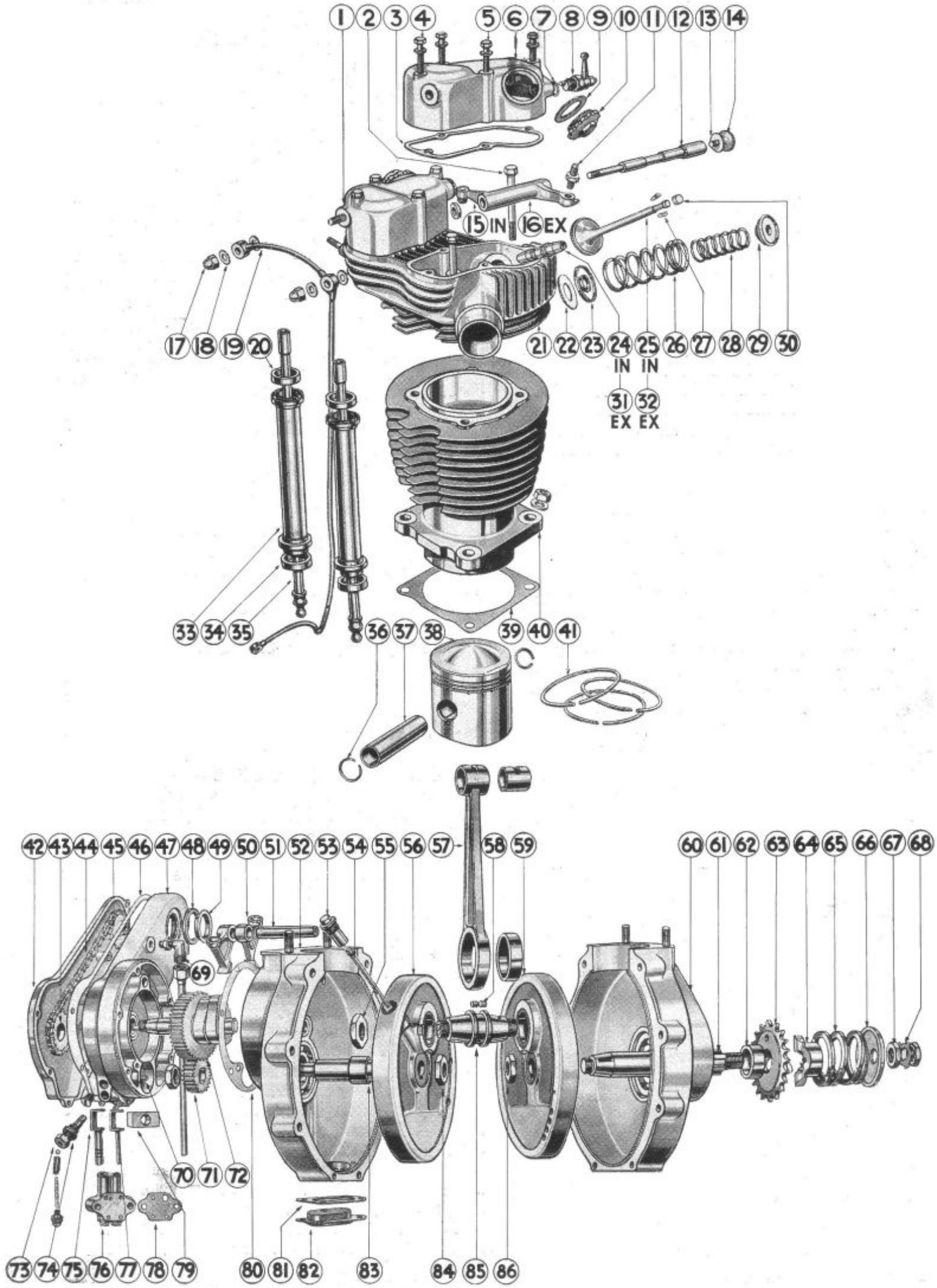

Fig. B4. Exploded View of Engine Assembly.

Undo the five screws holding the gear cover. Press on the end of the cam spindle (so that the camshaft stays in position and the timing gear is not disturbed) and pull the gear cover away from the crankcase ; if it sticks, tap gently on the back of the chain case with a mallet. The camshaft can now be withdrawn and the cam levers pulled off their spindle. The timing pinion is keyed on the parallel shaft ; the securing nut has a left hand thread. Pull the pinion off the shaft with an extractor.

If a new camshaft bush is required, ream after fitting to ·750″ dia. If possible, use a pilot reamer passing through the corresponding bush in the crankcase ; this must be done before the engine is built up. This bush is drilled with an oil hole and also has an oil groove. Press in the bush so that the oil hole registers with the corresponding oil hole through the boss. Note that previous editions of the Maintenance Manual have stated that this bush is not drilled. This was incorrect. This bush is drilled and grooved on all Model W/NG machines.

Examine the timing pinion and cam gear teeth for wear. It must be noted that the teeth will show a slight roughening during early life but this does not increase materially with long use and no replacement should be made simply because of slight tooth roughening. A new part should be fitted only if it appears that the worn part is likely to fail prematurely in service. Also examine the cam levers ; these will probably show slight flats or hollows on the curved pads which rub on the cams. The depth of the case hardening is sufficient to allow for careful stoning if desired, but this is not particularly recommended unless the wear is considerable, as flats will very soon form again in service.

When fitting the timing pinion, make sure that the key is in position. The radiused end of the hole goes on the shaft first ; the nut has a left-hand thread—no lock washer is used. Assemble the cam levers on to the pin ; the inlet lever is fitted first. The radiused pad bears on the cam, with the cupped arm uppermost. Lift the cam levers and insert the cam assembly so that the marked tooth on the cam wheel registers with the marked tooth on the pinion (sometimes the centre dot on the pinion is covered by the nut). The valve timing will then be correct.

The standard timing is as follows. This is measured with the standard tappet adjustment, *i.e.*, no clearance when cold ; see page B9.

Inlet valve opens	...	5° before T.D.C.
Inlet valve closes	...	55° after B.D.C.
Exhaust valve opens	...	60° before B.D.C.
Exhaust valve closes	...	20° after T.D.C.

Before fitting the timing cover see that the short pipe which delivers the oil from the pump into the oil way through the mainshaft is firmly in position and not bent or damaged.

See that the joint faces are clean.

Use a new joint washer, *not forgetting the additional paper washer ·005″ thick*, at the joint connection to the sump.

Get the cheesehead securing screws tight. Fit the breather pipe *behind* the chain case. Also the pipe below the case, if used.

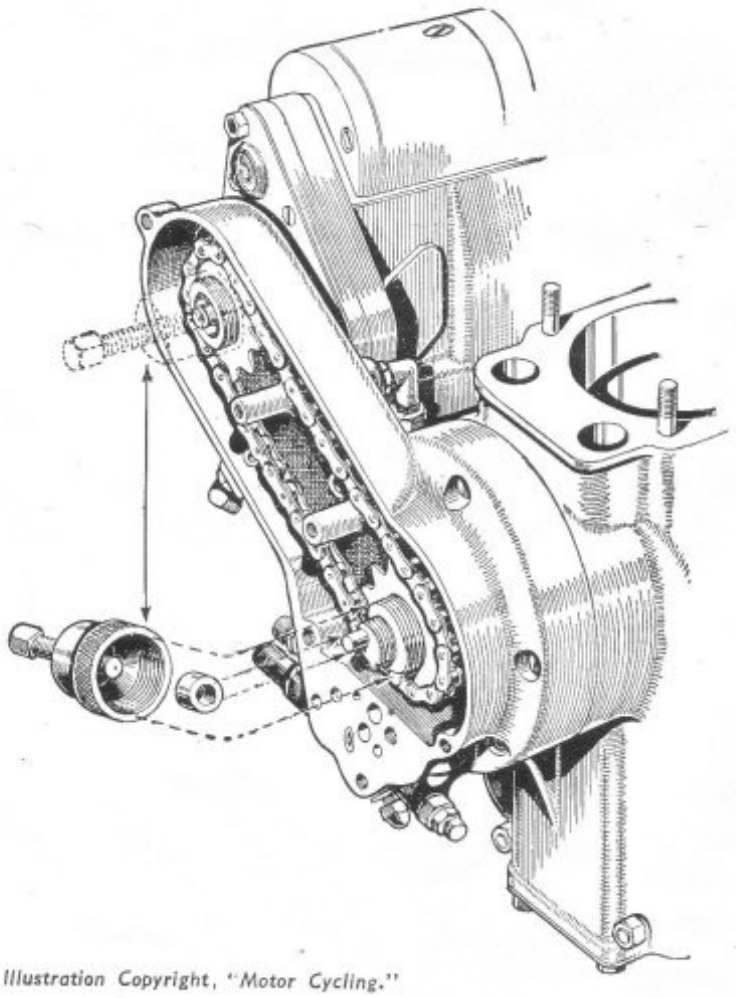

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Fig. B5. Magdyno Sprocket Extractor.

13. Crankcase (See Figs. B4 and 6).

Remove any remaining tie bolts through the crankcase lugs and place the crankcase assembly upright on the bench. Hold one half of the crankcase and give the other half a few gentle taps with a mallet just inside the crankcase mouth so as to drive the two halves apart. Withdraw the flywheel assembly, noting the position of any distance washers on the driving and/or timing side shafts.

The bearings are an interference fit in their housings. They can generally be extracted quite easily by heating the half crankcase and striking it smartly, face downwards, on a flat wooden bench. The circlip locating the outer race in the drive side case must be taken out after the inner race has been removed. Note the distance piece, ·285″ wide, between the two drive side bearings. Do not damage the spigot on the driving side crankcase.

The camshaft bush should be reamed, after fitting, to ·750″ dia. This bush is grooved but is not drilled with an oil hole. Note that previous editions of the Maintenance Manual have stated that this bush is drilled. This was incorrect. This bush is grooved but not drilled on all Model W/NG machines. (See also note re bush in timing case, item 12.)

The cam lever pin should be tight in the case.
Cam lever pin dia. ... ... ·4890″—·4895″
The two halves of the crankcase are spigotted together. When joining together see that there is no "step" between the two halves on the top face where the cylinder fits.

When fitting the flywheels into the crankcase, carefully note that they have from ·008″ to ·012″ end clearance. Hardened packing washers of various thicknesses (gauges 12-17) are supplied for adjustment within reasonable limits. These washers are inserted on either mainshaft as necessary to maintain the flywheel assembly central in the crankcase. The pull of the shock absorber spring will hold the assembly against the drive side ball race.

The copper pipe which projects down into the filter in the sump is driven into the oil hole in the case and must be tight. An air leak will cause the crankcase to flood due to an inefficient oil return. If a new pipe has to be fitted (this should rarely be necessary) be sure after fitting that the oilway is clear.

14. Flywheels (See Fig. B4).

Both mainshafts and crank pin are secured by the usual taper fixing. The mainshafts are also keyed, whilst the crankpin has a peg engaging with a keyway in the timing side flywheel. This ensures that the oil-ways between the timing shaft and the flywheel and between the flywheel and the crankpin register correctly, and that the valve timing will also be correct if the cam-wheel is assembled to the instructions given.

Both crankpin nuts and driving spindle nuts are right-hand thread. Both timing spindle nuts are left-hand thread.

To dismantle the wheels :—

First undo the crankpin nut on the driving side, holding by the driving side flywheel only. Then support the drive side flywheel and press out the crank pin complete with timing side flywheel, etc.

