

**1960**  
**Maintenance Manual**  
**and Instruction Book**

FOR

THE UNAPPROACHABLE

**Norton**  
REGD. TRADE MARK

MOTOR CYCLE

**Models No. 88, 99, ES2 & 50**

**NORTON MOTORS LIMITED**

**BRACEBRIDGE STREET, BIRMINGHAM. 6, ENGLAND**

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ASTon Cross 3711 (P.B.X.)

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"Nortomo, Birmingham."

**MODELS 88 and 99  
with H.C. Pistons and Sports Equipment**

These machines are basically to standard specification except for the following:—

	88	99
Compression ratio	9-1	8.2-1
Twin Monobloc Carburetters	Amal 376 to standard settings.	
Large Inlet Valve.		

Polished Inlet Port and combustion chamber.

**Sparkign Plugs.** For initial running-in the engine will be equipped with normal soft plugs which should be used until sufficient running has been completed to permit full use of the machine's capabilities. (See hand-book).

For use in engines to full sports specification only, a pair of alternative plugs—KLG FE100 or similar—will be found in the tool tray for subsequent use.

If the machines normal running consists mainly of town work it may be advisable to continue to use the softer plug, changing to the alternative only when high speeds are to be indulged in.

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## DATA

**IDENTIFICATION MARKS.** Engine No. and Prefix letters stamped on driving side of crankcase. Frame No. stamped on Left hand frame gusset below tool box. Should be identical to Engine No. Quote fully if writing or ordering parts.

	<b>88</b>	<b>99</b>
Bore ... ..	66 mm. (2.598")	68 mm. (2.677")
Stroke ... ..	72.6 mm. (2.859")	82 mm. (3.228")
Capacity ... ..	498 c.c. (30.384 cu. ins.)	598 c.c. (36.485 cu. ins.)
Compression Ratio ... ..	7.8	7.4
Sparking Plug ... ..	KLG FE80 Three point Lodge 2HLN or Champion N.5.	
<b>IGNITION TIMING</b>		
before T.D.C. fully advanced ... ..	$\frac{1}{4}$ " (6.35 mm.)	9/32" (7.14 mm.)
<b>VALVE TIMING</b>		
<b>Marked on all engines, mesh gears and sprockets, as instructed.</b>		
Tappet clearance cold		
Inlet ... ..	.003" (.076 mm.)	.003" (.076 mm.)
Exhaust ... ..	.005" (.127 mm.)	.005" (.127 mm.)
<b>AMAL CARBURETTER</b>		
Type ... ..	Monobloc 376	Monobloc 376
Main Jet ... ..	240	250
Throttle Valve ... ..	$3\frac{1}{2}$	3
Needle position ... ..	2	3
Pilot Jet ... ..	30	25
Choke Size ... ..	1" (25.4 mm.)	1.1/16" (26.98 mm.)
<b>ENGINE SPROCKET</b>		
Solo ... ..	19	20
Sidecar ... ..	17	18
<b>GEAR RATIOS</b>		
Solo ... ..	5.0, 6.8, 8.5, 12.75	4.75, 5.8, 8.08, 12.16
Sidecar ... ..	5.59, 6.8, 9.5, 14.28	5.28, 6.45, 8.97, 13.45
<b>CHAINS</b>		
Primary Chain		
Pitch ... ..	$\frac{1}{2}$ "	$\frac{1}{2}$ "
Width ... ..	.305"	.305"
Length ... ..	75 links	75 links
Rear Chain		
Pitch ... ..	$\frac{5}{8}$ "	$\frac{5}{8}$ "
Width ... ..	$\frac{1}{4}$ "	$\frac{1}{4}$ "
Length ... ..	98 links	97 links
Distributor Chain		
Pitch ... ..	$\frac{3}{8}$ "	$\frac{3}{8}$ "
Width ... ..	5/32"	5/32"
Length ... ..	42 links	42 links
Camshaft Chain		
Pitch ... ..	$\frac{3}{8}$ "	$\frac{3}{8}$ "
Width ... ..	.225"	.225"
Length ... ..	38 links	38 links
Petrol Tank Capacity ... ..	3 $\frac{5}{8}$ gal. (16 litres approx.)	3 $\frac{5}{8}$ gal. (16 litres approx.)
Oil Tank Working Capacity ... ..	4 $\frac{1}{2}$ pints (2.3 litres approx.)	4 $\frac{1}{2}$ pints (2.3 litres approx.)
Tyre size front ... ..	3.00 x 19	3.00 x 19
Tyre size rear ... ..	3.50 x 19	3.50 x 19
Tyre pressure front solo ... ..	25 lbs. (1755 gms./sq./cm.)	25 lbs. (1755 gms./sq./cm.)
Tyre pressure rear solo ... ..	20 lbs. (1410 gms./sq./cm.)	20 lbs. (1410 gms./sq./cm.)
Weight empty ... ..	390 lbs. (177 kilos.)	395 lbs. (179 kilos.)

## DATA (continued)

**IDENTIFICATION MARKS.** Engine No. and Prefix letters stamped on driving side of crank-case. Frame No. stamped on Left hand frame gusset below tool box. Should be identical to Engine No. Quote fully if writing or ordering parts.

	ES2	50
Bore ... ..	79 mm. (3.110")	71 mm. (2.795")
Stroke ... ..	100 mm. (3.937")	88 mm. (3.465")
Capacity ... ..	490 c.c. (29.896 cu. ins.)	348 c.c. (21.232 cu. ins.)
Compression Ratio ... ..	7.1	7.3
Sparkling Plug ... ..	KLG FE80 Three point Lodge 2HLN or Champion N.5.	
<b>IGNITION TIMING</b>		
before T.D.C. fully advanced ... ..	7/16" (11.11 mm.)	13/32" (10.32 mm.)
<b>VALVE TIMING</b> <span style="float: right;"><b>Marked on all engines, mesh gears and sprockets, as instructed.</b></span>		
Tappet clearance cold		
Inlet ... ..	Push rods to be free to rotate without up and down movement.	
Exhaust ... ..		
<b>AMAL CARBURETTER</b>		
Type ... ..	Monobloc 376	Monobloc 376
Main Jet ... ..	270	210
Throttle Valve ... ..	376/4	376/3½
Needle position ... ..	3	2
Pilot Jet ... ..	30	30
Choke Size ... ..	1.1/16" (26.98 mm.)	1" (25.4 mm.)
<b>ENGINE SPROCKET</b>		
Solo ... ..	20	17
Sidecar ... ..	18	Not recommended
<b>GEAR RATIOS</b>		
Solo ... ..	4.75, 5.8, 8.08, 12.16	5.59, 6.8, 9.5, 14.28
Sidecar ... ..	5.28, 6.45, 8.97, 13.45	
<b>CHAINS</b>		
Primary Chain		
Pitch ... ..	½"	½"
Width ... ..	.305"	.305"
Length ... ..	76 links	74 links
Rear Chain		
Pitch ... ..	⅝"	⅝"
Width ... ..	1¼"	1¼"
Length ... ..	98 links	97 links
Distributor Chain		
Pitch ... ..	⅜"	⅜"
Width ... ..	5/32"	5/32"
Length ... ..	44 links	44 links
Camshaft Chain		
Pitch ... ..		
Width ... ..		
Length ... ..		
Petrol Tank Capacity ... ..	3½ gal. (16 litres) approx.	3½ gal. (16 litres) approx.
Oil Tank Working Capacity	4½ pints (2.3 litres approx.)	4½ pints (2.3 litres approx.)
Tyre size front ... ..	3.00 × 19	3.00 × 19
Tyre size rear ... ..	3.50 × 19	3.50 × 19
Tyre pressure front solo	25 lbs. (1775 gms./sq.cm.)	25 lbs. (1775 gms./sq.cm.)
Tyre pressure rear solo	20 lbs. (1410 gms./sq.cm.)	20 lbs. (1410 gms./sq.cm.)
Weight empty ... ..	385 lbs. (173.6 kilos.)	380 lbs. (171 kilos.)

## INTRODUCTION

In preparing these instructions the elementary details and preliminary information that may be necessary to the absolute novice have been omitted, on the assumption that the majority of NORTON owners are already acquainted with the elementary details of starting, driving and maintenance. In connection with the latter we would stress the advisability of cultivating the habit of routine cleaning, lubrication, examination and adjustment of your machine. By this means many minor annoyances will be avoided and major breakdowns averted, and you will acquire the pride of ownership which marks the true enthusiast.

Below is a plan view of the machine with all controls clearly indicated. A short study of this will familiarise you with the position and function of each control.

To start the engine from cold, turn on the petrol and very slightly flood the carburetter, until petrol seeps (not drips) from the base of the mixing chamber. Turn the ignition key in the top of the headlamp switch in a clockwise direction to "IGN"; close or partly close the air lever. On single cylinder machines only rotate the engine with the kickstarter until the resistance of compression is felt, raise the exhaust valve lifter and depress the kickstarter a further two or three inches. Release the lifter and allow the kickstarter to return to its normal position.

A good swinging kick on the starter should set the engine going.

These machines are equipped with coil ignition and will not start until the ignition key has been turned to the appropriate position. Always remember to **TURN OFF THE IGNITION AND REMOVE THE KEY** when leaving the machine. Should the battery become run down the engine can be started by turning the key to the E.M.G. position, but a far more hefty kick is required than when starting normally.

A flat battery can be speedily re-charged by the procedure outlined under the heading of Emergency Charging in the Electrical Section.

All models provide for a reserve fuel supply. On machines with a single petrol tap it is of the two positional type the knurled circular knob being pulled out for normal running and

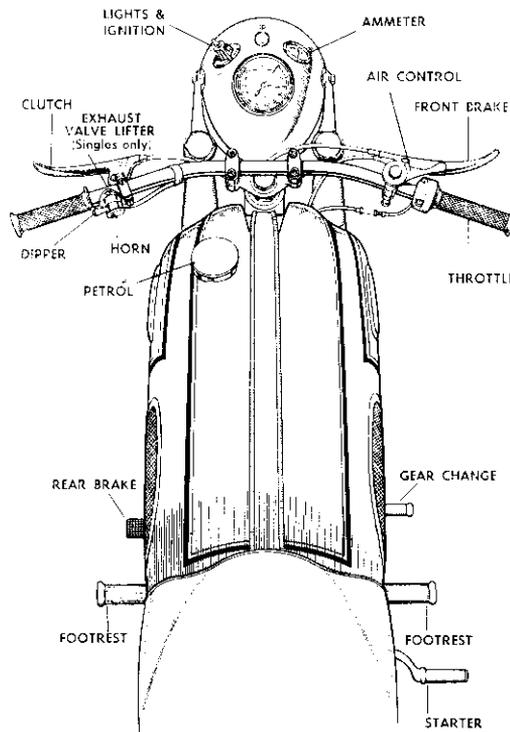


Fig. 1

the hexagonal one when the reserve is required. On machines with two taps, either tap may be used as a reserve and will provide fuel for some 5 to 8 miles of running.

Although the machine will have been greased up and all points requiring oil will have been dealt with at the works prior to the road test, it is always a safe policy to ensure that there is adequate oil in the oil tank, gearbox and oil bath chaincase. Remember to remove the level plug from the chaincase before topping up.

The first 1000 miles in the life of a new machine is of the utmost importance and the advisability of careful running in cannot be overstressed. At no time during the first 500 miles should the throttle be more than  $\frac{1}{2}$  to  $\frac{1}{3}$  open and care should be taken to avoid labouring of the engine by hanging on to too high a gear when conditions warrant a change down.

Over-revving in the low gears and violent acceleration should also be avoided and attempts made to keep the engine turning over at a speed at which it seems happy to operate. As the miles mount up, short bursts of wider throttle openings should be indulged in until at 1200-1500 miles it should be possible to use the machine's full capabilities with safety.

The use of running-in compound during the initial stages of the engine's life is strongly recommended. The compound, several brands of which are available and may be obtained from all Norton dealers, contains "colloidal graphite" which forms a graphoid surface on all working faces and greatly assists in preserving their high quality finish. The compound should be mixed with the lubricating oil in the proportion of one pint to one gallon of oil during running-in, but if its use is continued after this period, only half the quantity should be used. Remember that these are high efficiency engines which give of their best when running at relatively high revolutions and a change should be made to a lower gear immediately there are any signs of labouring. To obtain the best possible performance from your machine, full use should be made of the gearbox, which is quite capable of withstanding all the loads likely to be imposed upon it by normal use.

At the end of this book will be found a trouble tracing chart, reference to which will greatly facilitate the location and rectifying of any but the most unusual troubles which may be likely to cause an involuntary stop.

## CLEANING

Before attempting to polish the enamel on any part of the machine, all traces of grit adhering to the various components should be washed off, preferably with a reasonably high pressure hose. Polish the enamel periodically with a good quality wax polish. Note that chromium plating is not impervious to rust and should be wiped down when possible, after being in the rain. Wash off any road grit and clean with one of the chromium polishes available from any garage. Do NOT use ordinary metal polish.

## LUBRICATION

At the Works, Wakefield Castrol Oils have been used for many years exclusively with highly successful results; the correct grades for the models dealt with in this handbook being:—

WAKEFIELD CASTROL XXL, for Summer use.

WAKEFIELD CASTROL XL, for Winter use.

Other very suitable oils for NORTON machines are:—

SHELL-X-100-40 or B.P. ENERGOL S.A.E. 40 for Summer use.

SHELL-X-100-30 or B.P. ENERGOL S.A.E. 30 for Winter use.

MOBILOIL "BB" for Summer use. MOBILOIL "A" for Winter use.

ESSOLUBE 40 for Summer use. ESSOLUBE 30 for Winter use.

REGENT/CALTEX ADVANCED HAVOLINE 40 for Summer use.

REGENT/CALTEX ADVANCED HAVOLINE 30 for Winter use.

These oils should be used in engine and gearbox. For oil bath chaincase and forks use Wakefield's "Castrolite," Shell X-100-20, Prices Energol S.A.E. 20, Mobiloil "Arctic", Essolube 20, or Havoline 20. All bearings not automatically lubricated are fitted with nipples for grease gun lubrication. For these and

wheel hub bearings a good quality grease such as Wakefield's Castrolase medium, Prices Energrelase C3, Shell Retinax A, Mobilgrease M.P., Esso Multi Purpose grease or Regent/Caltex Marfak Multi Purpose 2 should be used.

Below is a lubrication chart indicating the approximate periods at which the various lubrication points should receive attention. If this chart is adhered to, excessive wear will not occur on any of the moving parts, the life of the machine will be prolonged and its performance will be considerably enhanced.

NOTE.—On a new machine, drain and flush out oil tank after 500 miles. Remove crankcase drain plug and allow to drain. Remove level indicator plug from oilbath chaincase and fill to this level.

## LUBRICATION CHART

<i>Period</i>	<i>Location</i>	<i>Lubricant</i>	<i>Period</i>	<i>Location</i>	<i>Lubricant</i>
Every 200 miles.	Oil tank, top up... ..	Oil	Every 2,000 miles.	Brake shoe cam (sparingly) ... ..	Grease
Every 1,000 miles.	Control cables ... ..	Oil		Brake rod jaw joints ... ..	Oil
	Control levers ... ..	Oil		Speedometer driving box	Grease
	Brake cable "U" clip	Oil		Drain and refill oil tank	Oil
	Gearbox, top up... ..	Oil	Every 5,000 miles.	Contact Breaker spindle	Oil
	Oil bath, top up... ..	Oil		Gearbox, drain and refill	Oil
	Brake pedal ... ..	Grease	Every 10,000 miles.	Telescopic Forks	See para. 100
			Oil bath, drain and refill	Oil	
			Hub bearings, repack	Grease	

## CONTROLS

**Throttle Twist Grip.** On right handlebar. When shut, warm engine should continue to tick over by adjustment of cable and throttle stop on carburetter. Twist grip may be adjusted to close or remain open when released, as preferred.

**Air Lever.** On right handlebar. Close or partly close when starting from cold. Open as soon as engine will run properly with full air. Should remain open for normal running.

**Exhaust Valve Lifter.** (Single cylinder machines only). Beneath left handlebar. Enables engine to be readily rotated.

**Front Brake Lever.** On right handlebar. Use as necessary in conjunction with rear brake pedal.

**Clutch Lever.** On left handlebar. Allows engine to run with gear engaged without forward movement of machine. Release gently to obtain forward motion.

**Rear Brake Pedal.** Pad on lever adjacent to left footrest.

**Gear Change Lever.** Adjacent to right footrest. Engages the various gears (4) and neutral or free engine position between bottom and second gear. Move upward for first or bottom gear and downward for all other gears. Use deliberate pressure—do not jab.

**Kickstarter.** Lever behind right footrest. Depress to rotate engine.

**Steering Damper** (when fitted). Knob or wing nut forward of handlebar centre. Rotate clockwise to stiffen handlebar movement.

**Lighting and Ignition Switch.** Left hand top of headlamp body. Three-positional rotating light switch:— off, low and high. Central removable ignition key:— OFF, straight in line. Ignition ON, turn clockwise, Emergency starting, turn anti-clockwise.

**Headlamp Dipping Switch and Horn Push.** Combined fitting on inside of left handlebar.

# THE ENGINE

## Models 88 & 99

### 1. ENGINE. LUBRICATION SYSTEM

This is of the dry sump type. The oil flows from the oil tank to the pump by gravity, assisted by suction from the feed side of the oil pump, through the gears, and is forced under pressure to various parts of the engine, drains to the lowest part of the crankcase and by suction from the return side of the pump is lifted back to the oil tank.

### 2. OIL FILTERS

There are two gauze filters in the lubrication system, the main one being attached to the adaptor screwed into the oil tank to which the oil feed pipe is connected. Clean filter when the tank is drained every two

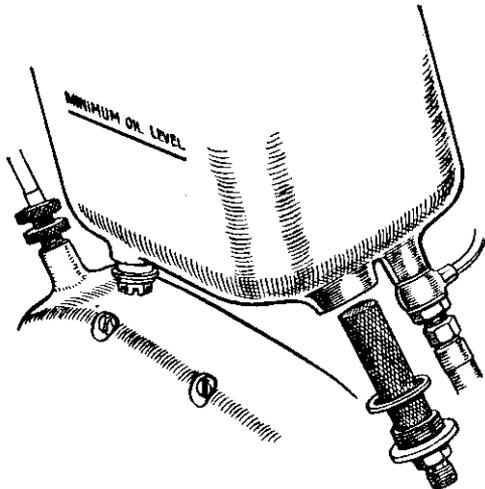


Fig. 2

thousand miles. A small cigarette type filter is incorporated in the pressure release valve. Removal of the hexagon plug from the rear edge of the timing cover exposes the filter and its attached spring. Clean periodically.

### 3. ENGINE OIL PUMP

This is of the gear type. The pump contains two pairs of gears, one on the feed side and the other on the return side.

The gears on the return side are twice the width of those on the feed, having twice the pumping capacity. This ensures that the

crankcase is free from oil when the engine is running.

To check the return of the oil to the tank, remove the oil filler cap. The oil return pipe can then be seen. After the engine has been running for a few minutes, the oil return flow will be spasmodic, due to the greater capacity of the return gears.

### 4. OIL LEVEL

The oil level in the oil tank should not be above three-quarters and not below half.

If the level is above the three-quarter mark, when the engine is running, the pressure built up in the oil tank by the oil return side of the pump may force the surplus oil through the air release pipe on to the road.

Always run engine for a few minutes before checking oil level. It is possible when an engine has been idle for any length of time for the oil to syphon through the return gears to the sump.

When this happens, all the oil is returned to the tank in the first few minutes that the engine is running.

When the oil level is below the half full mark there is such a small quantity of oil that it tends to overheat.

### 5. CIRCULATION OF THE OIL

The oil pump makes an oil tight joint with the timing cover by means of a synthetic rubber washer under compression.

Oil passes from the pump through drilled oil ways in the timing cover to the hollow timing side mainshaft, an extension of which rotates in an oil seal located in the cover. The built up crankshaft (Fig. 3) is suitably drilled to convey oil under pressure to the plain big ends. Surplus oil escaping from the pressure release valve into the timing cover builds up to a pre-determined level to lubricate the gears and timing chains, afterwards draining into the sump via a drilled hole. A lead from the oil return pipe (external) conveys oil to the hollow o.h.v. rocker spindles, push rod ends and valve guides, surplus oil returning to the sump via a drilled hole in the rear of the timing side cylinder.

Pressure release valve depicted in Fig. 6 is pre-set and incapable of adjustment. A

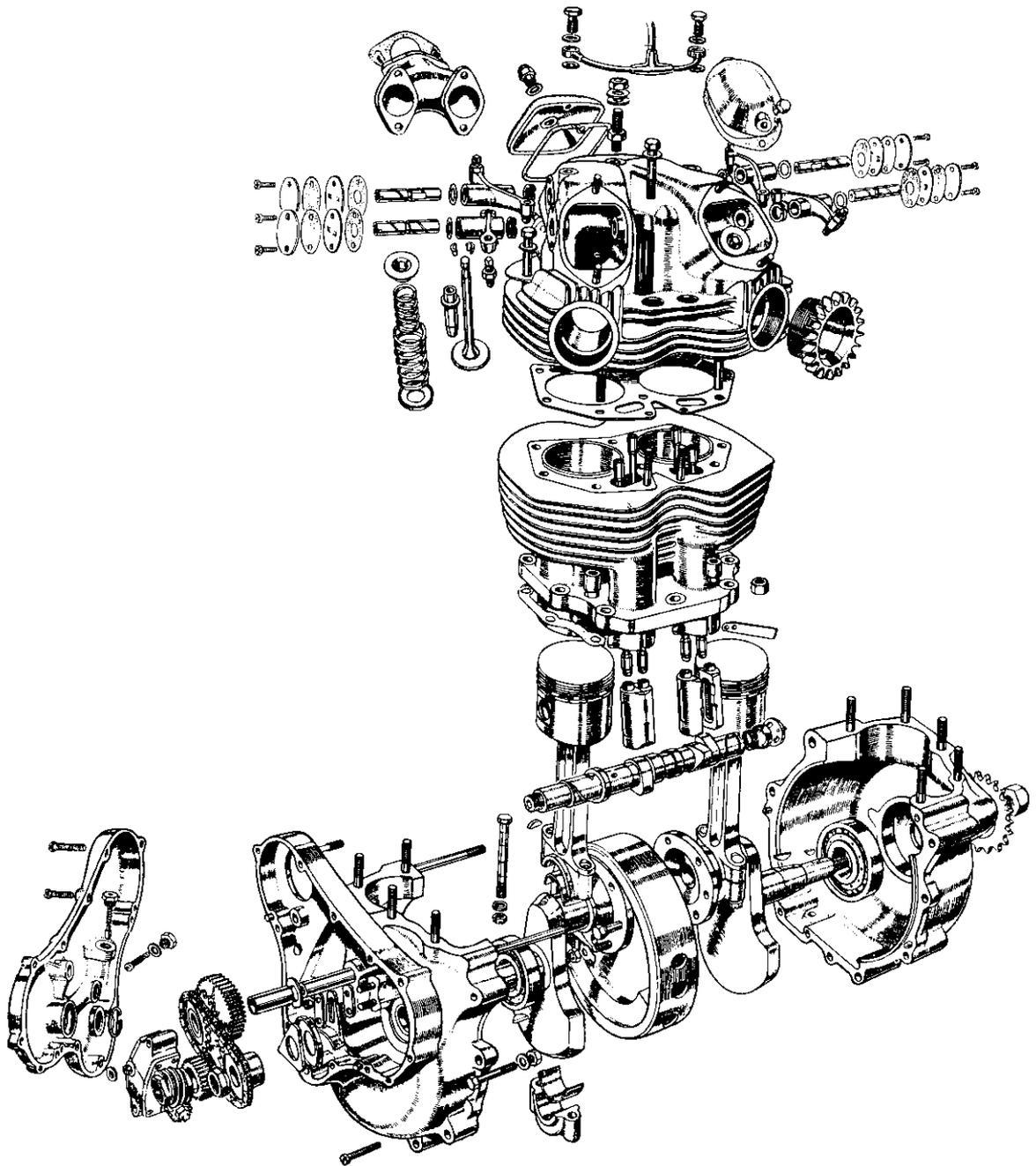


Fig. 3

timed breather working at the inner end of the camshaft (Fig. 3) controls the crankcase pressure. Any oil escaping from this source being conducted to the rear chain.

Removal of the filter screwed into the driving side of the sump enables the crankcase to be flushed out and the filter cleaned when the occasion arises.

## 6. OIL PRESSURE

Since no pressure gauge or indicator is fitted, the only check that oil is circulating is an inspection through the oil tank filler cap. With the engine running an intermittent stream of oil will be seen returning into the tank, the surface of the oil being covered with bubbles. In the event of it being considered necessary to check the oil pressure, the removal of the hexagon headed pin immediately below the pressure release valve unit will provide a convenient take off for a pressure gauge. It is preferable to check when the oil is hot as there is almost certain to be adequate pressure with cold oil.

With oil at normal working temperature and engine ticking over, there should be a minimum pressure of some 5 lbs., which should increase progressively with rising R.P.M. The ultimate pressure being dependant on engine condition and state of the oil.

Periodically, when the engine is ticking over, place a finger over the oil return hole in the oil tank. This will divert a large quantity of oil to the rocker mechanism and serve to flush out the small holes that feed oil to the rocker ball ends.

## 7. PETROL TANK—REMOVAL

Ensure that the petrol tap is in the "off" position. Disconnect the petrol pipe using two spanners, holding the tap with one whilst releasing the union nut with the other.

Remove the seat by removing the two wing nuts centrally situated beneath the seat pan and lifting off the seat. This will expose the bolt which tensions the securing strap holding the tank down on the rubber pads taped to the top tubes of the frame. Removal of this bolt and bending back the strap will enable the tank to be lifted out of position.

## 8. PETROL TANK—REFITTING

If new rubbers have been fitted to the frame top tubes, ensure that they are well bedded down and securely attached so that there is no possibility of metal to metal con-

tact between tank and frame. Pull securing strap into position, fit bolt and nut and tighten sufficiently tight to prevent loosening by vibration but not so tight as to overstress the tank structure. Re-fit petrol pipe using two spanners as for removal.

## 9. CYLINDER HEAD REMOVAL

Remove petrol tank (para. 7). Remove carburetter, leaving it attached to the machine by the throttle cable only. Remove exhaust pipes and silencers complete as a unit from each side of the machine. Remove high tension leads from sparking plugs and engine steady stay stud from the top of the rocker box. Disconnect oil feed pipe to rocker mechanism by unscrewing the two banjo connection bolts on the extreme top of the rocker box.

There are five bolt heads visible above the cylinder head finning and two nuts between the exhaust ports. In addition there are three nuts accessible through the cylinder finning, one beneath the inlet port and one under each exhaust port.

Removal of these nuts and bolts should enable the head to be lifted off. If the joint is tight a light blow beneath the exhaust port with a mallet or a block of wood should effectively release it. Lift the head and ensure that the gasket is either coming away clean with the head or remaining in position on top of the cylinder block. Lift the head as far as possible and obtain assistance to feed the four push rods into the head until they are clear of the cylinder block when the head may be tilted backwards and completely withdrawn.

## 10. REMOVAL OF CARBON

The piston crowns will now be exposed and the engine should be rotated until the pistons are on top dead centre. Carefully scrape the carbon from the piston crown, using a blunt knife or similar tool, taking care to avoid scratching or cutting the piston material. Deal similarly with the combustion chambers and valve ports although these cannot be thoroughly cleaned without removing the valves.

## 11. VALVE REMOVAL

With the cylinder head removed, the rocker inspection covers taken off, and the stud securing the inlet rocker inspection cover also removed, the o.h.v. rockers may be rotated sufficiently clear of the valve stem

to enable a normal Universal type valve spring compressor to be used for compressing the springs and removing the cotters. Each valve, together with its springs, should be carefully placed on one side so that it may be refitted in its original position.

Note that although the inlet and exhaust valves have the same head and stem diameters, they are not identical, the inlet head being curved on the underside. It is important that they should not be interchanged.

## 12. VALVE GRINDING

Remove all the carbon from the valve heads and stems. Lightly smear the seat portion with medium grinding compound, place the valve in the guide and grind lightly, holding the end of the valve stem in a hand vice or chuck. Do not revolve the valve a complete turn, but oscillate rapidly, frequently raising the valve from the seat and placing in a different position.

As soon as the grinding marks make a complete ring on valve and head, cease operations and remove all traces of grinding compound from valve, seat and port. If valves or seats are badly pitted it may be impossible to obtain a perfect seat by grinding. The seats will then have to be re-cut and the valves refaced or renewed.

## 13. VALVES—FITTING

Thoroughly clean valves, seats and valve pockets. Fit bottom collar over valve guide (if the collar has been removed) and place the spring and top collar in position. Lubricate valve stems and insert through valve guide. Compress valve spring and fit cotters.

A little thick grease smeared on the inside of the cotters will hold them in position until the spring is released.

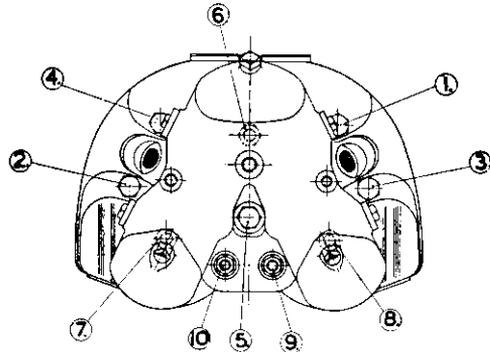
## 14. VALVE GUIDES—REMOVAL AND FITTING

Valve guides are drifted into position with a double diameter punch after the head has been heated up and should be removed in a similar manner. Heat the head—immersion in boiling water is quite sufficient—and knock out old guides. Re-heat the head and fit new guides. Valve seats must be trued up with cutter to ensure concentricity with new guide.

## 15. CYLINDER HEAD—FITTING

If the cylinder head gasket has been

removed, refit with the same face uppermost or renew. Rotate engine until pistons are on top dead centre. Place cylinder head on top of cylinder block and tilt it backwards whilst the pushrods are inserted into the two tunnels cast in the cylinder head. Note that the inlet push rods are longer than the exhaust, and one of each, i.e., inlet and exhaust should be inserted into the head, the long rods being nearer the centre, see Fig. 3.



ORDER OF TIGHTENING DOWN CYLINDER HEAD NUTS & BOLTS,

Fig. 4

Lower the head into position and allow the push rods to fall on to the tappets as the head approaches its normal location.

When the head is within about  $\frac{1}{4}$  in. of the cylinder joint face it should be supported in this position by using the two short sleeve nuts taken from beneath the exhaust ports as packing between the top fin of the cylinder block and the bottom cylinder head fin, placing them in a horizontal position between the fins whilst the rocker ball ends are entered into the upper ends of the push rods. A piece of bent wire may be found useful for drawing the inlet push rod into position, access being obtained through the exhaust inspection apertures.

Remove temporary distance pieces and lower head on to joint face.

Ensure that rockers and push rods are in correct contact. Attach all nuts and bolts and pinch down lightly, finally tightening in the order shown in Fig. 4.

## 16. ROCKER ADJUSTMENT

Removal of the single nut securing the inlet rocker inspection cover will provide access to both inlet rockers and enable the necessary feelers to be inserted between the

rocker adjuster and the valve stem end (Fig 5).

Rotate the engine until the particular inlet valve being dealt with is closed.

To adjust the clearance, hold the squared end of the adjuster by means of a special spanner provided and slacken the locknut. Insert a .003 in. feeler and rotate the adjuster in a clockwise direction until the feeler is just pinched, but may be still moved about fairly easily. Hold the adjuster whilst tightening the locknut and re-check with the feeler.

Rotate the engine until the other inlet valve is closed, repeat the operations and fit the inspection cover, ensuring that the paper washer is in good condition, and correctly positioned.

To adjust the exhaust rockers remove the inspection cover and proceed as already described, using a .005 in. feeler. Always re-check with the feeler after tightening the locknut and re-adjust if there is any doubt about the accuracy of the original setting.

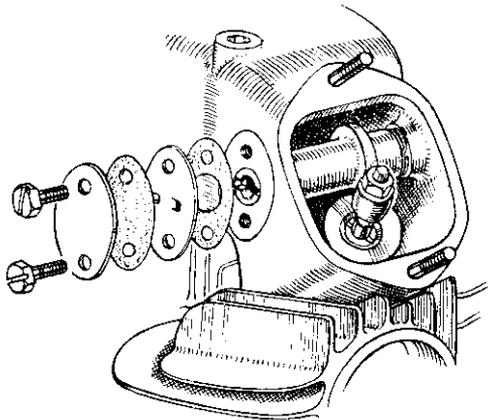


Fig. 5

### 17. ROCKER REMOVAL & FITTING

Remove inlet rocker inspection cover and cover securing stud. This latter may be withdrawn by locking two nuts on the outer end and rotating the lower of the nuts which should bring away the stud.