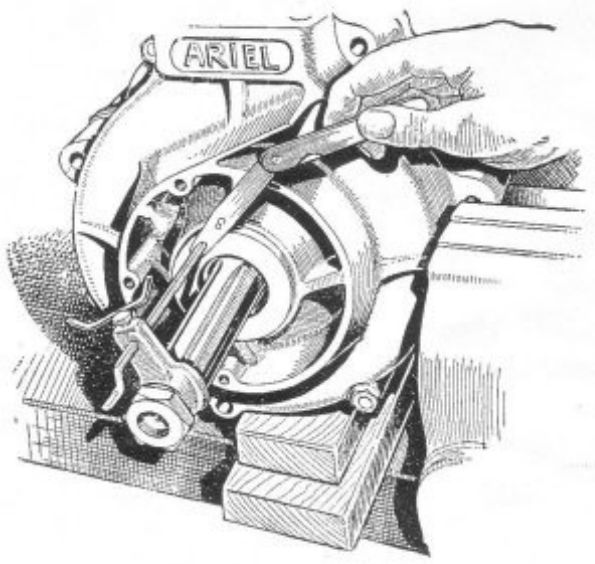

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Fig. B6. Testing End Float with a Pointer and Feeler Gauge.

The connecting rod has a double row roller bearing big end, the hardened steel crank-pin forming the inner member, while the hardened steel outer member is a press fit into the rod and can be renewed complete with crank pin when worn.

To remove the shafts (if required) :—

Undo securing nuts and press out each shaft (taper and keyed fixing). Take out oil purifier plug and tube in the timing side of the flywheel and clean out the oil ways.

The general method of rebuilding is a reversal of the instructions given for dismantling. The following additional information will, however, be valuable.

Fit shaft in each flywheel noting that the Woodruff key is properly located in the driving side wheel and the oilway location peg in the timing side wheel. Be sure the securing nuts are TIGHT. Get plenty of leverage (2 feet) on the special spanner but take care not to distort the threads.

Hold the timing side flywheel securely in a vice and fit the crankpin ; the pegged end with the oil hole in the taper fits into this flywheel. See that the nut is TIGHT.

Remove from vice and assemble to driving side flywheel. A special assembly jig should be used if available.

When trueing up it is more important to get the spindles to run dead true than the outside diameter and sides of the flywheels, although if correctly assembled both should run true. The error in the alignment of the shafts should not exceed ·002″. Fit the oil purifier tube and plug in the timing side flywheel.

After reassembly, check the register of the oilways by forcing oil down the hollow main shaft and seeing that it exudes round the big end bearing.

Note.—If a press is not available for parting the flywheels after the crankpin nut has been undone, they can be parted by driving a large tapered drift in between the wheels, close to the crank-pin. One or two sharp blows with a hammer will immediately force the flywheel off the taper on the crankpin.

Note.—See note on page C3 re omission of the oil purifier tube.

Special Flywheel Jig. (See Fig. B7.)

A special jig is available or may be made if the necessary machine tools are available. This jig consists of a strong base carrying two pedestals $8\frac{1}{4}$″ apart bored in line at a height of 4·9/16″ to a diameter of 2″. Hardened bushes with an inside diameter of 1·001″ are fitted in each bore. The holes in these bushes are there-

fore clearance holes for the mainshafts. The left-hand bush, as shown in the illustration, should be fixed in its pedestal but the other bush, or more properly a sleeve, 8½″ long must be a close sliding fit in the right-hand pedestal. The flywheel assembly is then mounted between the pedestals with the bushes acting as main bearings. A square or vee block, ·750″ wide, placed on the base of the jig, is sufficient to wedge the big end whilst the nuts (timing side first) are tightened. Generally speaking, this ensures the wheels being in line without further checking, but any final trueing can be done by removing the loose jig bush and applying a dial gauge to the exposed mainshaft, later reversing the assembly to obtain a reading from the other shaft.

15. Tappet Adjustment.

With cold engine, remove the rocker adjustment covers, rotate the engine until the piston is near the top of the cylinder with both valves fully closed and slack off the lock nut on the adjusting screw which goes through the end of the rocker arm and bears on the valve stem end cap. Rotate this adjuster until there is just no clearance, then retighten the locknut.

Check the adjustment by testing compression. If this is satisfactory it is clear that the valves are seating correctly. If there is no compression either a valve is being held off its seat through too close adjustment or there is a serious leakage elsewhere. In either case the cause must be found and rectified.

16. Exhaust Valve Lifter.

This may require adjusting occasionally, in which case it should be set by altering the position of the exhaust lifter arm on the eccentric spindle. To break the taper joint between the arm and spindle, undo the nut a couple of turns and give the face of the nut a light sharp blow to drive the spindle inwards.

Leave the Bowden cable connected and turn the engine until both valves are closed. Operate the exhaust lifter lever on the handlebar until the top end of the lifter arm has moved forward approx. ¼″ from the normal "off" position. Now turn the lifter spindle clockwise—screwdriver slot in spindle end—until it makes contact with the rocker and retighten locknut. Always test the adjustment after re-setting the tappets and be sure that the lifter has slight idle movement before it touches the rocker, with valve closed.

Oil leakage through the lifter is probably due to the cork packing washer requiring replacement. To fit a new washer, take off the lifter arm as described, remove the spring washer, shim(s) and cork washer. Fit the new cork washer, shim(s), spring washer and lifter arm. If the spring washer is at all loose fit additional shims between the spring washer and the cork washer.

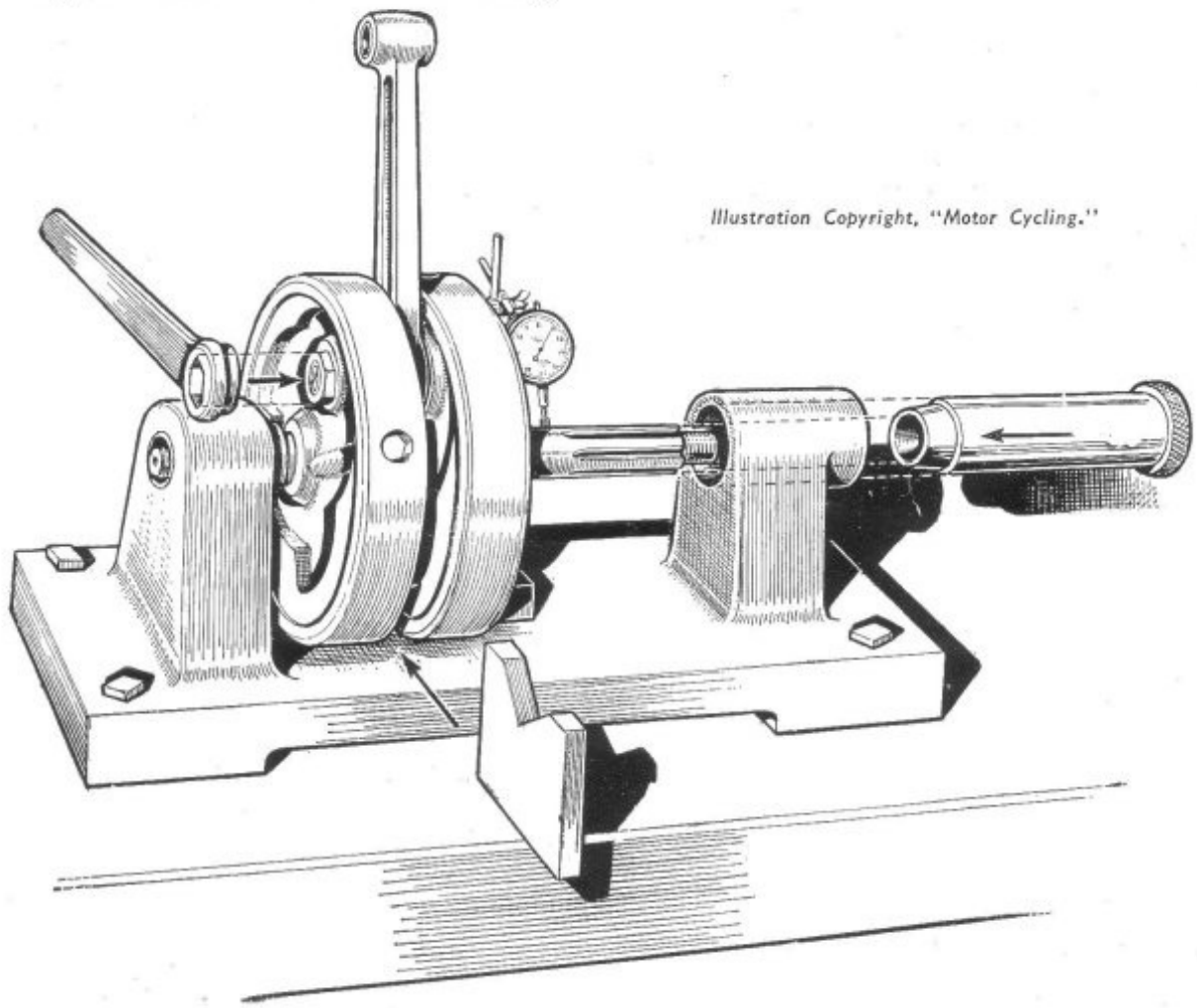

Fig. B7. The special Flywheel Jig. The loose V block is placed under the big-end to prevent the flywheels rotating whilst the crankpin nuts are being tightened.

THE LUBRICATION SYSTEM

(See note 5A on page C3 re Modification to Pressure Regulator).

1. Description of Working (See Fig. C1).

The lubrication system is of the dry sump type and is shown in the sectioned arrangement. It functions as follows :—

Bolted on to the outside of the timing case, but inside the magneto chain case, is the oil pump. This has two plungers working side by side in the phosphor bronze pump body. These two plungers are caused to move up and down by means of a crank on the end of the cam spindle, movement being transmitted from the crank to the plungers through the medium of a sliding block.

The plungers are of different diameters, but both have the same stroke so that one pump can pass more oil than the other. The smaller plunger is the delivery pump ; it draws oil from the tank and passes it through a pipe fixed in the back of the timing cover and projecting into the hollow main-shaft spindle on the timing side. The oil is then forced through the Oil Purifier in the flywheel, into the hollow crank-pin, and so direct to the big-end bearing which is thus receiving a continuous stream of cool, clean oil. Escaping from the big-end, the oil is thrown on to the cylinder walls and piston, lubricating and cooling these ; it then drains down into the crankcase.

Oil spray from the crankcase is forced through vent holes into the timing case and magneto chain case, where it lubricates the timing gear and, after reaching a pre-determined level—which is such that the timing pinion is running in an oil-bath—it then drains back into the crank-case. A spring loaded ball valve in the timing case creates a pressure which forces oil up to the overhead rocker gear for the lubrication of the rockers and valves. This oil then drains down the push rod enclosing tubes into the timing case.

Below the timing gear, at the bottom of the crankcase, is a small sump in which the oil collects after passing through a large filter. It is then pumped back to the tank by the larger pump plunger already described.

2. Flywheel Oil Purifier (See Fig. B4).

The centrifugal Oil Purifier is a mechanical device for separating dust, grit, dirt, etc., from the oil. No matter how clean an oil is used, dirt and grit will get drawn into the engine via the carburetter, and unless this grit is removed immediately, it will help to wear away the bearings. The Ariel Oil Purifier removes this grit as soon as ever it gets into the circulating oil.

The action is as follows : Oil enters the fly-wheel reservoir, about midway along its length, via a tube held in position by the cleaning plug in the flywheel periphery. Due to centrifugal action, grit, etc., is forced *outwards* into the cleaning plug, whilst the cleaned oil passes back through suitable oilways to the crankpin bearing.

The dirt which has collected in the cupped plug should be cleared away about every 5,000 miles. Where the motor cycle is used in particularly dusty conditions the plug should be removed for cleaning at shorter intervals.

NAMES OF PARTS IN LUBRICATION DIAGRAM, Fig. C1.