Remove the two bolts securing the oval cover plates over the ends of the rocker spindle holes (Fig. 5). Note that the inner of these has two projections for locating the radial position of the spindle and that the spindle has a threaded hole at its outer end. A 5/16in. x 26 thread bolt taken from some part of the machine may be used as an extractor bolt having first interposed a

piece of tube or large nut between the cylinder head and the bolt.

Note that the rocker hub has a spring washer at one end and a plain thrust washer at the other. These may be either carefully removed before the rocker is extracted or allowed to fall when the rocker is removed. Having withdrawn the rocker until the hub is clear of the spindle hole bosses, it is necessary to turn upside down in order to withdraw it completely.

Removal of the exhaust rockers is carried out in an identical manner but is rather more simple since it is not necessary to invert the rocker in order to extract it.

It will be noticed that the rocker spindles have a "flat" on one side. The spindles should be fitted with all 'flats' facing inwards to the centre of the engine and with the slot across the spindle end and lying horizontal. The spindle should be a reasonable push fit in the head or tighter.

The end load put on by the spring washer will hold the assembly in position whilst inserting the spindle.

Fit paper washer to oval face by means of a smear of oil. Fit oval washer with tags engaged in spindle slot, fit another paper washer, followed by the plain oval washer and secure with two pins (Fig. 5).

### 18. CYLINDER BLOCK—REMOVAL

Remove petrol tank, para. 7.

Remove cylinder head, para. 9.

Remove the nine cylinder base nuts (seven large, two small). It is necessary to lift the block slightly before certain of these nuts can be removed completely. When lifting the block, avoid tearing the paper washer fitted to the crankcase joint.

### 19. PISTONS—REMOVAL

With the cylinder block removed and the pistons exposed, it will be apparent from the angular position of the valve head recesses in the piston crowns that the two pistons are not interchangeable, and if a new one is required for any reason, it will be necessary to specify whether a nearside (lefthand) or offside (righthand) is wanted.

A new piston may be fitted either way round, but having once been used, should always be replaced in the same position.

To remove a piston, first extract the gudgeon pin retaining circlips by means of a pair of sharp nosed pliers and push out

the gudgeon pin. If the engine is badly carboned up it may be desirable to scrape the carbon from the narrow land outside the circlip before attempting to remove the gudgeon pin. Be sure to mark the piston so that it may be replaced in its original position.

## 20. PISTON RING REMOVAL AND FITTING

Unless new rings are being fitted it is not advisable to remove the carbon from the bottom of the ring groove or the back of the ring. When fitting new rings, remove all carbon from the piston by means of an old hacksaw blade or similar tool. When the grooves have been cleaned, check the new ring in the groove. There should be a side clearance of .004 in. Check also the ring end gap by inserting the ring in the cylinder bore and pushing it down with a piston to ensure that it is lying square. The gap should be:

Compression rings, .008 in.—.010 in.

Scraper rings, .008 in.—.010 in.

Check gap with feeler gauge.

## 21. PISTONS—FITTING

Fit rings to piston, spacing the ring gaps equally round the piston circumference. Fit one gudgeon pin circlip if both have been removed for dismantling. Unless great care has been taken in the removal of the circlips, it will be advisable to fit new ones. Fit piston to connecting rod, ensuring that it is the correct way round and that the valve head recesses are lying in the right direction. When both pistons are fitted, the forward recesses should be further apart than those at the rear of the engine. When fitting the circlips, make certain that they are properly bedded in the groove.

## 22 TAPPETS—REMOVAL AND FITTING

It is most unlikely that the tappets will require any attention until a very large mileage has been covered. They are fitted into the cylinder block and are readily accessible when the block has been removed.

Invert the cylinder block, remove the wire securing the tappet division plate screws and remove the screw nearest the tappets. This will enable the division plate to be swung out of position on the other screw. If

tight, a light blow on the opposite end of the tappets will effectively release the plate.

Note that the tappets must not be interchanged either singly or in pairs, nor should they be fitted the opposite way round.

The refitting is quite straightforward, remember to wire the division plate screws.

## 23. CYLINDER BLOCK FITTING

Clean both joint faces and ensure that the cylinder base paper washer is in good condition and is fitted so that the oil return hole is quite clear.

Fit piston ring compressors (obtainable from service department) to pistons, ensuring that the ring gaps are approximately equally spaced and that all are covered by the compressor. About  $\frac{1}{8}$  in. of piston should stand above the compressor. Smear the cylinder bores with oil and feed the cylinder block over the pistons forcing the piston ring compressors down the piston until they fall from the bottom of the piston skirt. Remove the compressors and lower the block to within about  $\frac{1}{4}$  in. of the joint, and replace the cylinder base nuts.

Completely lower the cylinder block and just pinch down the two nuts on either side of the block, tightening these in diagonal order. Tighten the three remaining large nuts, and finally the two 5/16 in nuts at the front of the block.

## 24. TIMING COVER REMOVAL AND FITTING

Remove the ten cheese-headed screws securing the cover which may then be withdrawn. If tight, lever gently behind the pressure release valve boss, and tap lightly with a wooden block on the opposite end of the cover. Take care not to lose the small rubber washer which forms the oil seal between the pump and the cover.

When refitting, ensure that both faces are quite clean and lightly smeared with jointing compound, preferably "Wellseal," which is non-hardening. Ensure also that the oil pump rubber sealing washer is in position. Take care not to damage the oil seal when entering the mainshaft into the cover, and do not press right home if there appears to be any obstruction. Refit all screws checking that there is a fibre washer under each head, and just pinch each one down before finally tightening each pair of opposite screws.

## 25. PRESSURE RELEASE VALVE—REMOVAL AND FITTING

The pressure release valve can only be completely dismantled when the timing cover is removed from the engine, although the filter can be withdrawn for cleaning by removing the external plug on the rear edge of the cover without disturbing the cover itself. A glance at Fig. 6 makes the order and location of the various parts quite clear.

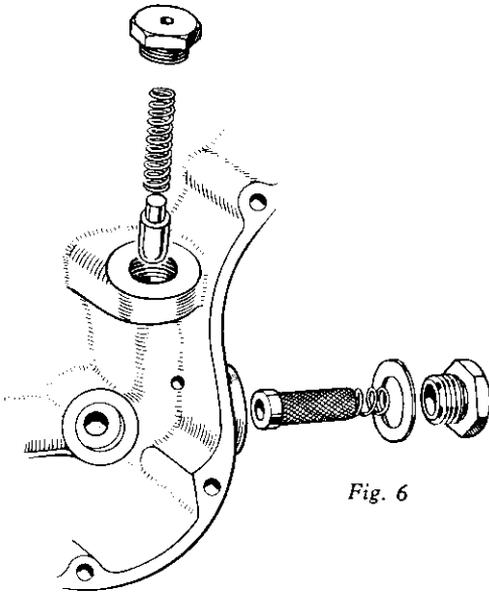


Fig. 6

## 26. OIL PUMP—REMOVAL AND FITTING

Whilst the timing cover is removed, no difficulty should be experienced in removing the oil pump, which is held only by the two nuts, situated one on either side of the body.

When these are removed, the pump should be readily withdrawn from its studs. If tight, a gentle leverage may be applied behind the driving spindle.

To replace the pump clean both faces and apply jointing compound very sparingly, particularly in the vicinity of the oil holes. Fit the pump and nuts, and tighten each nut a turn at a time to ensure even tightening.

## 27. OIL PUMP

The oil pump is of the gear type. It is not advisable to dismantle it.

When pump is removed from timing chest, test for play in the spindle by pulling and pushing the worm wheel.

Revolve spindle and place fingers on the

oil holes and the action of the gears should be felt if the pump is in good condition.

When revolving pump, any foreign matter obstructing the gears will be felt. Wash out with paraffin.

A marked drop in oil pressure, or oil draining from tank to crankcase may indicate that the pump requires re-conditioning; for which operation it should be returned to the service department, who make only a small charge for this work.

## 28. TIMING SPROCKETS AND CHAINS—REMOVAL

When removing the chains, it is necessary to withdraw the whole sprocket assembly with the chains in position. This may be accomplished without disturbing the timing chain tensioner secured to a boss in the timing chest by two nuts.

Remove the nut securing the camshaft sprocket and knock out the parallel peg holding the driving sprocket on to the distributor spindle. Support the spindle during this operation to avoid the possibility of bending it.

Removal of the camshaft sprocket may require the use of a standard type of sprocket extractor. The intermediate gear and sprocket will, of course, readily leave the spindle. Unscrew the oil pump worm, which has a lefthand thread, and withdraw the half-time pinion by means of a special extractor available from the spares department if necessary.

## 29. TIMING SPROCKET AND CHAINS FITTING AND ADJUSTMENT

Fit oil retaining disc and triangular washer to mainshaft and fit half-time pinion key. Fit half-time pinion with the chamfered edge outside and tap home with a tubular drift. Fit steel washer to intermediate shaft and camshaft (the latter is the thicker of the two) and fit the camshaft key. Rotate engine until the marked tooth on the half-time pinion is in the top dead centre position.

Rotate the camshaft till the keyway is in top dead centre position. Place the distributor chain (the narrower of the two chains) on the inner of the two sprockets on the intermediate gear and the camshaft chain on the other. Rotate the gear until the marked gear tooth is in the bottom dead centre position. This will give a marked sprocket tooth in the 11 o'clock position. The camshaft sprocket also has a marked tooth which should be at 11 o'clock position when the sprocket is meshed

with the chain. The chain and sprocket assembly may now be placed loosely in position, the distributor sprocket meshed with its driving chain and the whole assembly pushed home. Check that all marked teeth are correctly positioned, i.e. when the marked pinion and gear teeth are in mesh, both marked sprocket teeth are in the 11 o'clock position the intermediate sprocket tooth having just entered the chain whilst the camshaft sprocket tooth should be just about to leave the chain. Fit and tighten the oil pump worm and camshaft sprocket nut but do not fit the timing cover until the ignition has been timed (para. 30).

The chain tensioner can be fitted either before or after the chain is in position. It should be adjusted so that there is about  $\frac{1}{8}$  in. whip in the top run of the chain.

### 30. IGNITION TIMING (see also para. 121)

Before timing the ignition ensure that the distributor driving chain has about  $\frac{1}{8}$ " whip in one run. A slack chain will upset the timing. Adjust as necessary by slackening the two 'Allen' nuts near the upper edge of the distributor adaptor. A tap with a mallet or gentle leverage will pivot the assembly about the bottom stud sufficiently to allow for normal chain adjustment. To set the timing, remove the sparking plug from the timing side cylinder head and rotate the engine until the marked tooth on the camshaft sprocket is on top centre position. This will bring both pistons also to T.D.C. with the driving side on the firing stroke. The rotor should lie approximately vertical with the brass contact downwards. Rotate the engine backwards until the piston is the required amount down the stroke before T.D.C. (see data page). Slacken the set pin holding the distributor body to the adaptor and holding the ignition in the fully advanced position by pressing the rotor arm in a clockwise direction, slowly rotate the distributor body till the points just break. Lock the set pin and re-check. A preferred method of accurately locating the opening of the points electrically is set out below. Prepare a bulb and battery in circuit with short leads. Disconnect the coil lead from the distributor and attach one end of the circuit to this terminal; earthing the other end on the distributor body or similar component will light the bulb which will go out immediately the circuit is broken by the opening points. Accuracy in setting the ignition timing is important if emergency starting is to be obtained. If the engine is dismantled

without disturbing the distributor body the timing will re-assemble correctly providing that the rotor arm is pointing downwards and the marked camshaft sprocket tooth is on T.D.C. when the distributor sprocket peg is inserted.

### 31. REMOVAL OF ENGINE FROM FRAME

The engine and gearbox assembly is intended to be removed from the frame as a unit, and for this purpose it is advisable to support the frame on a block or box to provide rather more stability than is available from a central stand. Remove the petrol tank, oil bath chaincase, the oil tank and battery, together with their platform. Remove also the engine steady stay and disconnect all cables and electric wiring likely to prevent the engine/gearbox assembly being removed when all attachments are released.

Remove the remaining bolts holding the engine/gearbox assembly to the frame and lift the assembly clear of the frame. It will probably be necessary to obtain assistance to hold the cycle steady whilst removing the unit. No difficulty should be experienced in disconnecting the engine from the gearbox or vice versa.

### 32. CRANKSHAFT—REMOVAL AND FITTING

Remove engine sprocket key, remove timing cover, chains, sprockets, etc. (paras. 25 and 29). Remove breather pipe from rear of driving side crankcase, and the nuts from the top two crankcase studs. Remove half-time pinion key, and camshaft sprocket key. Remove the short bolt between the top front engine plate bosses, and the two cheese-headed screws, one between the bottom bosses and the other in the corner of the sump. The timing side crankcase may now be removed by levering gently between the crank cheek and the crankcase inner wall with a tyre lever or similar tool. There may be packing shims fitted between the crank cheek and the timing side bearings; ensure that none of these is lost.

Withdraw the camshaft, and from the bottom of the driving side camshaft bush, remove the automatic breather valve and spring. Rest the driving side half face uppermost on two wooden blocks high enough for the mainshaft to clear the bench, and withdraw the crankshaft. It will bring with it the inner race of the mainshaft roller bearing.

If any new parts have been fitted, or the location of the packing shims forgotten, it will be necessary to re-centralise the crankshaft when refitting. It is almost certain that some shims will be required between the driving side bearing and the crank cheek, so two shims should be placed on the mainshaft before fitting it into the driving side crankcase. Having ensured that the crankcase is right home against the bearing, take a measurement from the crankcase joint face at a point where there is no upstanding spigot to the upper side of the flywheel. This should measure  $\frac{1}{2}$  in., and whilst it is reasonably important, a rule measurement is sufficiently accurate. Shim up until this figure is obtained, and fit the timing side case. Pinch the two halves together with three bolts about equally spaced and check the crankshaft for end float. There should be .005 in.—.008 in. Add the necessary shims to the timing side mainshaft. Dismantle, lubricate bearings, apply jointing compound to crankcase faces and assemble fully.

### 33. BIG END BEARINGS—RENEWAL

The necessity for big end bearing renewal will be apparent by a thumping noise from the region of the crankcase, when the engine is pulling, and by a very low pressure—if checked. Check that the end cap and big end of the rod are marked for correct re-assembly and mark the rod and crankshaft to ensure that the rods are fitted the same way round as originally.

With a ring or box spanner and noting the pressure required, release the shakeproof nuts from the big end bolts.

Remove the nuts and washers, when a straight pull on the rod should remove the end cap. If the cap becomes wedged due to misalignment, tap carefully home and try another pull. The steel backed bearings may be readily picked out and replaced.

Over an extremely long period, there will be no measurable wear on the crankpins, and standard size bearing will be suitable replacements. No difficulty should be experienced in fitting the replacements but care should be taken to ensure that both rod and bearings are perfectly clean when assembled.

Lightly smear the crankpin with oil and re-assemble the end caps on the rod in the same position as originally fitted. With a box

or ring spanner, pull down the end cap nuts evenly and quite tightly but without sufficient pressure to cause distortion of the cap. If a torque wrench is being used tighten to 170/180 in./lbs.

### 34. CRANKSHAFT—DISMANTLING AND RE-ASSEMBLY

After a considerable mileage has been covered, the large oil well formed in the centre of the crankshaft assembly, will tend to become partially filled with sludge and carbon deposited centrifugally as the oil passes through. It is impossible to state at what mileage this should be cleaned out as it is entirely dependent on the frequency with which the oil is changed and the general cleanliness of the engine, but obviously it will not be dealt with until the unit is due for a major overhaul.

The flywheel is held between the two crank throws by four bolts and two studs, the nuts of the latter being secured by tab washers.

Before commencing to dismantle, mark the flywheel and one crank cheek to ensure re-assembly in the original position.

Bend back the tab washers on the same side of the flywheel as the bolt nuts, remove all nuts and withdraw the four bolts. This will enable the crank throw and flywheel to be removed.

Thoroughly clean out the centre holes and the feed holes to the bearings, ensure all faces are perfectly clean and re-assemble in the reverse order, lightly pinching down each nut before finally tightening in diagonal order. Remember to re-assemble the flywheel the same way round that it was originally fitted. Lock the bolt nuts with a punch mark and reset the tab washers.

### 35. SMALL END BUSH—REMOVAL AND FITTING

Whilst the connecting rod is removed, it may be found desirable to renew the small end bush, although the removal of the old bush and fitting of a new one can be carried out with only the cylinder barrel and pistons removed. Obtain a bolt at least twice the length of the bush, place a washer at the head of the bolt with an outside diameter slightly less than the bush. Place the bolt in the bush and over the screwed end of the bolt, place a piece of tubing longer than the

bush with an inside diameter slightly larger than the outside of the bush. Fit nut to bolt and tighten. As the nut is tightened the bush will be drawn from the connecting rod. Fit new bush in the reverse manner. Before fitting the bush to the rod, the inside diameter should be reamed to the size of the pin as, when fitted in the rod, the bush will compress slightly leaving sufficient material for truing with the reamer. Drill oil holes in the bush before reaming to size. The gudgeon pin should finally be a nice push fit in the bush.

### **36. CAMSHAFT BUSHES—REMOVAL AND REPLACEMENT**

Considerable difficulty will be experienced in removing the camshaft bush from the driving side half-case, if sufficient wear ever occurs for renewal of these bushes to be necessary. It is most strongly recommended to return the crankcase to our service department to have this operation carried out.

### **37. MAIN BEARINGS—REMOVAL AND REPLACEMENT**

To remove the main bearings, gently heat the case around the main bearing housing, avoiding overheating or a concentration of heat on one spot. Drop the half-case open side downwards square and true on to the bench or wooden block and the bearings (or outer race in the case of the driving side) will fall out. Replacements are more readily fitted whilst the case is still hot and should be pressed or carefully drifted home in the housing. Before fitting, it is wise to check that the replacements are a nice push fit on the mainshafts.

### **38. INTERMEDIATE GEAR SPINDLE AND BUSH—REMOVAL AND FITTING**

To remove and re-fit the bronze bush in the intermediate gear, adopt exactly the same procedure as for the small end bush (para. 35), although the same tackle will not be suitable.

In the unlikely event of the intermediate gear spindle requiring renewal, it should be drifted out of position whilst the case is still hot from removal of the main bearings. The replacement should be set perfectly square before pressing or drifting home. This operation should again be carried out whilst the case is sufficiently warm for the spindle to be partly inserted by hand. There is no necessity to remove the circlip from the hole into which the spindle fits either for removal or refitting.

### **39. BIG END FEED OIL SEAL—REMOVAL AND FITTING**

This oil seal which is fitted in the timing cover cannot be removed without damaging it beyond all further use and a replacement should be obtained before attempting its removal. Remove the original seal by first removing the retaining circlip and inserting a screwdriver or similar tool into the centre hole, under the seal and levering on the opposite side of the boss. Repeat this procedure a few times on opposite sides of the seal. Take care not to damage the recess into which the seal fits or the face on which it seats. Carefully press or drift the replacement seal into position, the metal covered face being outwards (visible.).

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## **THE ENGINE**

### **Models ES2 & 50**

#### **40. ENGINE, LUBRICATION SYSTEM**

This is of the dry sump type. The oil flows from the oil tank to the pump by gravity, assisted by suction from the feed side of the oil pump, through the gears, and is forced under pressure to various parts of the engine, drains to the lowest part of the

crankcase—that is the sludge trap—and by suction from the return side of the pump is lifted back to the oil tank.

#### **41. THE FILTER**

The only filter in the oil system is of the gauze type and is fitted to the feed side of the

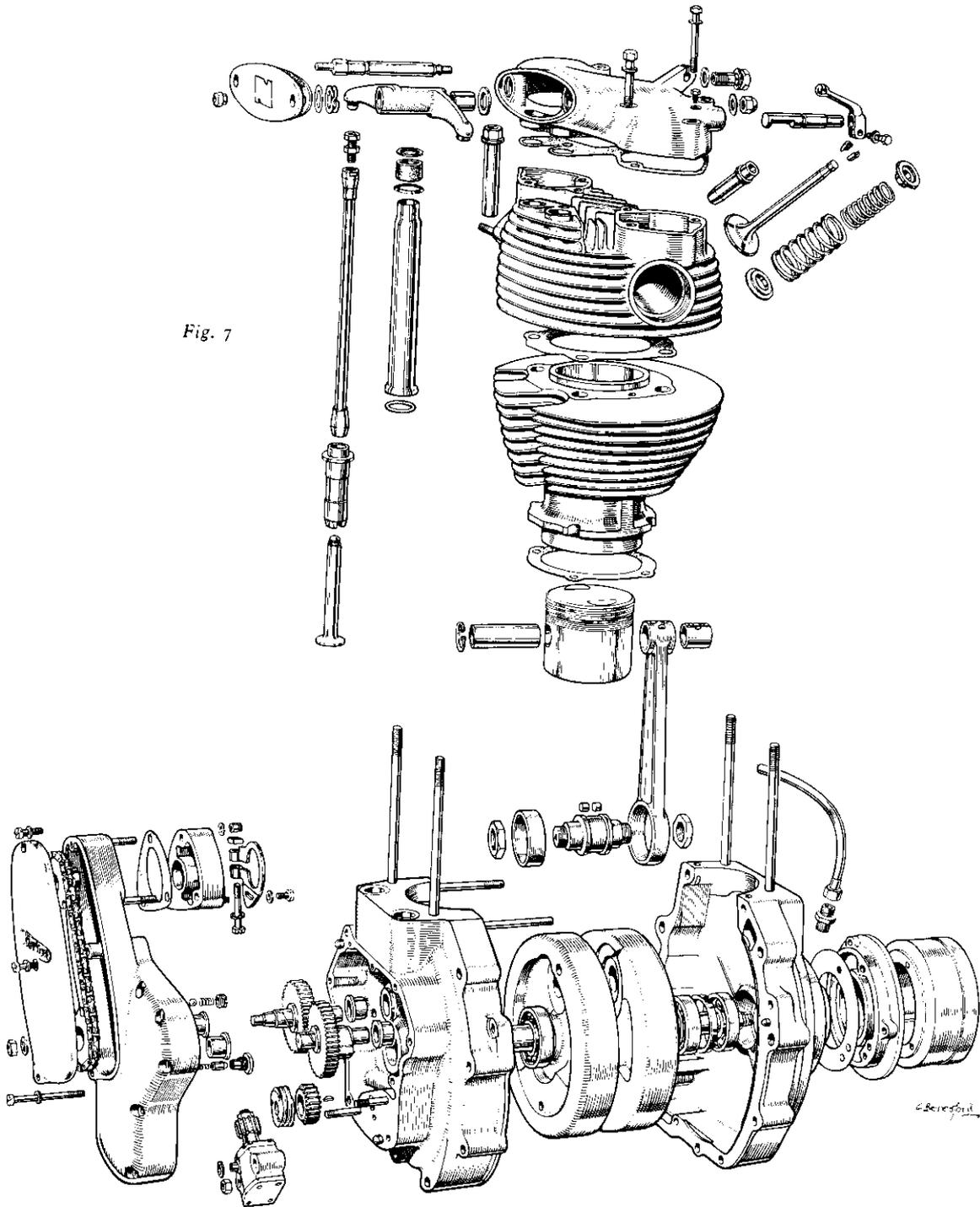


Fig. 7

oil circuit, attached to the adaptor screwed into the oil tank, to which the feed pipe is connected. (See Fig. 2.).

Clean filter, when oil tank is drained, every 2,000 miles.

#### 42. ENGINE OIL PUMP

This is of the gear type. The pump contains two pairs of gears, one on the feed side and the other on the return side.

The gears on the return side are twice the width of those on the feed, having twice the pumping capacity. This ensures that the crankcase is free from oil when the engine is running.

To check the return of the oil to the tank, remove the oil filler cap. The oil return pipe can then be seen. After the engine has been running for a few minutes, the oil return flow will be spasmodic, due to the greater capacity of the return gears.

#### 43. OIL LEVEL

The oil level in the oil tank should not be above three-quarters and not below half.

If the level is above the three-quarter mark when the engine is running, the pressure built up in the oil tank by the oil return side of the pump will force the surplus oil through the air release pipe on to the road.

Always run engine for a few minutes before checking oil level. It is possible when an engine has been idle for any length of time for the oil to syphon through the return gears to the sump.

When this happens, all the oil is returned to the tank in the first few minutes that the engine is running.

When the oil level is below the half full mark there is such a small quantity of oil that it tends to over-heat.

#### 44. THE CIRCULATION OF THE OIL

The oil is forced from the pump,

1. To the big-end bearing.
2. To the pressure control valve.

1. The oil passes down the timing panel through the big-end restriction jet, along the timing shaft, up the flywheel and is sprayed on to the roller big-end.
2. The oil pressure control valve is a spring-loaded ball, and acts as a safety valve, in the oil circuit. When the pressure of the oil lifts the ball from its seat, the oil passes the ball and is sprayed upon the timing gears. When the engine is assembled at the Works, the valve ball spring adjusting screw is screwed home and released  $1\frac{1}{2}$  threads. This is the only adjustment in the oiling system and it is not advisable to remove the ball from the valve unless it is suspected that the ball is sticking or not seating.

From the cylinder the oil drains down the sides of the crankcase and is picked up by ducts and carried to the main bearings and the timing gear bearings.

The oil collects in the timing case to such a level that the oil pump pinion is immersed, carrying oil to the half-time pinion and the timing gears.

A timed breather is incorporated in the driving side mainshaft and releases pressure through a small hole in the underside of the mainshaft bearing boss.

A lead is taken from the oil return pipe to a banjo fitting on the rocker box, feeding oil to the rocker shafts and ball ends. Surplus oil returns down the pushrod cover tubes to the crankcase. Excess oil from the O.H.V. valve spring chambers drains back through drilled holes in the cylinder head and barrel.

Oil is fed to the magdyno chain by passing through the inlet cam spindle bush into the chain case. Any excess of oil accumulated in the case, drains through the breather pipe.

Crankcase pressure is released by a valve on the driving side of the crankcase and oil mist is fed to the rear chain.

All the oil drains to the base of the crankcase to the sludge-trap, is picked up by the suction of the return side of the pump and returned to the tank.

The oil-way from the sludge-trap is situated so that any foreign matter is left in the trap. This leaves the case when the crankcase drain plug is removed and the oil drained.

# MAINTENANCE OF ENGINE

## DECARBONISING

### 45. REMOVAL OF ROCKER BOX CYLINDER HEAD and CYLINDER BARREL

Remove petrol tank (para. 7) and unscrew the rocker oil feed pipe top connection from the centre of the nearside of the rocker box, taking care not to lose the fibre washer from either side of the banjo. Disconnect exhaust valve lifter cable from lever and completely release the nine bolts holding the box to cylinder head. All but the rearmost bolt can be completely withdrawn whilst the box is in position. If necessary break joint by tapping box with mallet or light block of wood. A thin composition washer is fitted between head and box, do not tear this during removal.

Lift out pushrods now protruding from head.

To remove the cylinder head, remove the exhaust system complete, slacken the air filter hose clip (when fitted) on the carburettor air intake and push the hose into the air filter sufficient to enable the carburettor to be withdrawn when the two flange nuts and petrol feed pipe have been removed.

Disconnect high tension lead from sparking plug. Slacken each of the four cylinder head nuts and completely remove.

**NOTE!** A plain steel washer is fitted beneath each cylinder head nut.

Tap beneath inlet port with light block or mallet to break joint if necessary. The head should be lifted off from the timing side of the engine as it will bring with it the pushrod cover tubes held in position by rubber sleeves. Ensure that neither of the rubber rings forming the cover tube bottom seal is lost during this process.

Revolve engine till piston is around bottom dead centre position and lift off cylinder barrel; avoid tearing paper washer.

The barrel need not be removed for decarbonisation as the piston top can be readily cleaned with barrel in position and piston on top dead centre.

Immediately barrel is removed, cover crankcase mouth with clean rag to prevent ingress of dirt or foreign matter.

### 46. REMOVAL OF CARBON

Scrape carbon from top of piston and cylinder head.

Both are of the alloy type and care must be taken not to damage them.

Place an old piston ring at the top of the bore, and resting on top of piston. It will prevent the carbon being removed at the edge of the piston and end of the bore.

After an engine has been used for any considerable time, wear in the bore and the rings takes place, allowing a small amount of oil to pass.

The carbon on the piston edge and the top if the bore acts as an oil seal and if removed, engine may use a little more oil until carbon is reformed.

The carbon deposit in the valve ports and valve spring compartment cannot be removed unless the valves are removed.

Valves need **NOT** be removed at every de-carbonisation.

### 47. REMOVAL OF VALVES FROM CYLINDER HEAD

Compress valve springs with a suitable type of valve compressor.

When springs are compressed the valve cotters will fall from the valve stems.

Remove valve compressor.

Remove valves.

Remove valve springs and collars from valve spring compartment.

Remove carbon from underside of valve heads.

Check valve stems in guides; if free, do not touch guides, unless they are badly worn.

If guides and valves show no signs of excessive wear, re-grind valve seats.

Always grind the seats when new valves are fitted.

### 48. GRINDING OF VALVE SEATS

Use as little grinding compound as possible.

Place valve in guide and grind lightly, using a screwdriver or hand vice.

Do not revolve valve a complete turn, but oscillate, frequently raising valve from seat and placing in a different position.

Do not over-grind valve seats (a wide seat is not necessary).

When seat is ground sufficiently, that is, when the marks of the grinding make a complete ring on the seat and on the valve,

remove all signs of grinding paste from seat, valve and valve pockets.

If the valves or the seats are badly burnt or pitted, it may be impossible to obtain a perfect seat by grinding. The seat will then have to be re-cut, and the valves re-faced, or new valves fitted.

#### 49. FITTING OF VALVES

Thoroughly clean valves, seats, and valve pockets. Fit valve springs and collars. Lubricate valve stems.

Fit valves into guides, compress valve springs, and fit cotters.

If the valve cotters are greased with a thick grease, the grease will hold the cotters in place until the springs are released.

#### 50. REMOVING AND REFITTING OF VALVE GUIDES

Valve guides are a driving fit in the cylinder barrel or head.

To remove, warm head and tap out with a double diameter drift.

Use the drift to replace or fit new ones

Seats must be trued-up with cutter after refitting of guides, to ensure that the guides and seats are in alignment.

Oversize valve guides are usually available if required.

#### 51. FITTING OF CYLINDER BARREL, CYLINDER HEAD AND ROCKER BOX

Position piston rings so that gaps are equally spaced.

Lubricate rings, barrel and piston, and rotate engine till piston is near top of stroke.

Fit paper washer to crankcase mouth, ensuring that cylinder oil feed hole is unobstructed.

Fit barrel over piston and slide right home.

Clean cylinder head joint face on both head and barrel, and place aluminium gasket on top of barrel in position it previously occupied.

Fit head ensuring that the lower ends of the push rod cover tubes are seating correctly between the tappet guide collar and the flange on the bottom of the push rod cover tubes.

If the cover tubes have been withdrawn from the head, ensure that they are replaced as shown in Fig. 8. The flat steel washer being placed in the bottom of the enlarged push rod tunnel and held in position by the rubber sleeve. The angled washer being placed over the reduced end of the cover tube before pushing the tube home into the head. Smear with oil to assist re-assembly.

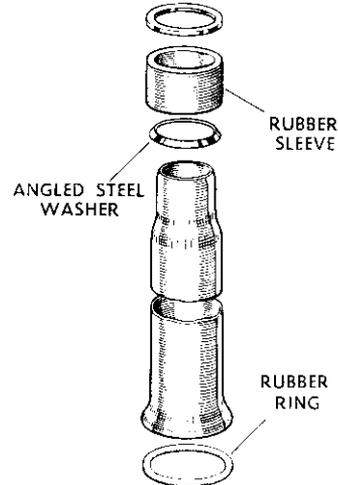


Fig. 8

Fit cylinder head nuts and lightly pinch each one. Finally, tighten in diagonal pairs. Replace push rods in position.

Clean rocker box and cylinder head joint faces and fit paper washer, smearing head with oil to hold washer in place.

Insert bolt in rearmost rocker box hole and place box in position.

Fit and pinch up all nine bolts finally tightening down evenly.

Fit remaining components, remove inspection cover and check push rod adjustment—no clearance but push rods free to rotate.

#### 52. DISMANTLING & RE-ASSEMBLY OF ROCKER BOX

Whilst rocker box is removed it may be necessary to remove the rockers for examination or re-bushing. Remove the inspection cover and the rocker spindle nuts and washers, and with a soft punch against the larger threaded end, drift the spindles out of position.

The rockers with their washers and shims may be extracted from the box.

Remove the exhaust valve lifter by first removing the small securing screw, when the lifter may be withdrawn.

The rocker bushes are a press fit in the rockers and may be pressed or drawn out as shown in Fig. 10.

Rocker ball ends and pads requiring reworking may be drifted out with a punch.

Press in new rocker ends, ensuring that the hole in the shank of the ball end is lined up with the oil hole in the rocker arm.