1. OIL TANK.
2. OIL TANK FILLER CAP.
3. OIL PLUG AND GAUGE.
4. FIBRE WASHER FOR OIL PLUG.
5. DRAIN PLUG.
6. FIBRE WASHER FOR DRAIN PLUG.
7. CLIP (ADJUSTABLE) FOR CONNECTION.
8. RUBBER CONNECTION.
9. CLIP FOR CONNECTION.
10. OIL PIPE WITH NIPPLE AND NUT, DELIVERY.
11. OIL PIPE WITH NIPPLE AND NUT, RETURN.
12. NUT FOR NIPPLE.
13. OIL UNION (DELIVERY—SHORT).
14. OIL UNION (RETURN—LONG).
15. FIBRE WASHER FOR OIL UNION.

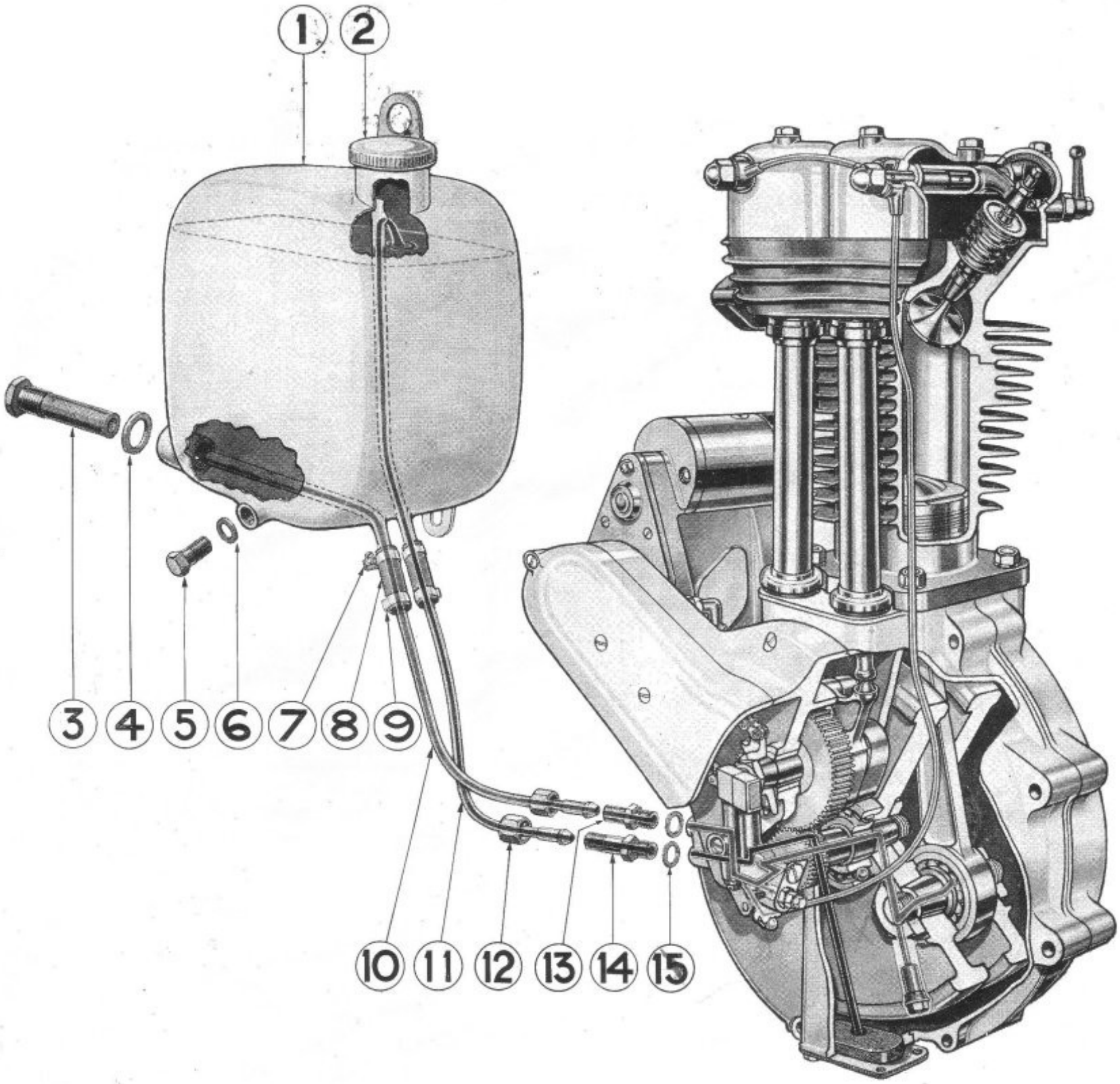

Fig. C1. Diagram of Lubrication System.

To get at the purifier, remove the crankcase sump by undoing the four set bolts, and drop the sump complete with filter. Rotate the engine until the plug is immediately above the sump and then undo the plug. When the plug is removed, the dirt (if present in any quantity) will be found packed quite hard inside the cup formed in the plug, and must be removed with the blade of a penknife. See that the tube is not damaged and if it drops out, replace with the large end in the plug. The plug locates the tube and keeps it in position.

When replacing the plug, see that it is screwed up dead tight. It is locked into position by being slightly bell-mouthed so that it binds in the thread.

The plug can also be removed from the top when the barrel is removed, as for de-carbonising.

Note.—Commencing with Engine No. BH20,310 the oil purifier tube is not fitted. Further, this tube may quite correctly be omitted when re-assembling any early W/NG machines in which the tube may have been fitted. **The plug must still be fitted.**

3. Gauze Oil Filters (See Figs. B4 and 8).

The sump filter should be cleaned whilst detached. When replacing, see that the suction pipe is located in the hole in the top of the gauze and do not forget the joint washer. Wire up the set bolts to prevent loss.

Similar remarks as to cleaning also apply to the filter in the oil tank. Unscrew the plug at the back of the tank, withdraw the filter and clean. When replacing, see that the internal oil pipe is located in the hole in the end of the filter gauze.

4. Oil Level in Tank.

Do not fill the oil tank above the level of one inch below the spout at the top of the return pipe, and do not allow the level to drop lower than about two-thirds full. The more oil there is in the tank, the cooler and cleaner it keeps.

Clean the two filters every time the oil is changed.

5. Oil Pressure (See also item 5A).

On machines up to Engine No. BH13716 inclusive the oil pressure can be varied slightly, but it should be noted that variation in pressure has no effect whatever upon the amount of oil passing into the engine for the lubrication of the big end and main bearings and piston, etc. Varying the pressure will, however, vary the amount of oil being pumped up to the overhead rocker gear.

The pressure is adjusted by means of the hexagon-headed screw immediately above the rocker feed oil pipe where it joins the timing case. Turning the screw clockwise increases the pressure whilst rotating the screw anti-clockwise has the reverse effect.

5A. Modification of Pressure Regulator.

On machines commencing at Engine No. BH.13717, the oil pressure regulator is omitted. The oil passes direct from the delivery pump to the short pipe delivering the oil into the drilled mainshaft. A by-pass oilway makes connection to the pipe conveying oil to the overhead rocker gear. To obtain pressure to force the oil up to the rocker gear, a spring loaded ball valve is incorporated in the gear cover end of the short oil delivery pipe to the mainshaft. Access to the valve is by removal of the pump ; then, with a pair of pliers, draw out the small steel plug in the middle hole. The ball valve takes its seating in this plug. This pressure valve is *not* adjustable.

6. Testing the Oil Flow.

The flow of oil can be tested by removing the plug above the regulator, when, with the engine running, oil will be pumped out at this point instead of passing along the oilways to the mainshaft and big end bearing.

On engines not fitted with the pressure regulator disconnect the lower end of the rocker oil feed pipe ; oil will then be pumped out here.

The oil supply can also be checked by removing the oil filler cap on the tank and seeing that the oil is returned via the return pipe. The oil will come through in a continuous stream for a few seconds when the engine is first started, but the flow will rapidly decrease until the oil is returning in bubbles. This is the normal condition of the returning oil.

7. Oil Feed to Overhead Rocker Gear.

Excess or insufficient oil to the overhead rocker gear is the result of the pressure regulator sticking or a choked oil pipe. Clean the oil feed pipe to the rocker gear and also clean the pressure regulator. The correct assembly of this part is as follows :—

(*a*) Steel ball.
(*b*) Ferrule—closed end next ball.
(c) Spring—fitting inside ferrule.
(*d*) Adjusting screw and locknut.

See item 5A for assembly of fixed pressure valve.

8. Heavy Increase in Oil Consumption together with a Smoky Exhaust.

A sudden increase in oil consumption or heavy smoking from the exhaust pipe is generally due to the scavenging oil pump having failed due to dirt on the pump ball valve. The pump valves should be cleaned and if the lubrication system appears dirty, the whole system should be carefully flushed out.

Other points likely to lead to a sudden increase in oil consumption are as follows :—

(1) Badly worn piston, piston rings or cylinder barrel or damage due to seizure.

(2) Air leaks in the return oil circuit. Check the following points :—

(*a*) The sump pipe may be loose in the crankcase ; make sure that this pipe is quite tight.

(*b*) The pump body may not be a good fit on the face of the timing cover. See that a paper washer is fitted, that the holes in the washer register with the pump ports, and that the securing screws are done up tightly. Occasionally two joint paper washers will be advantageous.

(*c*) An air leak at the joint between the back of the timing cover and the boss on the crankcase ; this is at the point where the oil return pipe projects from the boss which is inside the timing case. It will be noted from the instructions on page 10 that an extra ·005" washer should be fitted at this point. It may happen that after the engine has done some fairly considerable mileage, the timing cover will take a slight " set " away from the crankcase, so that even though an extra washer is inserted here as instructed, the joint may not be perfectly tight. *Remedy.*—Insert another washer—that is, a total of two extra washers. Extra washers at this point should not be overdone or the timing cover will be strained.

(*d*) A partial stoppage in the return oil system.

(*e*) A worn pump—this should be repaired or replaced.

9. Loss of Oil via Lower Breather Pipe.

Loss through the breather pipe under the magdyno chain case may be due to inefficiency in the oil return, or it may be simply that the connecting union requires screwing in further. Screw the union up as far as it will go and see that the non-return ball valve is in position. This valve consists of a quarter-inch steel ball dropped into the outer end of the union followed by a split brass ring which is held in position by the end of the nipple on the breather pipe.

On machines commencing at engine No. BH13717 the lower breather pipe is omitted. On earlier machines it is recommended, when convenient, that the lower breather pipe should be dispensed with, the hole in the timing case being closed with a plug (spares No. S22-4). If this is done the 90° elbow union holding the breather behind the case **must** be replaced by the later pattern (spares No. 2073C-41). On this later union the ball valve is held in position by a pin instead of by a split ring.

THE CLUTCH ASSEMBLY

1. Clutch Adjustment (See Fig. D1).

Adjustment to the clutch plates and springs is rarely necessary, and the spring plate tension is correct when the ends of the springs are just visible when looking across the face of the spring plate. This gives ample pressure to ensure efficient clutch grip. If the screws are tightened more it makes clutch withdrawal unnecessarily heavy. After adjusting the clutch, see that the spring plate lifts equally ; if not, the nuts should be eased off on the low side or tightened on the high side until it does.

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

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

If the plunger is pulled out take care not to lose the ball which comes between the ends of the clutch rod and the adjusting screw.

2. Clutch Plates—Removal and Re-assembly.* (See Fig. D3).

Remove the clutch dome held by four screws, and then undo the five spring retaining nuts projecting through the spring plate, when the clutch plates can be withdrawn. Care should be taken to re-assemble them in the correct order. The first plate to be put in is a plain plate, then a fabric insert plate, and a plain plate alternately, finishing with a plain plate. The heads of the spring retaining nuts should stand slightly proud of the spring plate (see adjustment, Item 1).