New rocker bushes may be pressed in or drawn into position by reversing the method of extraction illustrated.

New bushes should be reamed with 9/16" diameter reamer after fitting.

The re-assembly of the rockers in the box may require a little patience. Fig. 9 shows clearly the position of the various parts. Note that the steel shims on either side of the spring washers are identical, the thrust washer at the opposite end being much thicker.

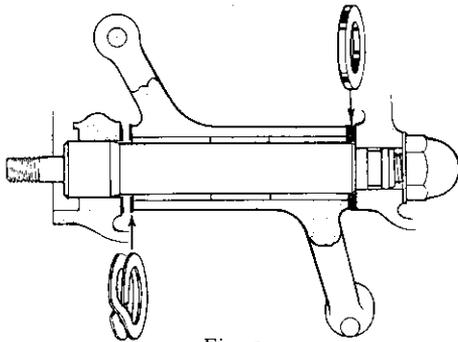


Fig. 9

Obtain a bar slightly smaller than the large spindle hole and having a lead on one end. Insert this into the hole far enough to allow the shims and spring washer to be placed over it. Carefully thread the rocker into position (it may be necessary to slightly withdraw the bar to get the rocker right home), centralise the washers as near as possible, remove bar and insert spindle, having previously smeared it with oil.

Using soft punch tap spindle part way through rocker.

Compress spring washer by means of screwdriver inserted into push rod hole and bearing on rocker arm and place thrust washer in position; the pressure of the spring washer will hold it until the spindle is knocked further home.

It is unlikely that the washer will be in true alignment with the spindle and will,

therefore, be pinched between the rocker box and the shoulder on the spindle when the latter is tapped further into position. To release the washer tap the opposite end of the spindle once only.

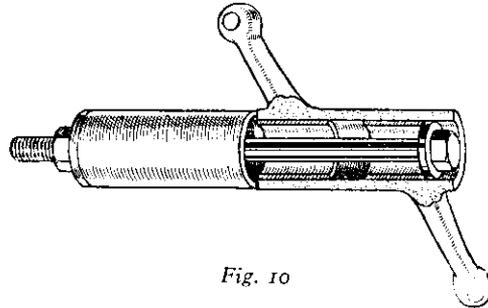


Fig. 10

Re-insert the screwdriver and again compress the spring washer. This will enable the thrust washer to be persuaded to drop over that part of the spindle on which it fits.

Insert tin strip or end of steel rule between rocker box and thrust washer, tap spindle fully home, remove tin strip, ensure that rocker is free to move, fit copper washer and dome nut and tighten.

### 53. TO ADJUST PUSH RODS

Release the middle hexagon—the locking nut—by placing one spanner on the bottom hexagon—the tappet stem or push rod—and the second on the locking nut.

Turn the top hexagon—the tappet head or push rod adjuster—in the desired direction, and when the correct clearance is obtained, tighten locking nut.

Check clearance after tightening locking nut.

When replacing inspection cover, great care should be exercised to avoid over-tightening as this would result in distortion of the cover, with possible breakage or oil leakage.

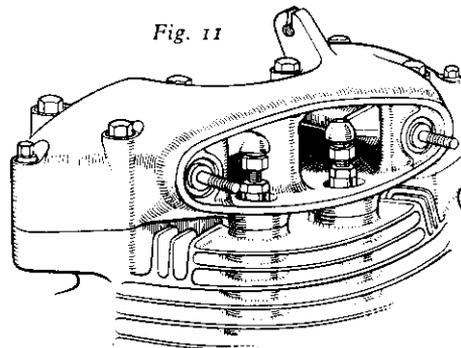


Fig. 11

#### 54. REMOVAL OF PISTON & RINGS

Remove cylinder barrel (para. 45).

Remove one circlip and the gudgeon pin.

Gudgeon pin is a running fit in the piston and small end bush.

Mark piston to ensure it is fitted the same way when replacing.

Remove piston rings. These may be readily "peeled" out of their grooves with the aid of a narrow bladed pen knife.

If it is decided not to fit new rings, it is not advisable to remove the carbon from the back of the ring or the bottom of the ring groove.

If it is decided to fit new rings, the grooves in the piston should be thoroughly cleaned. A portion of a broken hack-saw blade is an ideal tool for the job.

When the grooves have been cleaned, check the new ring for size in the grooves.

There should be a side clearance of .002".

Check rings in the cylinder bore for the correct width of gap.

Place ring in bore, push ring down bore, using the piston as a guide.

The ring gap should be:

Compression ring	... .012"—.016"
Scraper	... .005"

Check gap with feeler gauge.

#### 55. REFITTING PISTON

Fit rings to piston.

Fit piston to connecting rod with the piston in the same position as before dismantling.

Fit circlip. It is advisable to always replace circlip and fit a new one.

Fit cylinder barrel (para. 51).

#### 56. REMOVING AND FITTING OF SMALL END BUSH

If, when the cylinder barrel and piston are removed it is found that the small end bush is worn it should be renewed.

Bush must be withdrawn from connecting rod.

Obtain a bolt at least twice the length of the bush, place a washer at the head of the bolt with an outside diameter less than the bush. Place bolt in bush.

Over the screwed end of the bolt place a piece of tubing longer than the bush, with an inside diameter slightly larger than the outside of the bush.

Fit nut to bolt and tighten. As nut is tightened, the bush will be drawn from

the rod.

Care must be taken so that no strain is taken by the rod.

Fit new bush in the same manner.

Before fitting bush to rod, the inside diameter should be reamed to the size of the pin, as when fitted in the rod the bush will compress, leaving sufficient metal for trueing with the reamer. If this is not done, too much metal will need to be taken away with the reamer.

Drill oil holes in the bush before reaming to size.

The gudgeon pin should be a running fit in the small-end and the piston.

#### 57. REMOVAL OF TIMING PANEL

Remove chain cover held by three cheese-headed screws.

Remove sprockets with chain in position. If difficulty is experienced a withdrawing tool should be obtained. The cam spindle sprocket is held by taper and key; the contact breaker shaft is not keyed.

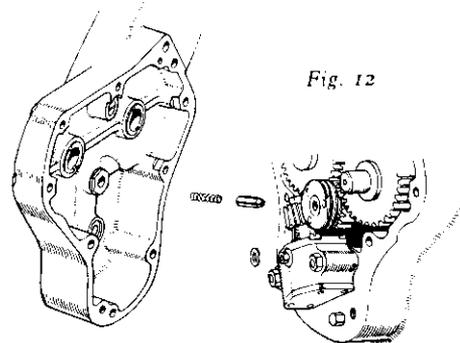


Fig. 12

Remove the contact breaker assembly by removing the set pin holding the clamping plate to the contact breaker housing, disconnecting the coil lead and withdrawing the contact breaker or merely disconnect the coil lead and remove the timing cover with the breaker still in position.

Remove panel screws and note that the top three are shorter than the bottom three. Two countersunk screws are inside the mag. chain case.

When withdrawing the panel see that the big end feed jet is not lost and that any shims fitted to the cam spindles remain in position.

Remove big end feed jet and spring.

### 58. FITTING TIMING PANEL

Clean the edges of the timing chest and the panel.

Smear the edges with gold-size or jointing compound.

Check fibre washer on the oil pump nipple, connecting pump to panel.

Place panel in position and the washer should prevent the edges of the panel meeting the case by  $1/32''$ . This ensures that when the panel pins are tightened, the washer is compressed, making an oil-tight joint.

Fit spring and jet in jet holder.

Fit panel and panel screws and tighten down evenly.

### 59. IGNITION TIMING (see also para. 121)

The contact breaker in which is incorporated the automatic advance mechanism, is chain driven from the inlet cam spindle, the sprocket being located on the tapered shaft and held with a central bolt. Before attempting to check or time the ignition ensure that the driving chain is correctly adjusted. Remove the chain cover and slacken the two 'Allen' nuts and the hexagon nut holding the distributor housing to the timing cover extension and move the housing on its studs until there is about  $3/16''$  whip in the chain. Tighten the 3 nuts.

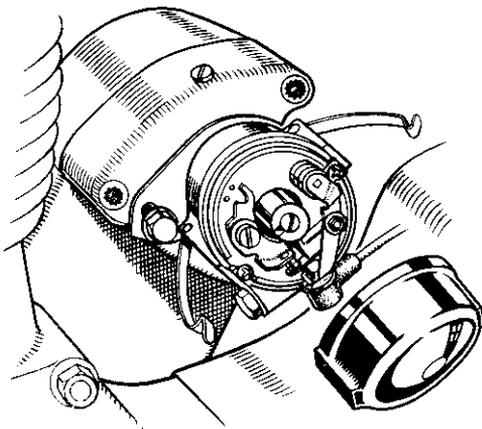


Fig. 13

Set the piston on T.D.C. with both valves closed. Slacken the contact breaker sprocket bolt and release the sprocket from its taper, levering gently behind the sprocket or using a suitable withdrawal tool if necessary. The contact breaker body should be located in its housing so that the coil wire terminal is at the 6 o'clock position which will bring the

oil hole in the spigot in line with the plug in the top of the housing at the same time the elongated hole in the clamping plate should be locked centrally about the set pin in the housing. Slackening the clamping bolt and rotating as necessary to obtain these conditions. **DO NOT ATTEMPT TO ROTATE THE SQUARE NUT ON THE CLAMPING BOLT.**

Rotate engine backwards until piston is in desired position before T.D.C. (see data page). With a small screwdriver in the slot in the cam end (not in the central screw head) rotate the cam clockwise until points just break using either cigarette paper or the electrical method described in para. 30 to ensure the accuracy necessary for satisfactory operation.

### 60. REMOVING TIMING GEARS, OIL PUMP, AND TAPPETS

Remove timing panel (para. 57), timing gears and oil pump are now visible.

Remove oil pump nuts and withdraw oil pump from studs.

Remove oil pump worm, LEFT HAND thread.

Timing gears may now be removed ensuring that any shims fitted to either end of the spindles are not lost.

Withdraw pinion from timing shaft using, if necessary, a sprocket drawer.

Unless absolutely necessary the tappets should not be removed as it is necessary to remove the tappet guides before the tappets may be withdrawn. The tappet guides are pressed into the crankcase and may be extracted by means of a sprocket drawer.

The inlet and exhaust tappets should not be interchanged.

### 61. FITTING TAPPETS, TIMING GEAR AND OIL PUMP

If new timing gears have been fitted then they will need checking and re-shimming for end float. When fully home in the case, the side of the gear should be clear of the boss carrying the pressure release valve. Shims should be added until this condition is obtained.

Fit timing cover, pull and push on inlet cam spindle and shim up till end float is just perceptible.

End float on exhaust cam spindle can only be properly checked when crankcase halves are separated.

Tappets must be entered into tappet guides from inside timing chest before the guides are pressed into position.

This necessitates a tubular drift to finally force the guides home.

Tappet guides are located radially by a peg in top of crankcase, which fits into a hole in tappet guide collar. Hole and peg should be as nearly in alignment as possible before pressing or tapping the guide into position.

Fit half-time pinion to mainshaft and rotate engine till crankpin is on T.D.C.

Fit cam gears, meshing the marked teeth with the appropriate markings on the pinion.

Fit and tighten oil pump worm, LEFT HAND thread, using punch or peg spanner.

Fit oil pump, ensuring that both faces are quite clean and using a minimum of jointing compound to avoid the oil holes becoming obstructed.

Check fibre washer on oil pump nipple and fit timing panel (para. 58).

Time ignition (para. 59).

## 62. OIL PUMP

The oil pump is of the gear type. It is not advisable to dismantle it.

When pump is removed from timing chest, test for play in the spindle by pulling and pushing the worm wheel.

Revolve spindle and place fingers on the oil holes and the action of the gears should be felt if the pump is in good condition.

When revolving pump, any foreign matter obstructing the gears will be felt. Wash out with paraffin.

## 63. OIL CONTROL VALVE

This is fitted in a boss on the inside of the timing panel. It is an assembly of a ball, spring and adjusting screw. The adjustment is set at the works and should not need any attention.

The control valve acts as a safety valve in the oil circuit. When the oil is cold, the oil pressure in the circuit tends to become excessively high, but the excess of pressure lifts the ball from its seat, allowing the oil to spray on to the timing gears.

If for any reason this is dismantled, the order of assembly is—ball, spring and adjuster nut.

Tighten the nut home and then screw out one and a half turns and lock with centre punch.

## 64. EXAMINATION OF THE ROLLER BIG END

With the cylinder removed, the big-end can be examined for wear.

Rotate the flywheels until the big-end is in the topmost position.

Hold connecting rod with both hands, pull and push, and any up and down play can be felt.

**DO NOT USE SIDE PRESSURE.**

**Do not mistake** side float for end play.

A small amount of rock is of no importance.

If any appreciable up and down movement is present a new crankpin bearing is necessary. The dismantling of the flywheels and fitting of crankpin is a skilled job requiring equipment not normally available to the average rider. The flywheel assembly should be returned to the works for this replacement.

## 65. REMOVING ENGINE FROM FRAME

See para. 31.

## 66. PARTING OF THE CRANKCASE HALVES

Remove crankcase drain plug and drain any oil that may be in the sump.

Remove cylinder barrel (para. 45), piston (para 54), timing gear and oil pump (para. 60).

Remove key from driving shaft.

Remove all the crankcase bolts and stud nuts, also the cheese headed screws from sump.

Crankcase halves can now be parted. Remove timing side first.

If leverage is necessary, revolve flywheels until the crankpin is at the mouth of the case, place a lever against the crankpin nut and lever outwards.

To remove the driving side of the case, lift the half of the case with the flywheels and lightly drop the end of the driving shaft on to a block of hard wood, when the case should leave the shaft.

## 67. REMOVAL OF BEARINGS FROM CRANKCASE

It should be possible to remove the bearings from the case by tapping a shaft through the bearings, the shaft having a diameter slightly larger than the engine shaft, but small enough to pass through the bearing,

should the bearing be tight in the case, without damage.

If the bearings are too tight in the housing to be removed by this method, the case should be heated round the bearing housings, when they should drop out.

Do not heat case sufficiently to destroy the temper of the bearings and do not use a concentrated flame.

#### **68. FITTING OF BEARINGS TO CRANKCASE**

Test bearings, to be a sliding fit on shafts.

Press the ball bearing lightly in to the driving side of the case.

Fit the spacing washer next to the ball bearing.

Press the roller bearing lightly in to driving side of the case.

#### **69. ASSEMBLY OF CRANKCASE**

Fit flywheels into case, and fit and tighten all bolts.

Test for side float in the flywheels there should be .005".

If the float is excessive, remove wheels from case.

Fit pen steel washers to the engine and timing shafts to take up the excess of float.

Fit the same thickness of washers on each shaft, keeping the wheels central in the case.

Check side float.

If the side float is correct, check connecting rod for being central in case.

There is side float in the big-end.

Place fingers on the bottom of the connecting rod and push rod towards the timing side of the case.

Measure the distance from the end of the small-end bush to the side of the crankcase mouth on the timing side.

Push rod to driving side of case and take the same measurement, from the driving side.

The two measurements should be within 1/64" of each other.

Rod can belined up by transferring the pen steel washers on the driving and timing shafts to whichever side needs them, to obtain the correct alignment.

When the correct alignment is obtained, remove wheels from case.

Lubricate main bearings and big-end.

Smear the two edges of the case with gold-size or jointing compound.

Fit the wheels into the case and tighten all bolts and nuts.

Fit timing gears (para. 24), and panel (para. 21).

#### **70. REMOVING AND FITTING OF TIMING GEAR BUSHES**

When engine is dismantled it may be found that the timing gear bushes require replacement. This is not a job to be undertaken by the average owner. The timing cover and half crankcase should be despatched to our service department.

# THE TRANSMISSION

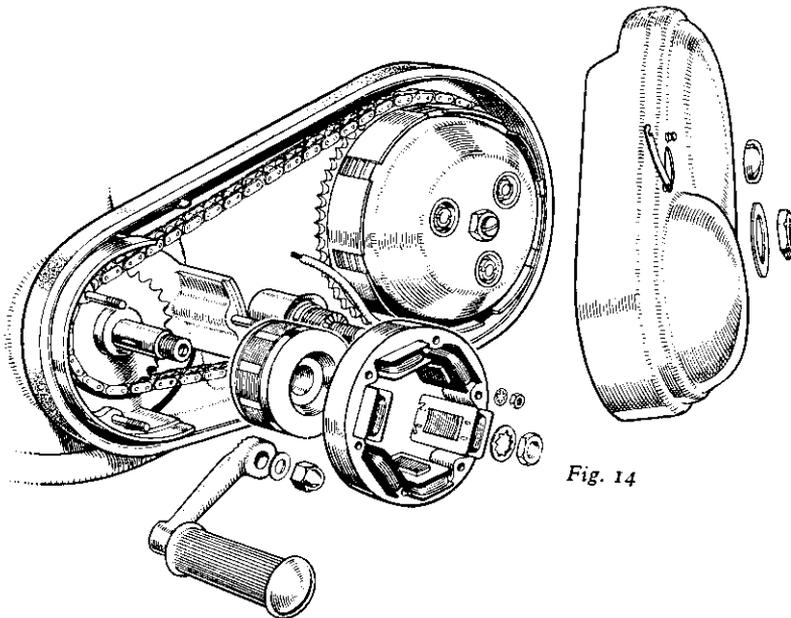


Fig. 14

## 71. CLUTCH ADJUSTMENT

In order to obtain quick, clean gear-changing and freedom from clutch drag, correct clutch adjustment is vital.

Screw down cable adjuster as far as possible.

Remove oil bath outer portion (para. 72) release nut locking the adjuster stud in the centre of the aluminium clutch pressure plate and screw in the stud, until contact with the push rod can be felt.

Screw back exactly half a turn and re-lock nut.

Re-adjust cable adjuster until there is  $\frac{1}{8}$ "- $\frac{3}{16}$ " idle movement before tension occurs in the cable.

Correct clutch spring adjustment is obtained when the adjusting screws are flush with ends of the spring boxes and when individual adjustment has been made to ensure clutch pressure plate withdraws squarely as seen when the oil bath cover is removed and the clutch lever operated.

## 72. REMOVAL AND RE-FITTING OF OIL BATH

Remove the brake pedal by withdrawing the jaw joint pin, and unscrewing the grease nipple from the pedal boss. Remove the left hand footrest and the large nut screwed on to the footrest tube. This will enable the

outer cover to be withdrawn exposing the driving chain, clutch and generator. Remove the three nuts holding the stator and withdraw it from its studs, drawing the cable care-

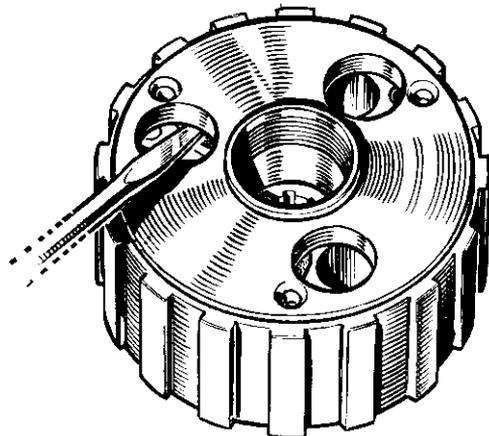


Fig. 15

fully through the inner chaincase until the stator can safely be rested on the front or rear engine plates. Remove mainshaft nut and rotor from mainshaft. Remove chain and withdraw engine sprocket using special extractor if necessary. Remove the three clutch spring nuts, springs and cups and the clutch outer plate. Engage low gear and obtain assistance

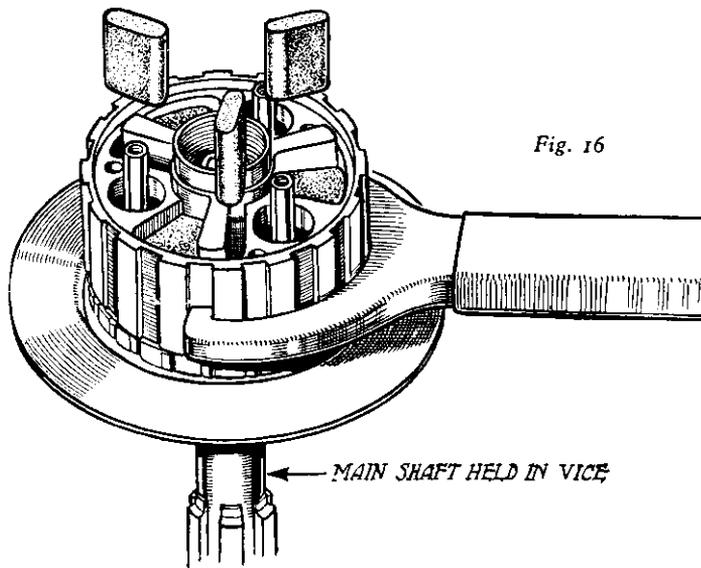


Fig. 16

to hold the rear wheel while the clutch retaining nut is being slackened. With this nut removed the clutch assembly may be withdrawn. Remove the three countersunk 'Allen' screws securing the stator housing to the crankcase. The inner chain case is now held by three countersunk screws at the front end, by a nut to the gearbox bottom bolt and to a pillar extending from the engine plate. Note the paper washer fitted between crankcase and chaincase.

Re-assemble in the reverse order watching that the slots in the stator housing are correctly positioned to pass the chain and fitting the chain spring link with its closed end pointing in direction of travel of the chain. Do not fit outer portion until clutch has been adjusted (para. 71). If the rubber sealing band has stretched it is permissible to cut out the desired amount providing that the joined ends are placed on the top run of the case. Fit stator with the edge from which the leads are taken, innermost and drawing surplus cable through to behind the inner portion. Fit outer cover, giving the rim a few blows with the ball of the hand or a rubber mallet whilst tightening the nut. Do not over tighten or the case may become distorted.

### 73. CLUTCH—TO DISMANTLE

Remove outer portion of the oil bath, and clutch (para. 72).

Remove clutch plates — with inserts and plain steel plates spaced alternately.

Remove clutch sprocket.

Place an old gearbox main axle (if available) in a vice with the splined end above the jaws, and fit body to axle.

Remove the three screws holding the front cover plate and tap the plate round until a screwdriver can be used to prise it off. Fig. 15.

A large "C" spanner is needed to remove the rubbers. This is placed over the body and engaged in the splines, and the large rubbers compressed while the small ones are removed.

The handle of the spanner should be of such a length that the load can be taken by the user's thigh, allowing both hands to be free to remove the rubbers.

A substitute for a "C" spanner can be made by fixing a handle to an old plain steel clutch plate.

Compress large rubbers and remove the small.

A small sharp-pointed tool is necessary to remove the rubbers, as after use they adhere to the body.

Large rubbers are easily removed after the small have been withdrawn.

Remove body from axle and replace in the reverse position.

Remove the three studs on the back cover plate.

Back plate, roller race, back cover and body can be separated.

### 74. EXAMINATION OF CLUTCH PARTS

Examine clutch inserts. They should be

“proud” of the plate.

Fitting of separate inserts to a plate is not advisable, as the new inserts would be “proud” of the remainder and take all the drive on the plate in which it had been fitted.

It is advisable, if possible, to replace plates with either new or reconditioned ones.

If all the new inserts are fitted to a plate, ensure that the inserts are level and flat and all contact the steel plates, taking their share of the drive.

Examine the drive on the plates for wear.

The plates with the inserts, drive on the outside diameter, and the plain steel, on the inside.

The splines on the body and the plain steel plates driven by the body rarely show any signs of wear.

The tongues on the plates with inserts, driving the sprocket, may show signs of wear and they may have “cut” in to the driven part of the sprocket.

This wear obstructs the free movement of the plates when the clutch is operated.

This can be rectified by filing or grinding the tongues on the plates square. Also the edge of the driven part of the sprocket.

The only effect this will have on the clutch is a slight amount of “back-lash” when the clutch is engaged or disengaged.

Examine plain steel plates for any roughness. The back plate sometimes develops this fault.

Examine the roller race, rollers and the cage.

Examine the back cover plate face for wear by the clutch body centre.

Examine clutch shock absorber rubbers. They may have become soft or cracked.

## 75. ASSEMBLY OF CLUTCH

Fit clutch body back cover plate to body, ensuring that the holes in the cover plate are in line with the holes in the body, and the spring studs an easy fit.

Fit clutch body centre and fit clutch large shock absorber rubbers in position to take the drive.

Compress the rubbers in position and fit the small ones.

Fit body front cover and tighten screws.

Fit roller race on to the back cover plate, fit clutch plate back, and spring studs, fit stud nut and tighten. Lock nuts with a centre punch.

Test roller race for freeness on its track, and apply a little anti-centrifuge grease.

Check all the clutch plates in the sprocket and on the body for freeness.

Fit sprocket to body. Revolve sprocket on race to check free movement.

Fit plates to sprocket and body. Order of fitting is—plain steel, inserts, plain, etc.

Revolve sprocket, ensuring that the plates are free.

Fit clutch to gearbox axle.

Fit clutch thrust rod, clutch outer plate spring cups, springs, and spring pins. Tighten till flush with cover and adjust as necessary to produce square withdrawal of outer plate.

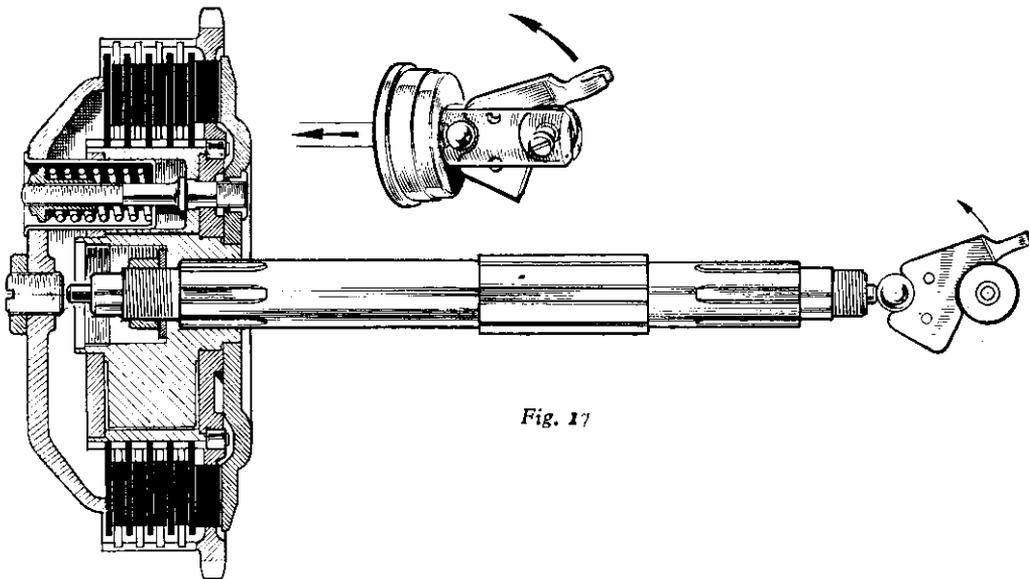


Fig. 17

## GEARBOX

### 76. REMOVAL FROM FRAME

With this frame it is not possible to remove the gearbox as a separate unit. The whole design is based on an engine/gearbox unit as an integral part and if for any reason it becomes necessary for the gearbox shell to be removed, it is essential to lift the engine/gearbox assembly from the frame as described in para. 31 and to remove the gearbox as a subsequent operation.

### 77. PRIMARY CHAIN ADJUSTMENT

Slacken top and bottom gearbox bolts and unscrew whichever of the lock nuts on the adjuster bolt (situated beneath oil tank on timing side) would prevent the box moving in the desired direction. Rotation of the other lock nut will remove the box in the required direction. There should be  $\frac{1}{4}$ " to  $\frac{5}{16}$ " slack in the chain when correctly adjusted.

Re-tighten all nuts and re-check chain tension.

### 78. OUTER COVER, REMOVAL

Remove the kick starter crank by releasing its pinch bolt and pulling off the crank.

Remove gear indicator by unscrewing the centre bolt from the positive spindle.

Remove oil filler and inspection plate, and disconnect clutch inner wire from operating lever.

Do not remove foot change pedal.

Remove five screws holding cover in position, and carefully pull the cover away by means of the footchange pedal. Take care not to tear paper washer.

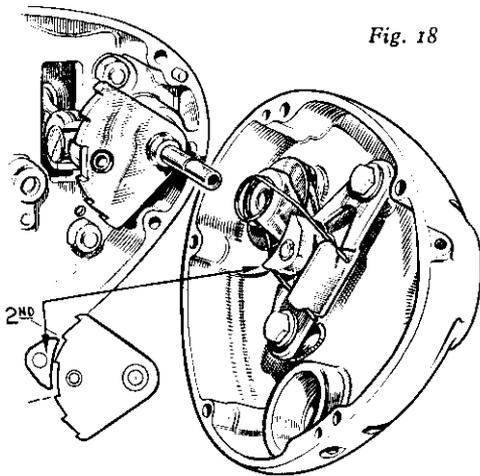


Fig. 18

### 79. OUTER COVER, FITTING

Ensure paper washer is undamaged or carefully scrape off old washer and fit new.

Ensure also foot change pawl spring not dislodged and lying correctly with its straight leg uppermost, each leg resting on the rocking pawl (Fig. 18) before fitting cover. Replace remaining parts.

Some oil will have been lost due to cover removal and should be replenished through the filler hole after the level plug: i.e. the small hexagon headed pin to the rear of the kickstarter axle, has been removed. Engine oil should be **slowly** poured in until it commences to drip through this screw hole.

### 80. POSITIVE FOOT CHANGE DISMANTLING

Removal of the outer cover will bring with it the positive footchange mechanism.

To dismantle, remove gear indicator and withdraw ratchet plate and spindle.

Remove pawl spring.

Remove operating lever, disengage return spring legs from pawl pin and withdraw pawl carrier.

New return spring cannot be fitted without removing spring stop plate.

### 81. POSITIVE FOOT CHANGE ASSEMBLY

Obtain any necessary replacements and ensure all parts clean.

Smear oil on all moving parts.

Place return spring in position and fit plate.

Place washer on pawl carrier spindle, insert into bush and push home whilst manoeuvring spring legs into position in groove in pawl pin.

Refit pawl spring with cranked leg to ground.

Fit ratchet and spindle.

Refit operating lever and gear indicator before fitting cover.

Use indicator to move ratchet plate into position to pilot operating pin into selector fork roller whilst fitting cover. Probably necessary to remove indicator, finally, to adjust lever to individual requirements.

### 82. INNER COVER, REMOVAL

With outer cover already removed, remove ratchet plate with spindle.

Remove locking ring securing clutch

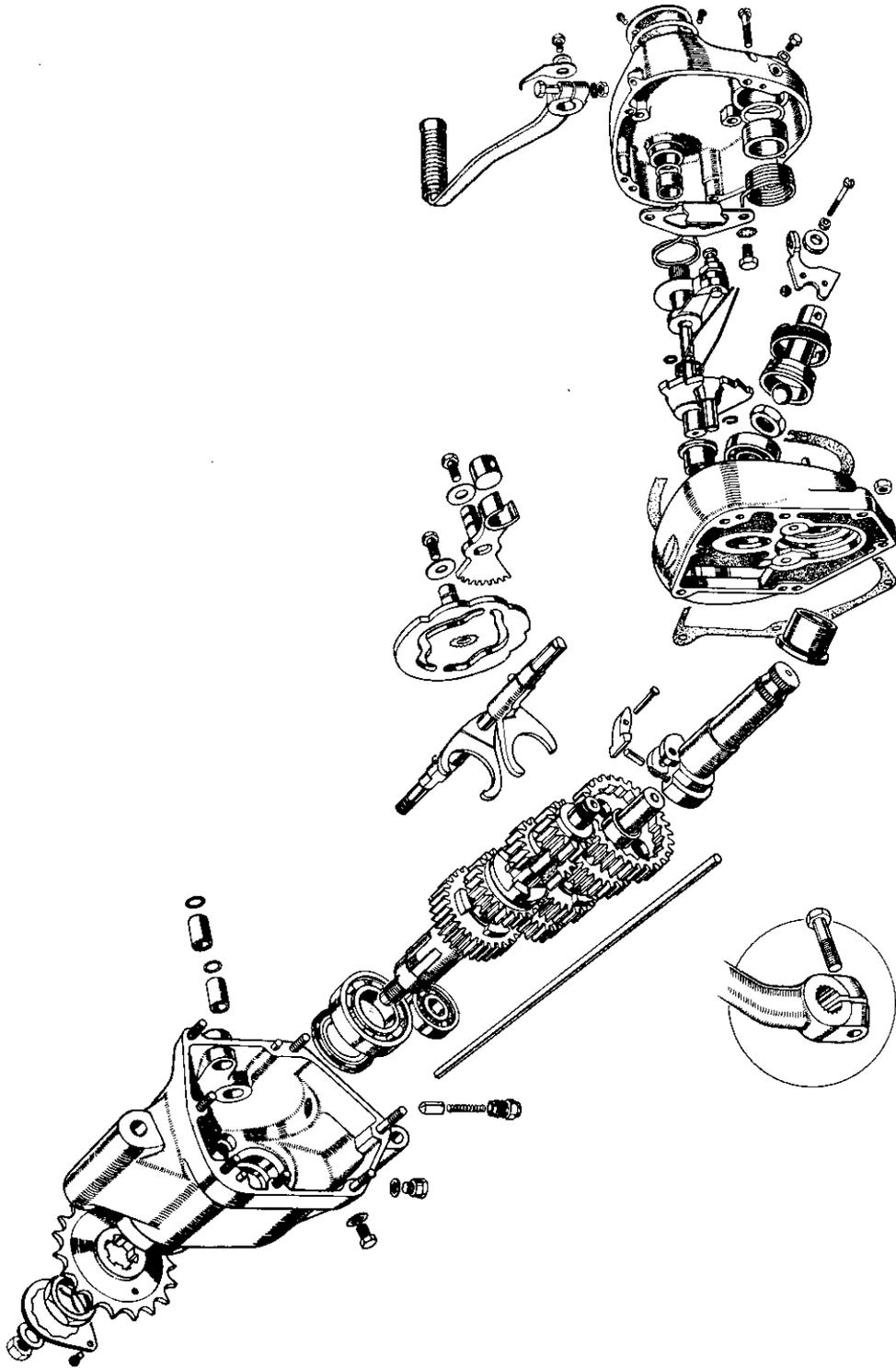


Fig. 19

operating lever body and withdraw body, ensuring that  $\frac{1}{2}$ " steel ball does not become lost. Remove mainshaft nut now exposed.