3. Removal of the Clutch Body and Sprocket.* (See Fig. D3).

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

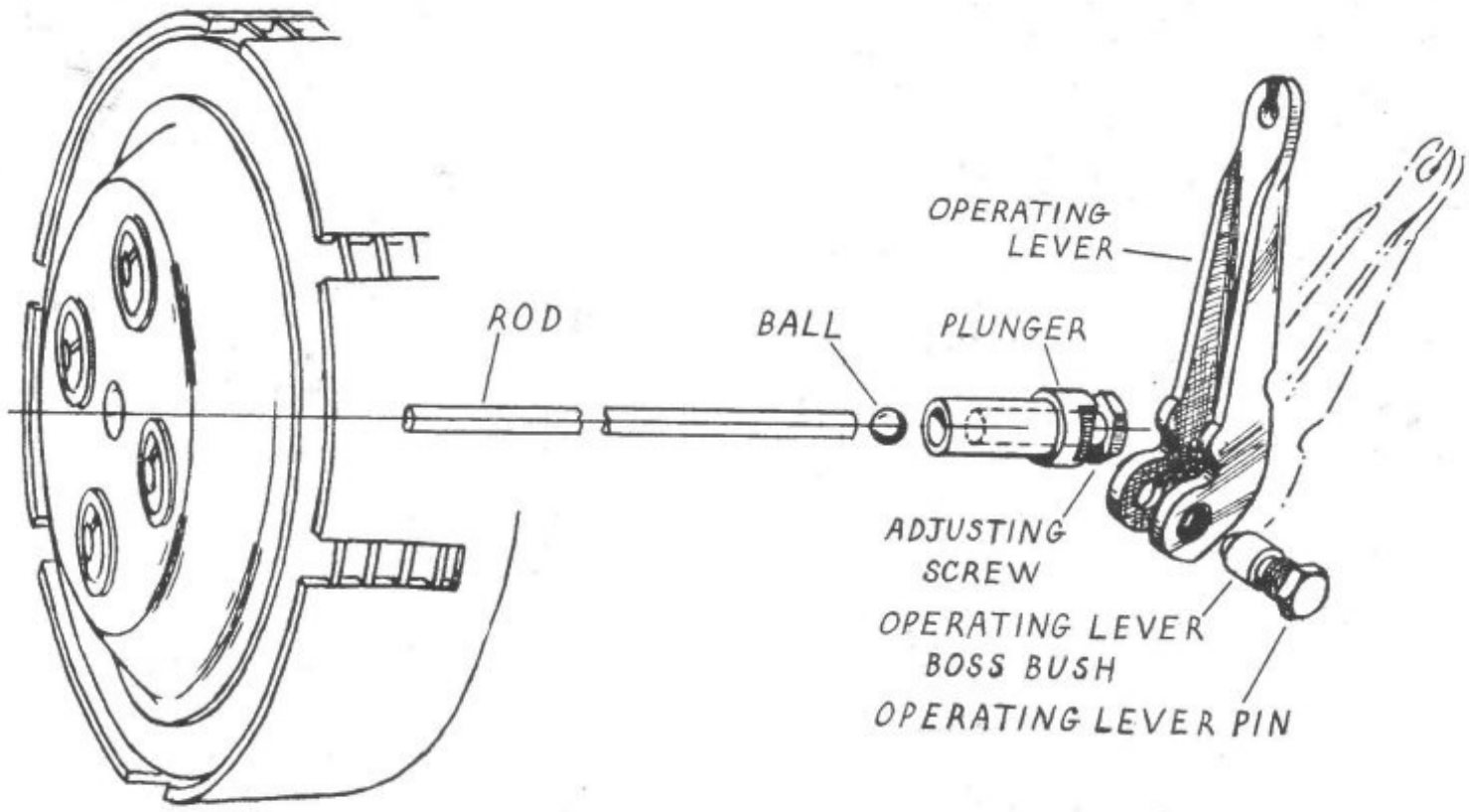

Fig. D1. Clutch Withdrawal Adjustment.

washer locking the six set bolts in the centre of the housing and take out the bolts ; the outer housing is now free. To remove the sprocket take off the outer half of the oilbath case when the sprocket with sleeve and needle roller bearing can be slipped off the shaft. Note that the rollers are not held in the cage and can therefore drop out when the sprocket is pulled off the shaft. When refitting these parts stick the rollers into the cage with a little grease. A plain washer fits *behind* the roller race and a tongued washer *outside* the race, next the clutch sprocket. Sometimes a tab washer is also fitted *behind* the outer clutch housing. This is used simply as a packing washer to increase the clearance between the clutch housing and the chain case.

When reassembling be absolutely sure that the six set bolts are screwed right home and that they are locked in position by the circular tab washer. Also do up the mainshaft nut, securing the clutch centre, dead tight. A lock washer is provided on the later machines. If not already incorporated, one of these lock washers (spares No. 3070-41) should be procured and fitted. It is most important to keep the clutch centre securely locked to the mainshaft.

** These instructions apply to machines fitted with aluminium Primary Chain cases. The actual clutch assembly is exactly the same on machines fitted with pressed steel chain cases but one or two small differences in assembly due to the steel chain case are dealt with on page D9.*

THE GEARBOX

1. Removing Gearbox from Frame.

Disconnect battery leads and remove battery.

Remove near side footrest.

Unscrew rear brake rod wing nut and allow brake pedal to fall below primary chain case.

Remove clutch dome, dismantle clutch (see page D1) and remove clutch centre and clutch case.

Take off outer half of primary chain case. Note the small round paper joint washer between the two halves of the case, at the footrest boss.

Disconnect primary chain and draw clutch sprocket off mainshaft, taking care not to lose rollers out of bronze cage.

Disconnect clutch cable and push out clutch operating rod with plunger and adjuster towards the off-side, in order to prevent loss or damage.

Undo two $\frac{1}{4}$" bolts securing battery carrier to the engine plate and remove the carrier.

Remove gearbox clamp bolt (top—$\frac{1}{2}$" dia.) towards the offside and loosen gearbox adjuster. Slacken the tie bolts through the rear engine plates and seat tube lugs and also through the plates and crankcase lugs to give the gearbox clamping lug some play between the plates.

Remove gearbox pivot bolt at bottom and take out box towards the off side.

2. Dismantling the Box (See Fig. D3).

First remove the clutch and clutch sprocket assembly, as already described. Next undo the nuts holding the gearbox outer cover and pull away the cover complete with the foot control operating mechanism and kick-start lever. Now unscrew the nut on the end of the mainshaft and pull off the ratchet pinion and sleeve. Undo the nuts holding the inner case and pull this away from the main gearbox casing, taking care not to lose the 12 rollers forming the roller race on the gear operating camshaft. (A bronze bush is used in place of the roller race on later machines.) Now unscrew the pawl spring plug at the bottom of the gearbox and take out the pawl spring, after which the entire gear assembly together with camshaft and operating forks can be removed from the gearbox *en bloc*. It may be found easier if the mainshaft is first pulled out from the clutch end.

The driving gear, ball bearing and rear sprocket are now left in the gearbox case. To remove these, hold the sprocket so that it cannot rotate and undo the large nut securing the sprocket to the driving gear sleeve. It will be noted that the nut is locked in position by punching the metal into the castellations of the driving gear. A new nut should therefore be used when reassembling. (On later machines a lock washer is used instead of punching, and a new nut would not be required.) The driving gear will push through into the gearbox case whilst the ball bearing can be taken out after removing the spring circlip and dust packing.

A good method of holding the sprocket is as follows: Procure a scrap mainshaft and grind two flats on the part which carries the clutch roller race. Hold the mainshaft upright, clutch end at the bottom, and grip the two flats in a vice. Now take the sliding gear and slip this on to the shaft with a larger end (second gear pinion) on top. If the gearbox is slipped over the shaft the dogs on the second gear pinion will engage with the dogs on the driving gear thus holding the driving gear and sprocket quite firm whilst the nut is unscrewed.

An alternative method is to hold the sprocket with a length of chain but this is not so rigid or convenient as the method described.

If the operating forks are removed from the camshaft, note that the two forks are different, the one with the long fork operating the gear clutch on the layshaft.

3. Re-assembling the Box (See Fig. D3).

Re-assembly is straightforward, but it will be found easiest to make a complete sub-assembly of the layshaft with gears, mainshaft gears

(except driving gear which is already in the box) and camshaft and fork assembly, after which the whole assembly can be fed together into the gearbox shell. The mainshaft is then inserted through the driving gear. The rollers for the cam spindle should be held in place with thick grease whilst the Inner Gearbox Cover is fitted.

The mainshaft should have 1/64" – 1/32" end play when the K.S. ratchet assembly has been fitted and secured with the nut on the end of the shaft. If the end float is excessive, it can be taken up by countersinking the securing nut so that its inner face projects over the shoulder on the shaft and forces the ratchet further along the shaft. It is inadvisable to use shims for adjusting end float.

When assembling the toothed ratchet of the gear control mechanism with the gear on the end of the camshaft, see that the marked teeth on the two members are assembled together, otherwise the gears will not be in correct register. Whilst it is quite possible to reassemble the foot control mechanism in one complete unit with the end cover, it will probably generally be found simpler to reassemble first the pawl, ratchet, operating plate and spring box, after which the outer case and foot control lever can be put back into position.

4. Foot Gear Change Mechanism. (See Fig. D2).

This mechanism is very simple and strong although it may appear somewhat complex. The action is as follows: The foot change lever bush (F.C.L. bush) is fitted with the rectangular extension inside the gearbox outer cover and is secured by the foot change lever bush bolt (F.C.L.B. bolt), the plain end of which projects into the spring box between the two main springs. The spring box and control quadrant are carried on the ratchet sleeve; the box, however, is free, whilst the quadrant is fixed on splines. The foot change lever fits on the fine splines at the outer end. The sector and ratchet assembly (rivetted together) with toothed quadrant, is positively fixed to the sector spindle which passes through the ratchet sleeve and carries the movable indicator on the outer end. The peg A, firmly fixed in the control quadrant, has one end located between the pawl springs in the spring box, and the other end located in the slot in the pawl. The pawl is pivotted on the peg B which is firmly fixed in the spring box and which passes through a slot in the control quadrant.