Remove the seven nuts holding the cover to the shell and withdraw the cover from the studs, tapping behind the front end to loosen if necessary. Avoid damaging paper washer.

### 83. INNER COVER, FITTING

Ensure paper washer undamaged and faces clean.

Fit cover and its seven securing nuts, just pinching all down and finally tightening opposite nuts in pairs.

Fit and tighten mainshaft nut.

Fit clutch operating body with ball but before tightening the locking ring ensure that the operating lever is lying in alignment with clutch cable adjuster hole, in order to obtain a straight pull on the cable.

Fit ratchet plate and spindle.

### 84. INNER COVER, DISMANTLING

The footchange mechanism having been already dealt with, and the clutch operating parts having been removed in order to enable inner cover to be withdrawn, only the kickstarter mechanism remains.

Lever out return spring end from hole in kickstarter axle when the axle can be withdrawn from its bush. Removal of the pawl pin results in pawl, plunger and spring falling out of position.

If the nose of the pawl is worn or chipped, it should be renewed.

### 85. INNER COVER, ASSEMBLING

Examine pawl cam and stop pieces rivetted to cover. if loose re-rivet.

Fit pawl spring, plunger, pawl and pin.

Insert axle into bush, fit return spring.

NOTE that clutch operating mechanism cannot be re-assembled until cover is fitted to box.

### 86. REMOVAL OF GEARS

If the clutch has been removed, it will be helpful to fit a short length of tubing over the end of the main axle and hold it in place with a clutch nut to retain the axle in position whilst the gears are being removed.

Remove end cover (paras. 78 and 82).

Remove the low gear and kickstarter wheel the large gear on the layshaft which has a bronze bush pressed into its centre.

Remove the small wheel from the end of

the main axle.

Remove the mainshaft second gear; this is fitted with a fully floating bush. Unscrew the striker fork shaft by means of the two flats machined on its outer end and remove it together with the layshaft second gear and the striker fork.

Remove the tubular distance piece or clutch and withdraw the main axle together with the third gear and striker fork.

Withdraw the layshaft and the two remaining gears.

Gently warming the box and dropping it face downwards on a wooden block will withdraw the layshaft bearing.

Remove axle sprocket nut which has a left hand thread and is held with a locking washer and screw, and withdraw the main gearwheel. If the gearbox is in the frame and the rear chain in position, obtain assistance to hold rear wheel whilst the nut is being removed.

If the gearbox is removed from the frame, the sprocket may be held by passing a length of old chain around it and holding the ends in a vice.

### 87. REMOVAL OF CAM PLATE

Remove the domed hexagon nut from beneath the forward side of the gearbox. This contains the cam plate indexing plunger which will drop out when the nut is removed.

Remove the two bolts fitted with plain washers visible on the forward side of the gearbox shell. These secure the cam plate and cam plate quadrant, both of which may be pushed through into the box when the bolts are removed. Both cam plate and quadrant are carried in a bronze bush. it is unlikely that these bushes will ever require renewing, but they may be readily pressed or drifted out should the necessity arise.

### 88. FITTING CAM PLATE

Place the quadrant in position and secure it with its bolt and washers. Place the cam plate in position so that one of the end grooves in its circumference is across the centre of the indexing plunger hole in the gearbox shell and meshing its gear with the last tooth but one on the quadrant, ensuring that the correct end of the quadrant rack is being used. Assemble the positive mechanism on to the inner cover. Place cover in position and connect quadrant lever to ratchet by means of knuckle pin.

Set positive footchange to top gear and check that the indexing plunger groove lies

in the correct position to mesh with the indexing plunger when fitted. Withdraw cam plate and re-mesh as necessary until the correct position is obtained when the cam plate bolts and washers should be fitted and tightened. Fit indexing plunger, spring and plunger bush.

### 89. FITTING GEARS INTO GEAR BOX

Fit the main gear wheel, press the wheel home in its bearing, fit gearbox axle sprocket, tighten the nut, fit locking washer and pin.

Fit distance tube in place of clutch and add clutch nut.

Fit third gear wheel (21 teeth) and top gear wheel (18 teeth) to layshaft and fit inner race with rollers and cage to end of shaft. Grease the rollers and fit shaft into box.

Set the cam plate into the second gear position, i.e., with indexing plunger in the

groove next to the shallow neutral groove.

Fit striking fork to mainshaft third gear (21 teeth) and fit gear to main axle, meshing it with the layshaft gear already in position.

Fit the second fork to the layshaft second gear (24 teeth) and fit the second gear with the fork to the layshaft. The pegs on the striking forks fit into the cam plate slots.

With the gearbox in the frame, little trouble will be experienced in holding the first fork in position. Fit the first fork in position and hold with a screwdriver or similar tool whilst the second is placed in position.

Fit striking fork shaft and screw into the case.

Fit the remaining gears.

Fit end cover.

Remove tubular distance piece from clutch end of mainshaft. Remember to finally refill with oil to the level plug.

## WHEELS, HUBS & BRAKES

### 90. FRONT WHEEL, REMOVAL

Place machine on centre stand. Detach brake cable from cam lever and cable adjuster from brake plate. Remove spindle nut from off-side of spindle. Slacken pinch bolt in near side fork end. Take the weight of the wheel in the left hand and withdraw the spindle by means of a tommy bar placed through the hole in the head of the spindle.

### 91. FRONT WHEEL, FITTING

Re-assemble in the reverse order. Insert spindle from near side. Lock pinch bolt in near side fork end after tightening the spindle nut.

### 92. REAR WHEEL, REMOVAL

With machine on centre stand, disconnect tail and stop lamp leads by pulling the cable either side of the rubber covered snap connection behind the number plate. Remove the end bolt from each side lifting handle, which will enable the loose end of the mudguard to be removed whilst the wheel is withdrawn.

Disconnect speedometer driving cable.

Remove the three rubber plugs from the end of the hub and with suitable box spanner, unscrew the sleeve nuts then exposed.

Remove wheel spindle and distance piece and draw wheel off its studs.

This method of wheel removal leaves the chain and brake drum in position.

To remove wheel complete with brake drum, disconnect rear chain and remove chainguard. Remove brake rod adjusting nut, and disconnect speedometer drive. Release wheel spindle and nut from near side stub axle, enabling wheel to be slid along the adjusting slots and removed.

### 93. REAR WHEEL, REFITTING

Reverse dismantling operations. Fit spring link to chain with closed end of spring facing direction of travel, ensure chain adjuster plates correctly seated and when all is tightened, check rear chain for correct tension. There should be  $\frac{3}{4}$ " slack midway between the sprockets with the weight of the machine on the wheels. Adjust rear brake as necessary.

### 94. REAR HUB, DISMANTLING

Remove rear wheel (para. 92). Remove locking ring, felt washer and distance piece from plain side of hub.

Drift out inner sleeve, it will bring with it the single row bearing.

Using a suitable punch, knock out the bearing in the brake side of the hub, together with the peened-in washer, felt washer and pen steel washer.

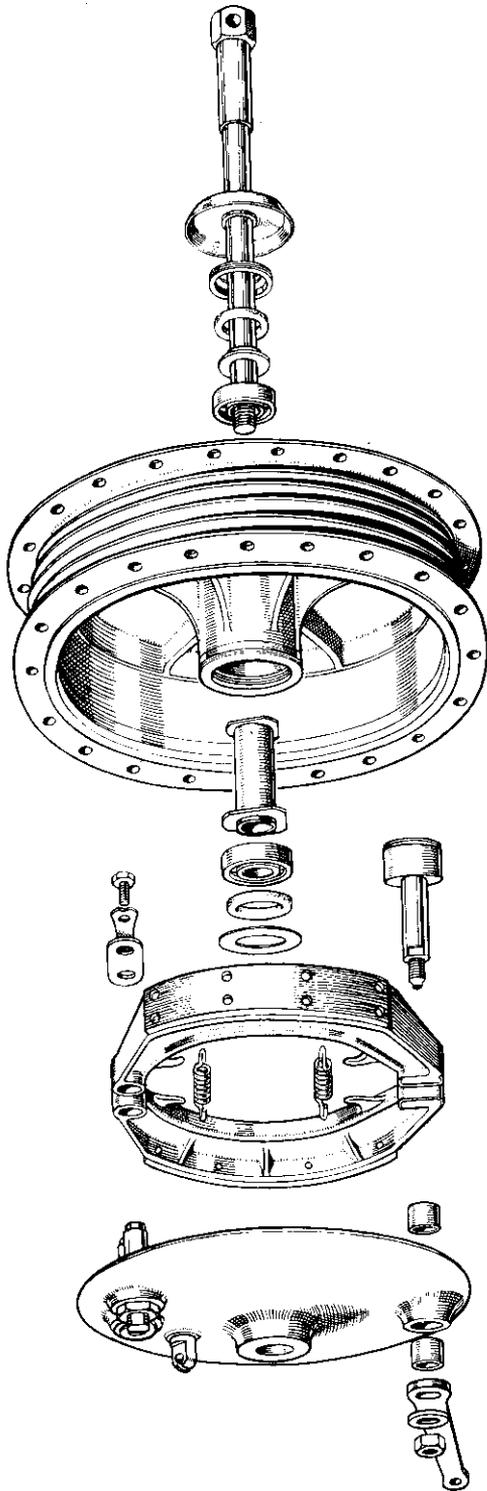


Fig. 20  
**FRONT HUB**

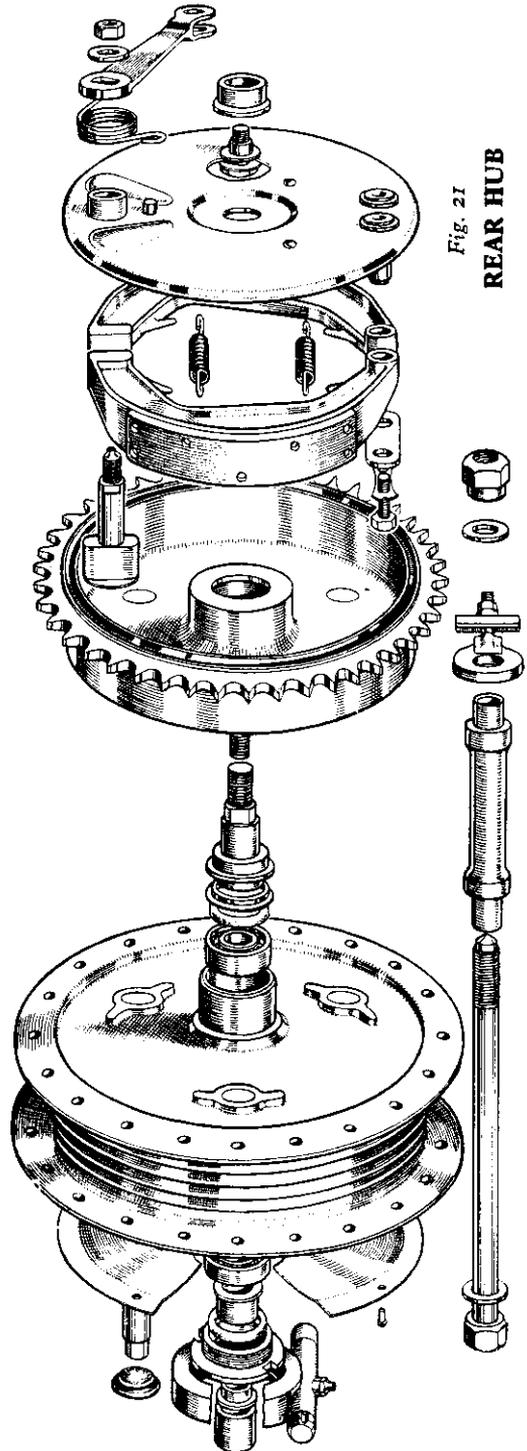


Fig. 21  
**REAR HUB**

### 95. REAR HUB, RE-ASSEMBLING

Pack bearings with grease, wiping off surplus.

Fit single row bearing to screwed side of hub, fit inner sleeve with the long end into single row bearing.

Fit distance piece, felt washer and locking ring and tighten.

Press double row bearing into position on opposite side of hub, followed by the pen steel washer and dished washer. Lightly rivet the dished washer into position.

### 96. FRONT HUB, DISMANTLING

Remove front wheel (para. 90).

Remove brake plate.

Remove locking ring, felt washer and distance piece from opposite side of hub.

With suitable punch knock the bearing in the brake side further into the hub until the single row bearing drops clear.

Remove distance tube.

From this side of the hub, drift out the remaining bearing, together with the peened-in washer, felt washer and pen steel washer.

### 97. FRONT HUB, RE-ASSEMBLING

Pack bearings with grease.

Press single row bearing into position followed by the distance piece (with collar against the bearing), felt washer and locking ring which can be tightened up.

Insert distance tube through brake side of hub, ensuring that it is right home against the bearing just fitted.

Press double row bearing into position.

Fit pen steel washer and felt washer.

Lightly rivet remaining washer into its recess.

### 98. BRAKES, ADJUSTMENT, Front

The adjuster situated at the lower end of the operating cable may be screwed outward as necessary to maintain minimum clearance between brake linings and drum, until such time as the operation of the handlebar lever results in the cam lever moving beyond its best position i.e. a right angle between cable and lever.

At this stage disconnect the cable 'U' clips and remove the cam lever. Turn the lever over and re-fit. This will restore the lever to something like the position it originally occupied and will provide a new lease of life.

### Rear

It is important that the pedal is not depressed beyond its normal travel whilst the return spring concealed within the hub of the pedal is fitted. This spring will be overstressed and likely to require early renewal as a result of such treatment. Adjustment of the pedal position is effected by slackening the spindle and moving the adjustable stop into the desired position.

Adjustment of the nut on the rear end of the brake rod is the only adjustment provided.

Remember that adjustment of the rear chain will necessitate also adjustment of the brake rod.

### 99. BRAKES, DISMANTLING AND ASSEMBLY

Remove brake plate from the drum.

Remove brake lever return spring from the lever.

Remove nut and washer from the cam spindle.

Remove brake lever.

Remove cam spindle from bush in the brake plate.

Tap the end of the spindle lightly until the cam is clear of the shoes.

Remove brake shoe return springs.

Remove the small pin from the end of each pivot pin and lift off the pivot pin tie plate.

Remove the brake shoes.

Cam spindle bush can be removed from the plate after removing the nut holding bush to plate. (Rear only).

### TO RE-ASSEMBLE

Fit cam spindle bush to plate.

Fit brake shoes. Smear a little oil on the pivot pins.

Fit ONE shoe to pivot pin.

Fit spring to the shoe fitted to the pin, near pin.

Hold second shoe near to the one fitted and fit the spring, stretch the spring and fit second shoe to pivot pin.

Fit second spring to both shoes.

Fit cam spindle to plate. Hold shoes apart with screwdriver or similar tool and allow cam to pass the ends of the shoes.

Fit tie plate over shoulders on pivot pins. Fit and tighten both pins.