When the footchange lever is moved it rotates the ratchet sleeve and the control quad-

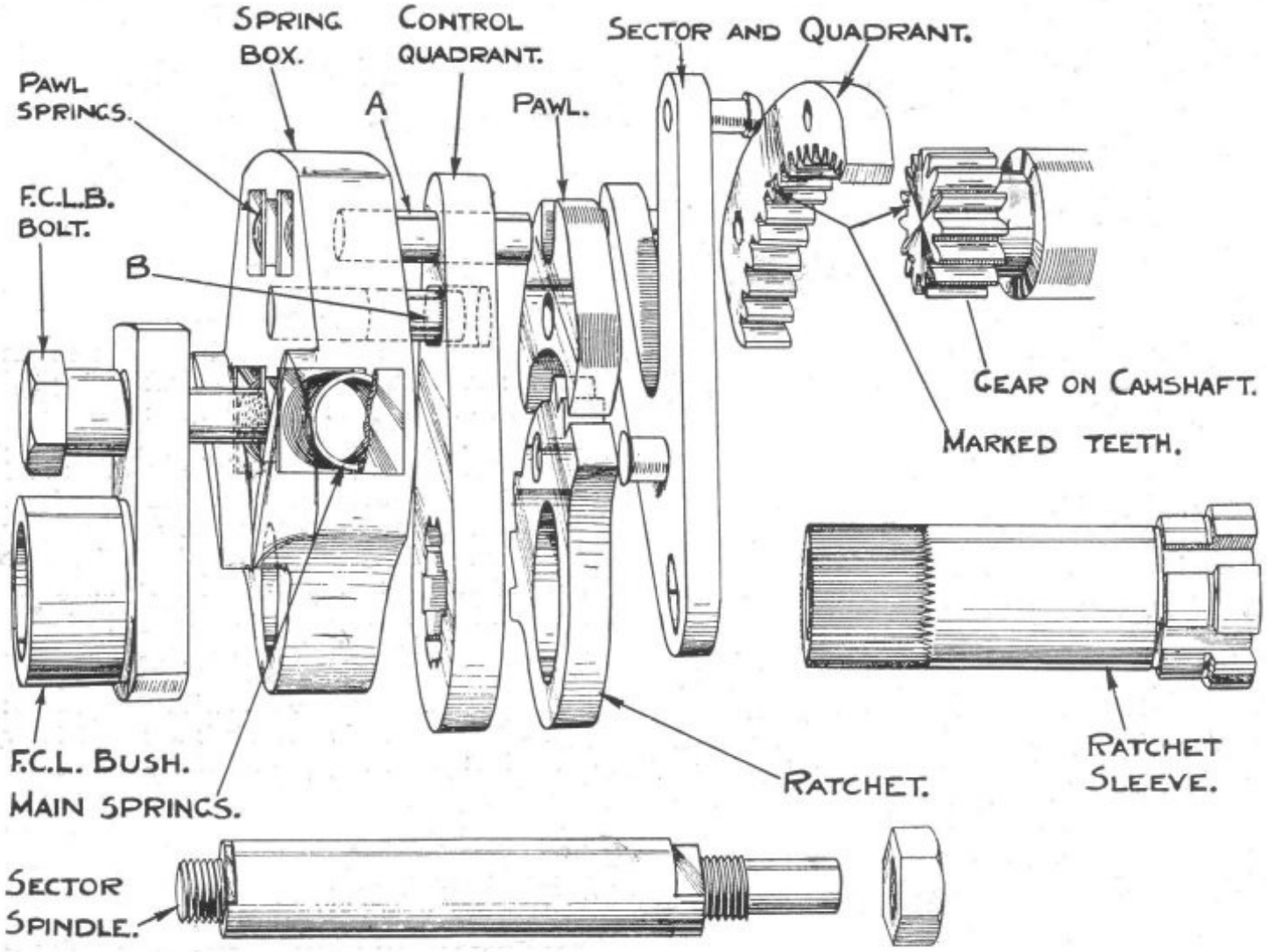

Fig. D2. Exploded arrangement of Foot Gear Change Mechanism.

rant which is splined on to it. The peg A, fixed in the control quadrant, tips the pawl round the peg B until it engages with the ratchet after which continued movement of the control quadrant causes the whole assembly of control quadrant, sector and spring box, etc. to move until one of the flanges on the side of the spring box comes up against the rectangular extension of the F.C.L. bush. This movement is transferred from the sector and quadrant to the gear on the camshaft causing rotation of the camshaft and movement of the gears.

As soon as the foot change lever is released, the main springs in the spring box return the assembly to the central position, and the pawl springs disengage the pawl from the ratchet.

5. Kickstarter Lever Return Spring.

Make sure that the spring has sufficient tension to bring the lever back to the upright position, where it should be held firmly by the spring catch. Early machines did not have the spring catch, which should, however, be fitted to all such earlier machines.

If the spring is weak, the tension must be increased or, if the spring has broken, it must be replaced. The general procedure is the same.

1. Disconnect clutch cable at gearbox end and loosen off-side footrest and swing out of the way.
2. Take off foot change lever and remove pinch bolt through kickstarter lever.
3. Remove six nuts securing gearbox outer cover.
4. Hold kickstarter lever and pull off outer cover with kickstarter and foot change mechanism. Withdraw clutch operating plunger and take care not to lose ball between adjusting screw and clutch rod.
5. If the spring is only insufficiently tensioned proceed as detailed in item 6.
   If the spring is broken or has to be replaced, pull the kickstarter lever off the splined shaft and push the shaft and quadrant out of the cover. Remove the old spring. Take the new spring and remove the binding wire. Hold the quadrant and shaft assembly with the splined end of the shaft towards you and the quadrant hanging down. Slip the spring on to the shaft so that the inner end engages with the lowest of the slots next the quadrant, *i.e.*, slot at 6 o'clock. See that the spring is the right way round ; the coils should run clockwise from the centre to the outside of the spring. Slip the shaft through the bush in the outer cover and place the looped outer end of the spring over the peg in the outer cover. Place the kickstarter lever on the spindle and wind-up for 1½ to 2 turns. The actual amount may vary with different springs. Finish up so that the quadrant is in the normal "out of action" position (*i.e.*, below the shaft as at the commencement of fitting the new spring) with the cover held in the normal horizontal position. Now give a further half turn equivalent to depressing the K.S. lever to start the engine. The spring must not close solid but must exert enough tension to return the lever smartly to the normal upright position.
6. If the spring coils close up solid, unwind the spring, place the inner end one or two slots to the left (clockwise) and refit as described in 5. If the spring has insufficient tension move the inner end one or two slots to the right (anti-clockwise) and refit.
7. Refit the gear control mechanism (see p. D3, item 3) into the inner end cover and replace cover and bolt up.
8. Fit foot change lever, bolt up K.S. lever and re-assemble clutch withdrawal. Put footrest into position and tighten.

6. Lubrication.

Check the oil level with a dipstick inserted through the filling orifice in top of gearbox, behind the foot starter lever. The correct level is approximately 2½-ins. below filler orifice. Use oil C.600. The oil may be poured in through the filling orifice or it may be injected with a gun, through the grease nipple just in front of the filler (point 16).

NAMES OF PARTS IN GEARBOX ASSEMBLY, Fig. D3.

1. SECTOR SPINDLE BUSH.
2. GEARBOX COVER (INNER).
3. CAMSHAFT BUSH (K.S. CASE).
4. GEARBOX COVER STUD.
5. LAYSHAFT SPINDLE BUSH.
6. MAINSHAFT BEARING.
7. K.S. SPINDLE BUSH (INNER).
8. K.S. STOP PEG RUBBER.
9. K.S. SPINDLE.
10. K.S. QUADRANT.
11. K.S. SPINDLE.
12. K.S. SPINDLE GREASE NIPPLE.
13. LAYSHAFT SPINDLE.
14. K.S. LEVER.
15. THIRD GEAR, LAYSHAFT.
16. FIRST GEAR, LAYSHAFT.
17. LAYSHAFT CLUTCH.
18. K.S. LEVER PEDAL.
19. SECOND GEAR, LAYSHAFT.
20. LAYSHAFT SMALL GEAR.
21. OPERATING FORK (LAYSHAFT).
22. OPERATING FORK (MAINSHAFT).
23. GEARBOX STUD.
24. GEARBOX SHELL.
25. DRIVING GEAR BEARING.
26. BEARING RETAINING RING.
27. DRIVING GEAR INNER WASHER (LIPPED).
28. DRIVING GEAR FELT WASHER.
29. DRIVING SPROCKET SPACING COLLAR.
30. DRIVING GEAR OUTER WASHER (FLAT).
31. DRIVING GEAR LOCATING RING (SPLIT).
32. DRIVING SPROCKET.
33. DRIVING GEAR NUT.
34. SECTOR SPINDLE.
35. GEAR SECTOR, QUADRANT AND RATCHET ASSY.
36. PAWL.
37. CONTROL QUADRANT.
38. RATCHET SLEEVE.
39. CAMSHAFT ROLLERS.
40. PINION FORMED ON CAMSHAFT.
41. RATCHET NUT.
42. DRIVING RATCHET.
43. RATCHET PINION.
44. RATCHET PINION SPRING.
45. THIRD GEAR MAINSHAFT.
46. OPERATING PEG.
47. MAINSHAFT SLIDING GEAR.
48. DRIVING GEAR.
49. CAMSHAFT.
50. GEARBOX GREASE NIPPLE.
51. GEARBOX FILLER PLUG.
52. GEARBOX ADJUSTMENT PEG.
53. CLUTCH OPERATING ROD.
54. CLUTCH OPERATING PLUNGER.
55. CLUTCH OPERATING LEVER.
56. MAIN SPRING.
57. PAWL SPRING.
58. SPRING BOX.
59. COVER PLATE FOR SPRING BOX.
60. FOOT CONTROL LEVER.
61. FOOT CONTROL LEVER RUBBER.
62. CLUTCH SPRING ADJUSTING NUT.
63. CLUTCH SPRING.
64. CLUTCH SPRING CUP.
65. SPRING PLATE.
66. CLUTCH PLAIN PLATE.
67. CLUTCH PLATE FITTED FABRIC INSERTS.
68. FABRIC INSERT.
69. CLUTCH SPRING STUD.
70. CLUTCH CENTRE.
71. CHAIN WHEEL CENTRE BOLT.
72. CHAIN WHEEL CENTRE TAB WASHER.
73. CLUTCH CASE.
74. CLUTCH CASE BAND.
75. MAINSHAFT NUT, CLUTCH END.
76. MAINSHAFT NUT PLAIN WASHER.
77. THRUST WASHER (KEYED).
78. NEEDLE ROLLER CAGE.
79. THRUST WASHER (PLAIN).
80. NEEDLE ROLLER.
81. CHAIN WHEEL.
82. MAINSHAFT NUT LOCK WASHER.

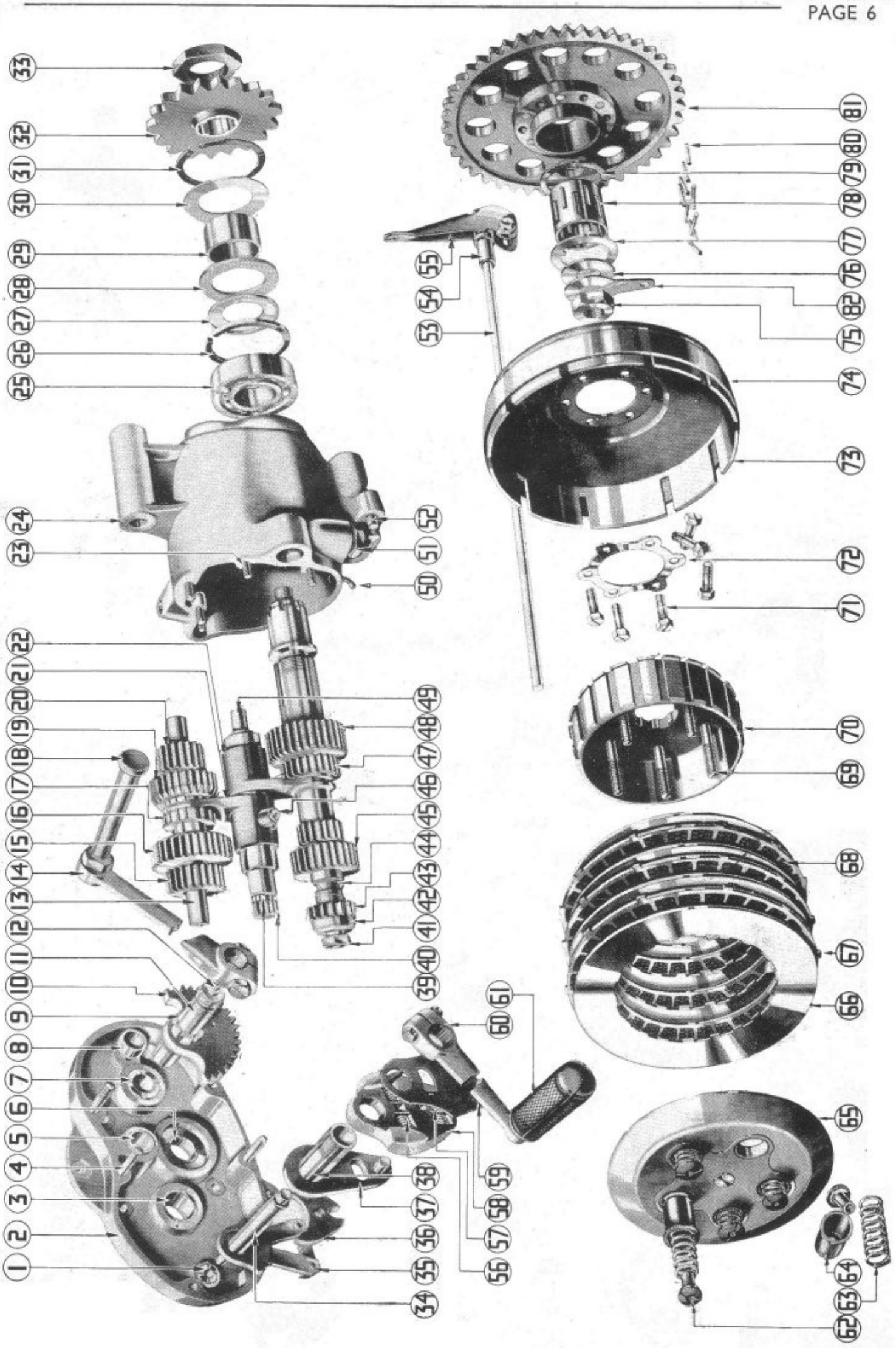

Fig. D3. Exploded View of Gearbox Assembly.

THE TRANSMISSION

1. Primary Chain ($\frac{1}{2}$" x ·305" x 80 Pitches.)

The method of removal and replacement is indicated on page B1.

Chain adjustment is effected by swinging the gearbox, which is pivot mounted, back or forward as required. Slack off the pivot bolt which is below the gearbox and which passes through the two lugs on the cradle tubes ; similarly, slack off the clamp bolt passing through the engine plates above the gearbox. At the top rear extremity of the offside engine plate will be found the draw bolt adjuster ; rotating the nut on the draw bolt swings the box about the pivot bolt, varying the chain tension. Adjust until the primary chain has approximately $\frac{3}{8}$" up and down movement midway between the sprockets, at the tightest point. Retighten clamp bolt and pivot bolt.

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

2. Rear Chain. ($\frac{5}{8}$" x $\frac{3}{8}$" x 92 pitches.)

The spring clip is fitted on the inner side of the chain, in order to prevent it touching the back of the primary chain case and possibly becoming displaced. It is quite accessible through the rear wheel spokes. The open end of the spring clip must always *follow* the closed end when the chain is running in the normal direction.

To adjust the chain, slack off the two rear wheel spindle nuts E (Fig. E3) and loosen the nut securing the brake anchor bar to the brake plate ; then adjust by rotating the screw adjusters K ; turn each adjuster by an equal amount. The chain should have approximately $\frac{5}{8}$" movement at the tightest point midway between the sprockets. After making the adjustment, tighten up the spindle nuts, the locknuts on the adjusting screws and the brake anchor bar nut. Adjust the rear brake if necessary ; see brake adjustment, p. E5.

3. Chain Lubrication.

The primary chain is lubricated by dipping into the oil in the case. Maintain the oil level up to the " Oil Level Plug," but do not overfill or the oil may be thrown out of the case where the gearbox mainshaft enters. The oil level is *not* maintained by the engine lubrication system. No drain plug is fitted and if it is desired to drain off the oil, the outer half of the chaincase must be removed.

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

As the rear chain is not enclosed it will collect mud and dirt and should be removed periodically for thorough cleaning. Soak the chain in a tin of paraffin and then scrub with a stiff brush to remove all dirt. A final wash in clean paraffin to swill off all loose grit, is very desirable. The chain should then be immersed in a bath of molten tallow and moved about for several minutes to enable the tallow to work into the joints. Then hang up to enable the surplus tallow to drain off.

If tallow is not available, engine or gear oil may be used but the effect will not be so lasting.

4. Chain Rivet Extractor (See Fig. D4).

The Pennant type of rivet extractor is illustrated in Fig. D4. To use, screw up the punch, press down the lever on the side plate to open

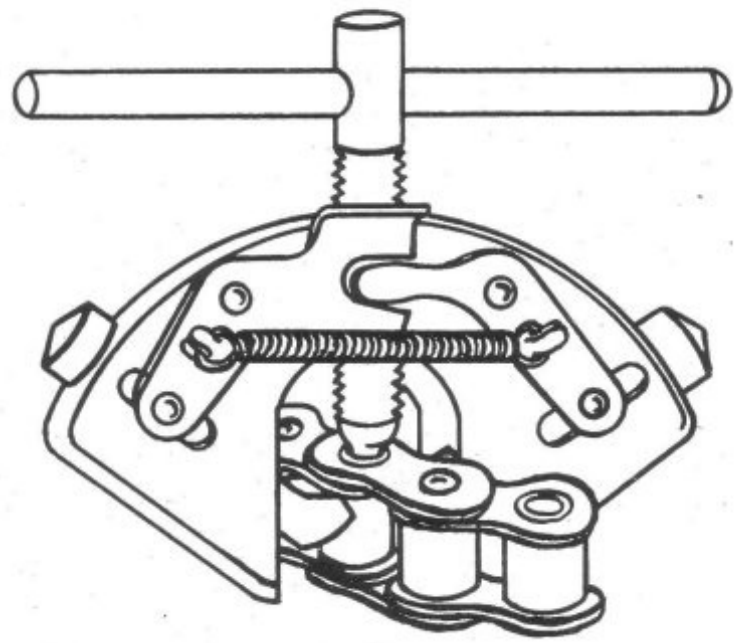

Fig. D4.

the sliding jaws, place the chain roller between the jaws and release the lever so that the jaws close on to the roller and support the side plate. Screw down the punch until the rivet head is forced through the top or outer plate.

5. Chain Alterations and Repairs (See Fig. D4).

The illustration, Fig. D5, shows a short length of chain ending in a plain inner link at the left hand end and a cranked link at the right hand end ; the various parts are lettered for reference as under :—

A. Roller.
B. Inner plate.
C. Outer plate.
D, E, F, G, H, Rivets.

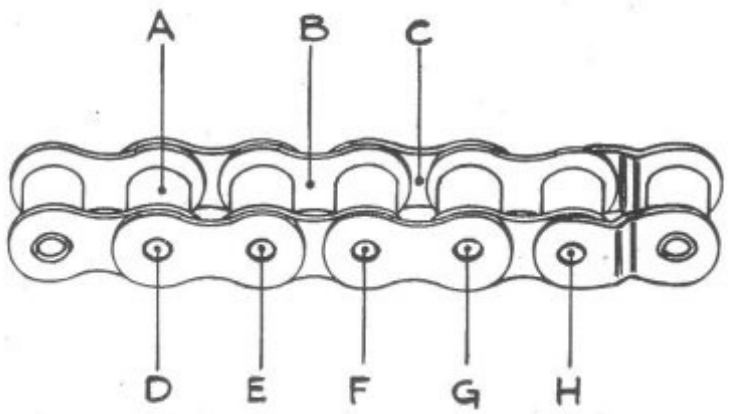

Fig. D5. Length of Chain with Cranked Link.

(a) **Broken Roller or Damaged Inner Plate.**
Should a roller A, or an inner plate B, become damaged, it is necessary to replace the the inner link. To remove the inner link B, extract the four rivets D, E, F, G; these are the two rivets passing through the damaged inner link, and the two adjacent rivets. The damaged inner link and the two pairs of outer plates are then replaced by the triple connecting link (Fig. D6), i.e., a double connecting link plus a single connecting link.

No attempt should be made to replace rollers only ; remove and replace the inner link complete.

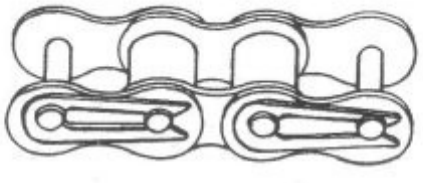

Fig. D6. Triple Connecting Link.

(b) **Broken or Damaged Outer Plate.**
If an outer plate C is damaged, remove the rivets F and G and replace with a single connecting link (Fig. D7).

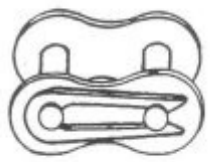

Fig. D7. Single Connecting Link.

(c) **To Shorten a Chain having a Cranked Link at one end.**
Remove the rivet H (securing the cranked link), take out the cranked link and join the ends of the chain with a single connecting link (Fig. D7).

(d) **To shorten a Chain not containing a Cranked Link.**
Extract the third and fourth rivets (F and G) counting from the joint (left hand end of chain in Fig. D5) and join up the chain by using the double cranked link (Fig. D8) and single connecting link (Fig. D7).

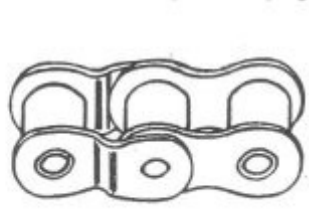

Fig. D8. Double Cranked Link.

(e) **Fitting Spring Clips.**
Care should be taken when fitting spring clips not to strain them unduly, they must be slid into position and no attempt made to spring them over the tops of the rivets. When connecting up, put the loose outer plate in position (never try to run a chain without it), place the large end of the slot in the clip over one of the rivets, engage the points with the groove in the other rivet and slide the clip until it springs home around the rivet.

It is essential to fit spring clips with the closed end pointing in the direction of motion ; should any fouling occur the tendency then is to retain them in position rather than to dislodge them.

To remove a spring clip, press against the points with a coin or screwdriver.

When a clip is removed after having been in use for some time, it is advisable to replace it by a new one.

THE PRIMARY CHAIN CASE

1. The Aluminium Case. The aluminium chaincase requires little description. It consists of outer and inner halves with a detachable dome over the clutch. The dome is secured to the outer half by four cheese-head screws, one of which passes through into the back half. The clutch may be dismantled (see page D1) after removing the dome. When the clutch has been removed the outer half of the case can be taken off by undoing the remaining eleven cheese-head screws and the brake pedal stop bolt ; this bolt should be replaced temporarily to steady the inner half of the chaincase.

It is necessary to remove the engine shaft shock absorber and sprocket assembly and also the clutch sprocket before the inner half of the case can be taken off. It will then be seen that the inner half is held only by one screw passing into the crankcase just to the rear of the engine sprocket, and the brake pedal stop bolt.

Take care not to damage the needle valve screw regulating rear chain lubrication. To refit the chain cases, place the inner half in position and hold the rear end with the pedal stop bolt. Secure the front end with 11/16" long cheese-head screw behind the sprocket. Tighten this screw very firmly and prevent it unscrewing by punching the edge of the aluminium case into one end of the screw-driver slot.

In fitting the outer half it is helpful in positioning the case to fit the oil regulating screw into the outer half but do not screw it in too far or it will be damaged and prevent the two halves facing together. Make sure the joint washer is properly located and do not forget the small round joint washer at the footrest boss.

2. The Pressed Steel Chain Case. The steel chain case is similar, in general arrangement, to the aluminium case, but the following detail differences in assembly should be noted.

The clutch dome is held by ten $\frac{3}{16}$in. cheese-head screws. When these are taken out the clutch is exposed and may be dismantled as explained on page D.1.

It must, however, now be noted that if it is required to examine the primary chain it is not necessary to dismantle the clutch. A cover plate behind the clutch can be released by undoing the two countersunk screws exposed by the removal of the dome. The ten screws holding the dome also secure the cover plate, the countersunk screws being used to retain the plate in position when the dome screws are removed. Having freed the cover plate, take out the 18 $\frac{3}{16}$in. screws holding together the two halves and pull away the outer half.

The back half may be removed, after dismantling the clutch and removing chain and sprockets by freeing the front fixings of the two rear chain guards, loosening the bolt securing the bottom of the case to the cradle tube near the gearbox fixing and removing the four cheese-head screws holding the front end to the crankcase.

When refitting the case, note that the screw holes in the circular clamp plate around the engine shaft will correspond with the fixing holes in the chaincase in one position only. Do up these screws securely and lock with wire through the heads. Tighten the bolt through the rear fixing. See that the joint washer is sound and bedding down evenly and that the cork ring around the footrest distance tube is in position. If the clutch cover plate has been removed see that the part marked TOP comes uppermost. Note that the joint washer for the cover plate is positioned in the recess in the outer half of the chain case, fix the outer and inner halves with the $\frac{3}{16}$in. screws and pick up the cover plate with the two countersunk screws ; these screws pass through the middle holes of the three which are close together. When ready to fit the clutch dome pull up these screws securely as they are covered by the dome and cannot be tightened when the dome is fixed.

3. Adjustment for Rear Chain Lubrication. The arrangement of the adjuster for rear chain lubrication is rather different on the steel chaincase from the aluminium case. On the latter a plain taper ended screw is used to regulate the oil flow. On the steel case a taper ended spring loaded plunger is used. This is contained in a casing inside the chaincase, the spring holding the valve open. The regulation is obtained by a screw in the end of the chaincase, the screw thus being at right angles to the plunger. The ends of the screw and plunger are tapered so that as the screw is rotated into the case the tapered end slides over the tapered end of the plunger, pushing this out and so closing the oil outlet to the chain. This screw is secured by a lock-nut ; the screw in the aluminium case is held by a light coil spring.

FRONT WHEEL and BRAKE

1. Removal of Wheel.

Remove bolt from top end of brake anchor bar. Remove knurled adjusting nut on bottom end of brake rod. Disconnect speedometer cable at lower end. Slacken spindle nuts, pull washers out of recesses in fork ends and wheel will drop out.

2. Removal of Brake (See Fig. E2).

After taking out the wheel undo the brake plate locknut and remove brake plate complete with shoes. Pull off shoes. Lightly grease the brake cam spindle and clean and grease the cam spindle bearing so that it will move on the brake plate and centralise the shoes when the brake is applied.

Examine the brake linings and treat as described for the rear wheel.

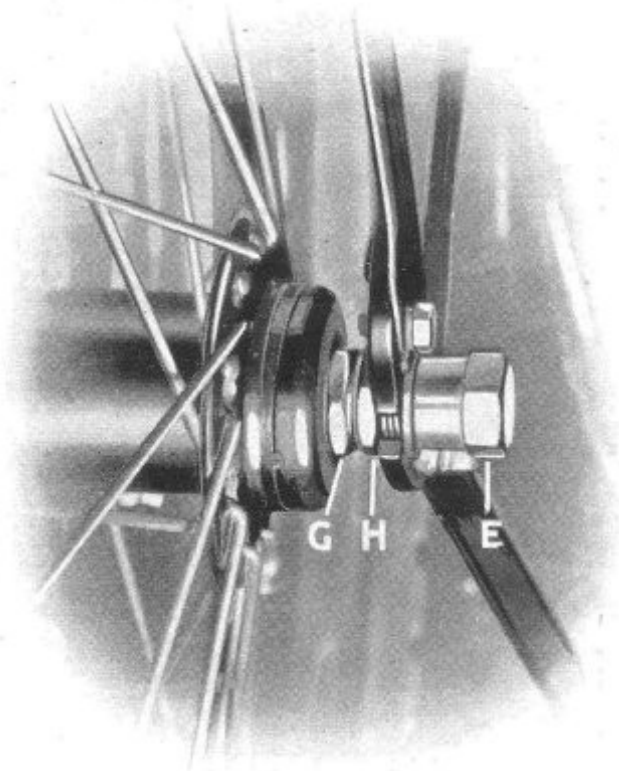

Fig. E1. Wheel Bearing Adjustment.

3. Removal of Bearings (See Fig. E2).

The bearings are taper roller and are treated as described for the Rear Wheel.

4. Re-assembly.

Re-assembly is simply the reversal of the instructions for dismantling but be sure that the brake plate anchor bar is secure ; that the spindle nut washers are properly located in the fork ends, and the spindle nuts are tight.

5. Wheel Bearing Adjustment (See Fig. E1).

Proceed as instructed for rear wheel.

6. Brake Adjustment.

Screw up the knurled adjusting nut on the brake rod as far as it will go without the brake rubbing.

7. Bearing Lubrication.

Proceed as instructed for rear wheel.

WHEEL ALIGNMENT

Procure a plain board about 6ft. long, 3in. wide and $\frac{3}{4}$in. thick ; see that one edge is perfectly straight. With the machine on the stand, place the straight edge of the board alongside the two wheels so that it touches each wheel. Turn the handlebars if necessary so that the front wheel touches the edge of the board at two points. If the wheels are in perfect alignment the board will also touch the rear wheel at two points. If it does not touch in this manner, slack off the rear wheel spindle nuts and turn the chain adjusters (see Fig. E3) until the wheel touches the board at two points. The handlebars may require turning very slightly to adjust the position of the front wheel to correspond with the new position of the rear wheel.

When the two wheels are in proper alignment, the straight edge of the board will touch each wheel at two points.

NAMES OF PARTS IN FRONT HUB and BRAKE ASSEMBLY, Fig. E2.

1. SPEEDOMETER GEARBOX COMPLETE, LESS PINION.
2. BRAKE CAM SPINDLE DISHED WASHER.
3. BRAKE CAM LEVER AND SWIVEL PIECE.
4. BRAKE PLATE WITH FIXED FITTINGS.
5. GEAR PINION ON GEARBOX SHAFT.
6. BRAKE CAM.
7. BRAKE CAM WASHER—LOOSE, NEXT CAM.
8. BRAKE LINING RIVET.
9. BRAKE LINING.
10. BRAKE SHOE HALF WITH LINING.
11. BRAKE SHOE RETURN SPRING.
12. WHEEL SPINDLE NUT.
13. BRAKE PLATE LOCKNUT.
14. ABUTMENT NUT FOR BEARING—INSIDE BRAKE PLATE.
15. GREASE RETAINER.
16. TAPER ROLLER BEARING.
17. GEAR RING SCREWING TO HUB TUBE.
18. HUB AND BRAKE DRUM ASSY.
19. WHEEL SPINDLE.
20. LOCK WASHER FOR SPINDLE.
21. BEARING ADJUSTING NUT.
22. LOCK FOR NUT BEARING ADJUSTING NUT.

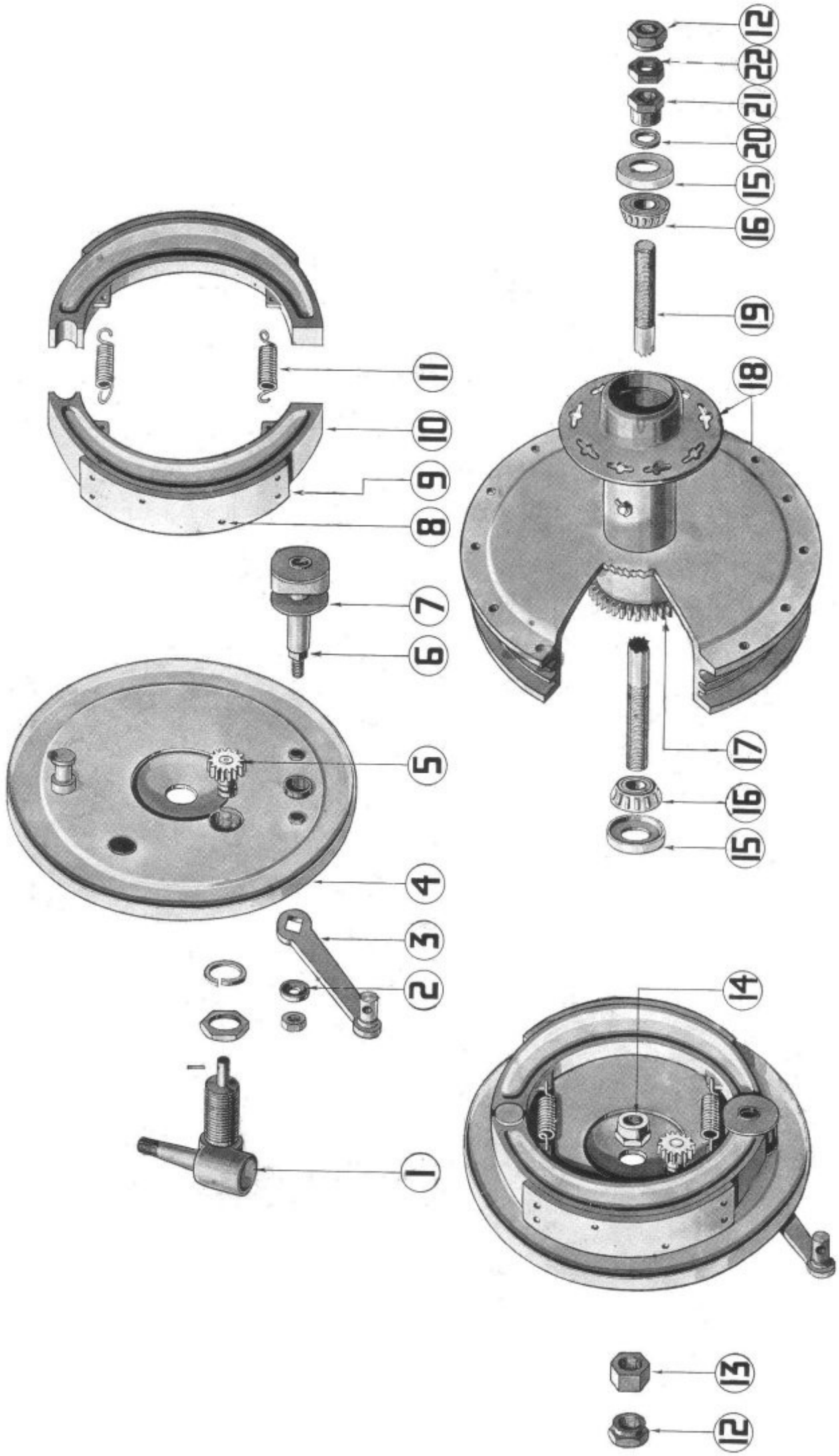

Fig. E2. Exploded View of Front Hub and Brake Assembly.

REAR WHEEL and BRAKE

1. Removal of Wheel.

Remove wing nut on brake rod.
Disconnect chain.
Uncouple front end of brake anchor bar.
Slacken spindle nuts.
Lift hinged portion of guard and pull out wheel.

2. Removal of Brake (See Fig. E4).

After removing wheel undo brake plate locknut and remove brake plate complete with shoes. Pull off shoes. Lightly grease :—
Brake cam spindle ;

Fulcrum adjustment wedge and spindles.

Examine the brake linings for wear and, if necessary, fit new linings or replacement shoes and linings. If new linings are fitted see that they are riveted down so that they lie in close contact with the shoe. Also see that the rivet heads are countersunk in the lining and that the foot of the rivet is carefully punched over.

3. Removal of Bearings (See Fig. E4).

First take out the wheel and remove the brake plate as described in items 1 and 2.

Screw off the two thin adjusting and locking nuts (G and H, Fig. E1) and tap out the spindle towards the brake drum side. Prise off the two dirt excluding covers ; these will probably be damaged and therefore require replacement. The inner races, rollers and cages of the taper roller bearings will drop out complete.

The outer races are pressed into the hub and should not be removed needlessly. Each race bears against an abutment washer in the hub tube. Remove the race by driving out with a drift placed through the hub and bearing up against the back of the abutment washer.

Examine the track of the outer race. The inner race track cannot easily be seen as it is masked by the rollers and roller cage ; however, wash in petrol, examine as well as possible, and also examine the taper rollers and the cage. If any parts are seriously worn or damaged replace the whole bearing assembly, *i.e.*, outer race together with inner race, rollers and cage.

4. Wheel Bearing Adjustment (See Fig. E1).

When the wheel has been refitted to the frame, slacken the outer spindle nut E on side opposite brake drum ; hold inner cone adjusting

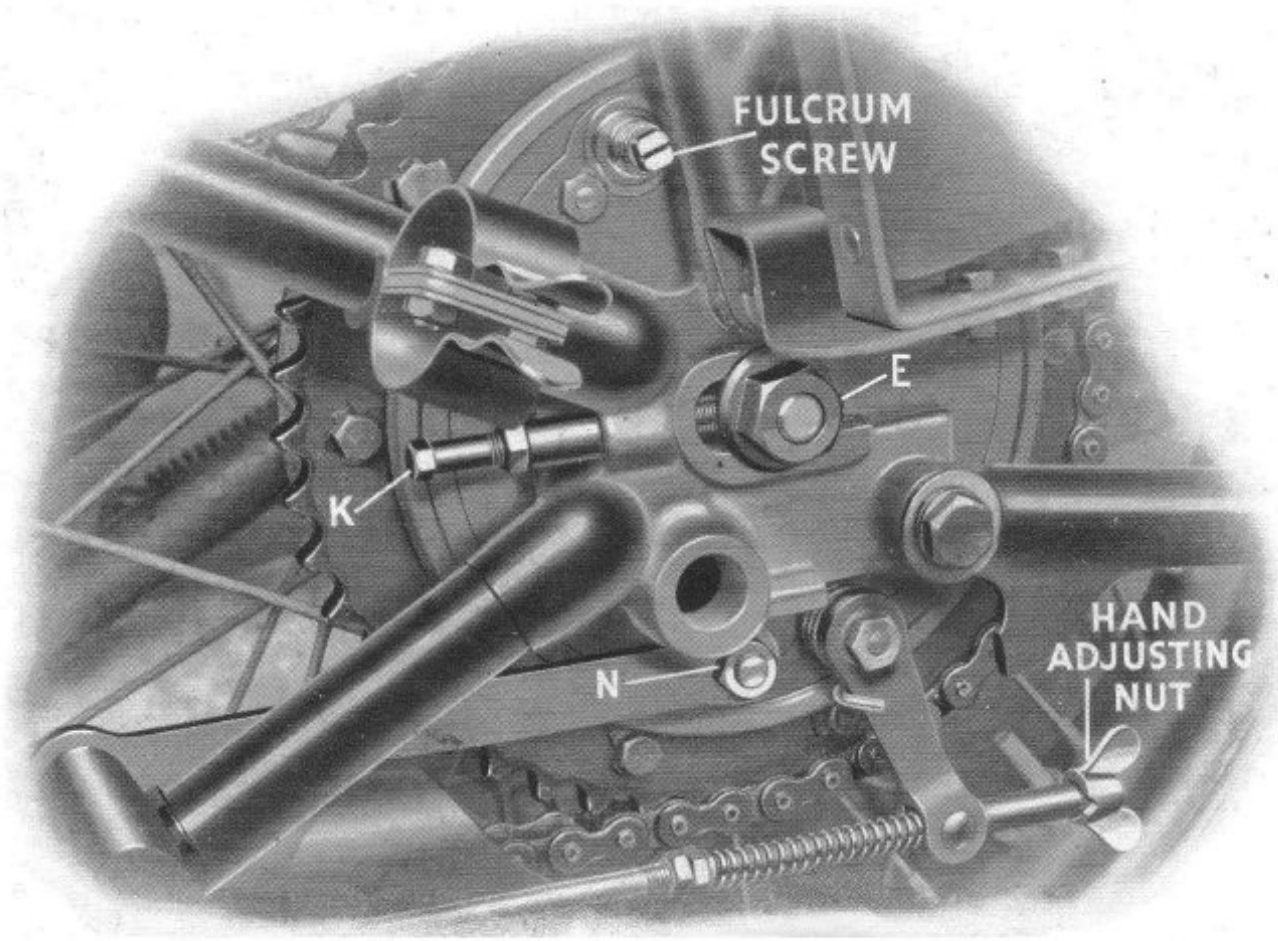

Fig. E3. Rear Brake Fulcrum and Chain Adjustment.

nut G and loosen outer locknut H. Adjust inner nut, and then, still holding this inner nut. tighten the locknut and the outer spindle nut, When the bearing is correctly adjusted **there must be just the slightest slack as measured at the rim.**

5. Brake Adjustment (See Fig. E3).

All normal brake adjustment must be made by rotating the square-ended fulcrum screw situated in the brake plate diametrically opposite the brake lever bearing. Turn clockwise to compensate for wear. The hand adjuster on the rear end of the brake rod must be slacked off whilst the fulcrum adjustment is made. When the fulcrum spindle will turn no further, re-tighten the hand adjusting nut until the brake pedal has only a trace of idle movement. **Always adjust the rear brake by means of the fulcrum adjuster. The thumb screw on the brake rod must only be used to compensate for rear chain adjustment. This is important if good braking and even wear on the brake linings is to be obtained.**

The wedge holder, *i.e.*, the part carrying the fulcrum screw, is riveted to the brake plate on early models but is bolted to the plate on later machines. Bolts, cast-in to the wedge holder, are used ; not studs. Therefore, do not try to unscrew the bolts from the holder. Simply unscrew the nuts outside the brake plate, and withdraw the holder. Put shakeproof washers under the nuts when replacing.

6. Bearing Lubrication.

The hub should be packed with grease during assembly or grease may be pumped in via the grease nipple after the bearings have been assembled, but before the brake plate is fitted. Spin the wheel a few times, holding by the spindle and wipe off any surplus grease which works out past the bearings.

WHEEL BUILDING

The following instructions apply to front and rear wheels.

The rim lies centrally between the outer face of the bearing adjusting lock nut on the one side and the outer face of the brake plate lock nut on the other side.

The spokes should be laced so that on the brake side each spoke crosses two others. On the flange side each spoke crosses three others.

The front wheel has 36 spokes.

18 flange side $8\frac{5}{8}$" x 10G x 80° head.

18 brake side $6\frac{3}{4}$" x 10G x 80° head.

The rear wheel has 40 spokes.

20 flange side $8\frac{5}{8}$" x 10G x 80° head.

20 brake side $6\frac{1}{2}$" x 10G butted 8G x 80° head.

Small variations have occured, from time to time, in the length of the spokes fitted to the front wheel having the cast iron brake drum (this drum has been fitted to practically all machines). When steel spoke nipples are used, the above spoke lengths may be used, whatever length may be given in the relevant Spares List.

NAMES OF PARTS IN REAR HUB and BRAKE ASSEMBLY, Fig. E4.

1. BRAKE PLATE WITH FIXED FITTINGS.
2. BRAKE CAM.
3. BRAKE CAM WASHER—LOOSE.
4. BRAKE FULCRUM ADJUSTING WEDGE.
5. BRAKE FULCRUM ADJUSTING SPINDLE.
6. BRAKE LINING.
7. BRAKE SHOE HALF WITH LINING.
8. BRAKE SHOE RETURN SPRING.
9. WHEEL SPINDLE NUT.
10. FORK END SPINDLE BUSH.
11. BRAKE PLATE LOCK NUT.
12. ABUTMENT NUT FOR BEARING.
13. CHAIN SPROCKET BOLT.
14. CHAIN SPROCKET BOLT TAB WASHER.
15. CHAIN SPROCKET.
16. WHEEL SPINDLE.
17. GREASE RETAINER.
18. TAPER ROLLER BEARING.
19. HUB, BRAKE DRUM, AND SPOKE FLANGE.
20. LOCK WASHER FOR SPINDLE.
21. BEARING ADJUSTING AND LOCKING NUTS.
22. SPINDLE DISTANCE PIECE.
23. WHEEL SPINDLE NUT WASHER.

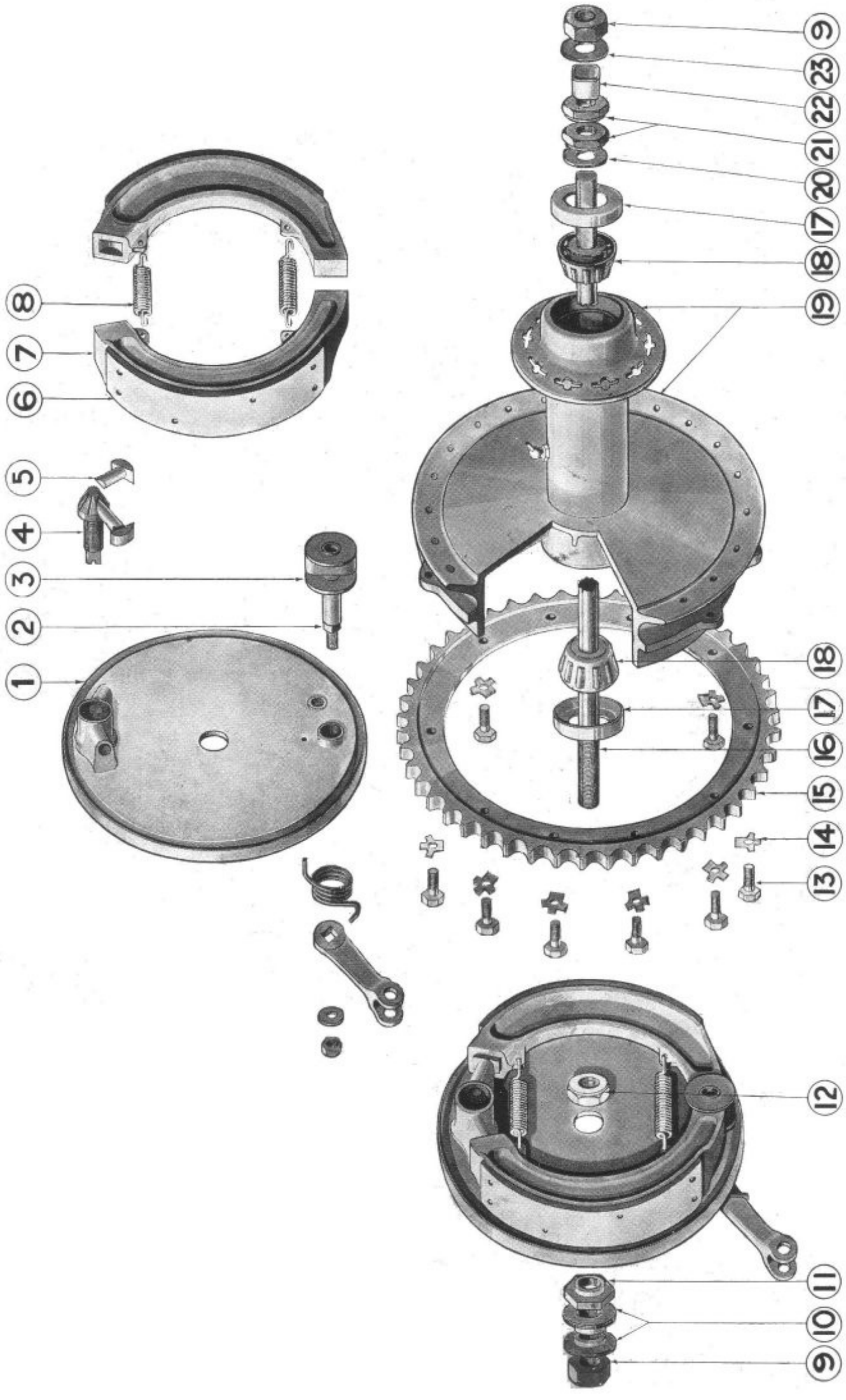

Fig. E4. Exploded View of Rear Hub and Brake Assembly.