## FRONT FORKS

### 100. MAINTENANCE

Replenish damping oil at approximately 5,000 mile intervals or whenever the normal characteristics of the forks appear to have deteriorated.

Remove the drain plug from each fork end and unscrew the filler plug from the top of each leg. It will be possible to renew the oil without removing the filler plug from the top of the damper rod. Allow oil to drain off and operate the forks a few times to eject the last drops.

Replace drain plugs.

7 ozs. of Wakefield's Castrolite, Shell X-100-20, B.P. Energol S.A.E. 20, Mobiloil Arctic or Essolube 20 should be poured into each fork leg.

Should a softer movement be required for any reason, a slightly less quantity should be used.

### 101. STEERING HEAD ADJUSTMENT

Place a wooden block or box under the frame tubes of sufficient height to raise the front wheel clear of the ground. Place thumb of left hand on the joint between the steering head of the frame and the fork head clip.

Attempt to lift the forks with the right hand. Any movement at the head races will be readily felt.

To adjust, slacken the steering column locking nut and the pinch bolt clamping each leg into the fork crown.

Adjust by means of the nut situated on the steering column below the head clip, until all the play is removed, but the forks are still free to rotate on the head races.

Re-tighten the steering column locking nut and the pinch bolts.

**Thief-proof locking device.** For solo machines, an abutment on the bottom left hand side of the steering head, and a hole in the left hand side of the fork crown, permit a padlock to be fitted which will lock the steering on full right lock.

### 102. REMOVAL OF FRONT FORKS

Release brake and clutch cables from handlebar levers. Remove handlebar clips and allow bar to rest on tank. Unscrew filler plugs and draw up the plug to expose its locknut at the top of the damper rod. Using two spanners, release the locknut and remove

the filler plugs and their washers.

Remove headlamp and allow to hang by cables. Remove lower end of brake cable from brake plate. Remove headclip nut and tap beneath headclip to release from tapers at top of main tubes. Remove headclip followed by top covers and their rubber washers.

Remove steering top plate pin from the frame below the steering head. Remove steering column nut and dust cover and carefully withdraw the forks. Head races may be readily drifted out for replacement.

### 103. REFITTING FRONT FORKS

Grease head races and drift into position. Soak felt washer in oil and place on top of the top race. Insert steering column through head lug, place dust cover in position, fit and adjust steering column nut.

Attach fork stop plate to frame below head lug. Slacken main tube pinch bolts and place top covers and rubber washers in position on each leg. Fit headclip ensuring that tightening of the centre nut does not affect head race adjustment. Pour the measured quantity of damping oil into each leg, fit filler plugs to damper rods and fit and tighten filler plugs. Re-tighten main tube pinch bolts. Re-fit all remaining components adjusting handlebar position as necessary and ensuring that headlamp is correctly set for height and lateral position of beam.

### 104. FORK LEG DISMANTLING

The individual legs may be dismantled either with the fork in position in the frame or otherwise. Having drained the oil, unscrew filler plug from top of leg and lift it sufficiently for an open ended spanner to be used to slacken the nut which locks the damper rod into the filler plug. Release the pinch bolt nut on the steering column lug below the head lug and pull jerkily on the fork end, when the leg should be withdrawn complete. If necessary, partly replace the filler plug and tap it smartly with mallet or hide hammer to release the leg from the taper in the head clip. Remove main spring from fork leg and the tubular bottom cover which is screwed into the top of the fork end. Remove the locking ring from the mouth of the fork end which will allow the fork end to be removed

from the main tube, together with the damper unit and rod, which may now be withdrawn from the fork end after removing the securing bolt, accessible across the wheel spindle hole, by means of a box spanner. Should it be considered necessary to further dismantle the damper unit, the top gland should be unscrewed and the rod withdrawn, after which, removal of the nut from the bottom of the rod will enable the cup, slotted washer and cross pin to be removed. No difficulty should be experienced in fitting new bushes either to the top of the fork end or the bottom of the main tube.

### 105. FORK LEG, ASSEMBLY

Thoroughly clean all components and lightly smear each one with oil before placing into position. Fit cross pin, cup and slotted washer to short screwed end of the damper rod. Fit and tighten securing nut. Insert this assembly into the damper body and screw home the top gland carefully holding the body in a vice whilst tightening it. Do not overtighten the vice or the body may become distorted. Place washer in bottom of fork end. Place damper unit in position and secure with bolt. Be careful not to bend damper rod. Insert damper rod into main tube and place fork end over lower end of tube. Fit bronze bush and oil seal, ensuring that radiused edge of bore is uppermost. Fit locking ring, do not tighten sufficiently to distort metal case of seal. Lightly grease upper part of main tube and fit and secure bottom cover. Fit main spring. Replace nut on upper end of damper rod and insert main tube into position with a "pull through" if necessary. Draw up the damper rod, place filler plug washer in position and attach the rod to the filler plug, locking it in position by the nut already on the rod. Tighten filler plug to draw main rod right home in its taper. Tighten pinch bolt in crown lug. Fill each leg with 7 ozs. S.A.E. 20 (see para. 100).

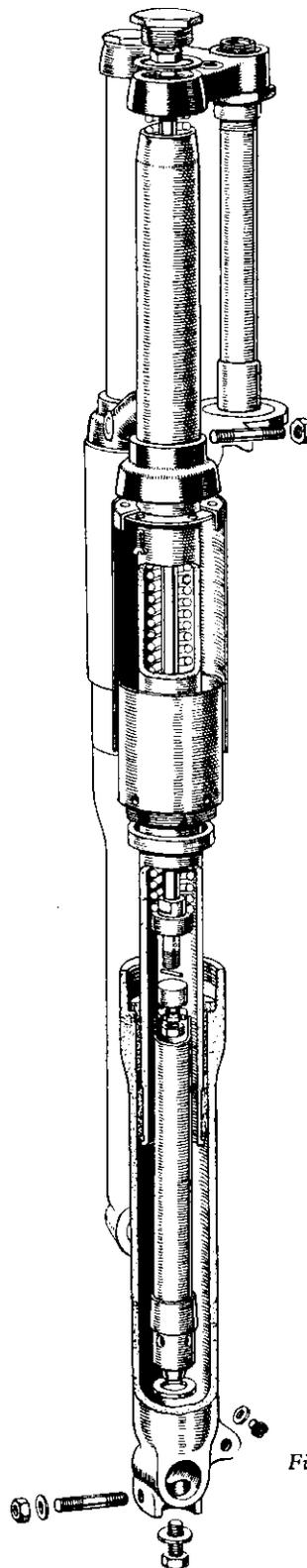


Fig. 22

## REAR SPRINGING

### 106. SWINGING ARM REMOVAL AND ASSEMBLY

With the rear wheel withdrawn, remove the rear suspension units secured only by a single bolt and nut at either end. Remove the nut and washer from one end of the swinging arm bolt, withdraw the bolt, and remove the swinging arm. To renew the silent block bushes, drift out one end, remove the tubular distance piece and drift out the remaining bush. Press in replacement till the outer steel sleeve is flush with the end of the tube. Remember to replace the distance piece before inserting the second bush.

When securing the swinging arm in position in the frame, a dimension of  $1\frac{1}{8}$  in. should be taken from the hole forming the top absorber anchorage to the shock absorber anchorage hole in the swinging arm, the arm being held in this position whilst tightening the swinging arm pivot bolt.

### 107. REAR SUSPENSION UNITS

These fittings embody quite complicated oil damping arrangements which are carefully set to provide the correct suspension characteristics for your machine. They are

sealed and are virtually leak proof and should **not be interfered with**. In the unlikely event of any attention being necessary, their removal is quite simple and straightforward and they should be taken to your usual Norton dealer or the nearest Norton distributor.

It is quite permissible to remove the covers in order to grease the spring to promote silent operation.

These units are adjustable to three positions by means of the 'C' spanner provided. The weak or normal solo position is in use when the abutment spot welded to the lowest member is in engagement with the topmost position on the scroll attached to the base of plated bottom cover or when this part is rotated as far as possible in an anti-clockwise direction. Rotation in a clockwise direction (by means of the key) will result in the stronger positions being engaged. It is important that both units are adjusted to the same position.

No attempt whatever should be made by the normal rider to dismantle, drain or refill these units.

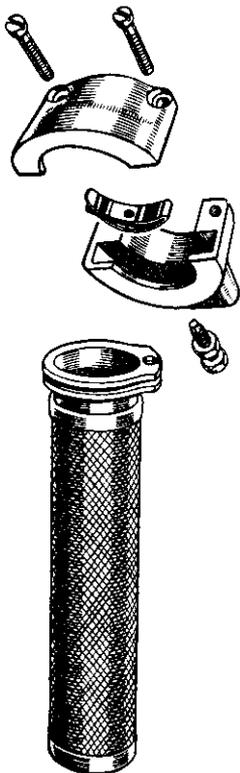


Fig. 23

## HANDLEBAR FITTINGS

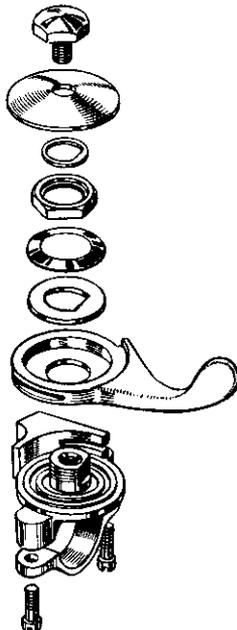


Fig. 24

### 108. AIR CONTROL LEVER

The air control lever is shown in Fig 24 in the position in which it should be assembled, having first greased both sides of the lever.

After fitting the adjusting nut it should be tightened to give the required tension.

To remove the control cables from the lever, open the lever as far as possible, hold the outer cable, and as the lever is closed, pull the outer cable from the lever body.

Remove nipple from the lever.

To fit the cables, fit nipple into the lever, close the lever, pull the outer cable away from the lever and fit the cable to the lever body.

### 109. CLUTCH AND FRONT BRAKE CONTROL LEVERS

The clutch and front brake controls are so simple as to require no instructions for

their dismantling or assembly.

The pivot bolts have shoulders machined on them, allowing the nuts on the bolts to be tightened while allowing clearance for easy movement of the lever.

To remove the clutch cable from the lever, turn the clutch operating arm on the clutch worm by other means than the cable, and the nipple can be removed from the arm, and inner and outer cables can be removed from the lever.

To remove the brake cable from the lever, remove the split cotter and pin holding the "U" clip to the brake arm, and the inner and outer cables can be removed from the lever.

Re-assemble in reverse order.

### 110. TWIST GRIP

The twist grip assembly is shown in Fig. 23.

To assemble the twist grip, grease the portion of the handlebar where grip works.

Fit sleeve to the bar.

Grease the drum on the sleeve.

Fit spring and adjuster bolt and nut to the bottom half clip.

Thread the cable through the hole in the half clip.

Fit the nipple to the drum on the sleeve.

(Sufficient length of cable can be obtained by lifting the throttle slide and holding in position by piece of soft wood placed in the air intake).

Fit the top half clip.

Adjust the tightness of the grip with the adjusting screw and lock in the desired position.

Dismantle in the reverse order.

## AMAL CARBURETTER

### 111. DISMANTLING OF THE CARBURETTER

The easiest way to remove the carburetter is to turn both petrol taps off and disconnect feed pipe from carburetter, remove the two nuts securing carburetter flange and unscrew the knurled ring immediately below where the control cables enter the top of the mixing chamber body so that the slides may be withdrawn, either before or after the carburetter is removed. The air and throttle valves may be left on the cables unless it is desired to change or renew the cables or valves.

The throttle valve needle may be removed or adjusted for position by removal of the spring clip at the top of the slide.

Remove the float chamber cover by removing the three screws securing it, and withdraw the hinged float, this will enable the nylon needle which controls the flow of fuel to be withdrawn and cleaned.

Removal of the nut at the base of the mixing chamber gives access to the main jet which may be unscrewed from the jet holder which also carries the needle jet, accessible by removal of jet holder. Removal of these parts enables the jet block to be pushed or tapped out through the large end of the mixing chamber body when the jet block locating screw has been removed. This screw lies to the left of and slightly below the pilot air adjuster which is the horizontal milled headed screw equipped with restrict- ing spring.

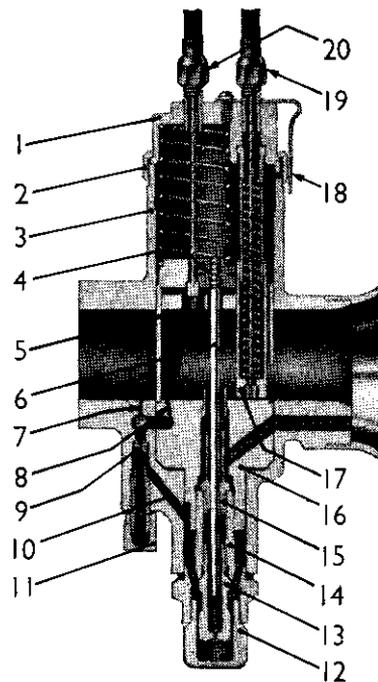


Fig. 25

- |                             |                              |
|-----------------------------|------------------------------|
| 1—Mixing Chamber Top        | 14—Jet Holder                |
| 2—Mixing Chamber Cap        | 15—Needle Jet                |
| 3—Carburetter Body          | 16—Jet Block                 |
| 4—Jet Needle Clip           | 17—Air Valve                 |
| 5—Throttle Valve            | 18—Mixing Chamber Cap        |
| 6—Jet Needle                | Spring                       |
| 7—Pilot Outlet              | 19—Cable Adjuster (Air)      |
| 8—Pilot by-pass             | 20—Cable Adjuster (Throttle) |
| 9—Pilot Jet                 | 21—Tickler                   |
| 10—Petrol feed to pilot jet | 23—Banjo                     |
| 11—Pilot Jet Cover Nut      | 29—Pilot Air Adjusting Screw |
| 12—Main Jet Cover           | 30—Throttle Adjusting Screw  |
| 13—Main Jet                 |                              |

### 112. RE-ASSEMBLY OF CARBURETTER

Re-assembly should present no difficulty but the following points should be watched. The washer fitted to the stub of the jet block should be in good condition, also the one fitted to the needle jet holder. When fitting throttle valve ensure that taper needle really enters the centre hole in the jet block, and throttle works freely when mixing chamber top cap be fitted and secured. Fit float with narrow side of hinge uppermost and ensure that side cover washer and body are clean and undamaged to obtain a petrol tight joint.

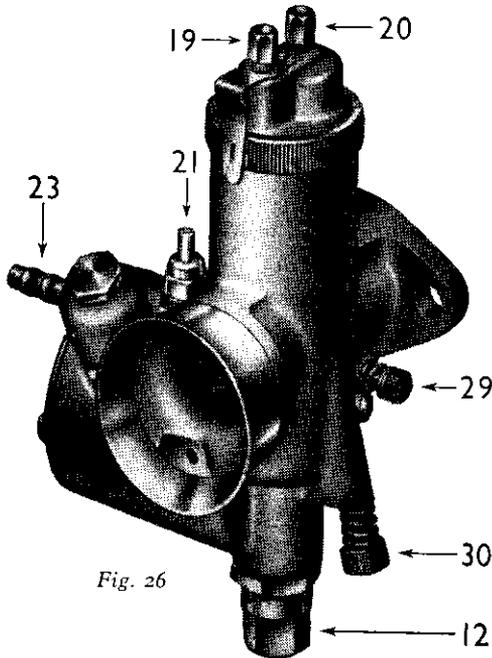


Fig. 26

### 113. CARBURETTER TUNING

There are four distinct phases of tuning and each must be handled separately to obtain best results for any particular set of conditions. For all these positions the air valve should be fully open, the engine should be at its normal working temperature, and the machine should be driven on a slight up gradient to ensure engine pulling the whole time.

#### 1st MAIN JET.

This jet controls the fuel supply when the throttle is more than  $\frac{3}{4}$  open. With the throttle fully open and the engine pulling hard, slightly close the air lever when there should be a slight falling off of speed indicating a

reasonably correct mixture. If maximum speed is obtained before the throttle is fully open, then a larger main jet is required; similarly if there is an increase in speed with the air lever slightly closed.

#### 2nd SLOW RUNNING.

Having fixed the main jet, set the throttle adjusting screw to provide fairly fast idling with the twist grip in the fully closed position and the ignition (where manually controlled) set for best slow running. Screw out the throttle adjusting screw until engine begins to falter; now adjust the pilot air screw in or out as necessary to make the engine run evenly and faster. Lower the throttle adjusting screw further to reduce engine speed until a position of the pilot air screw is found at which the engine runs evenly and steadily on the smallest throttle opening.

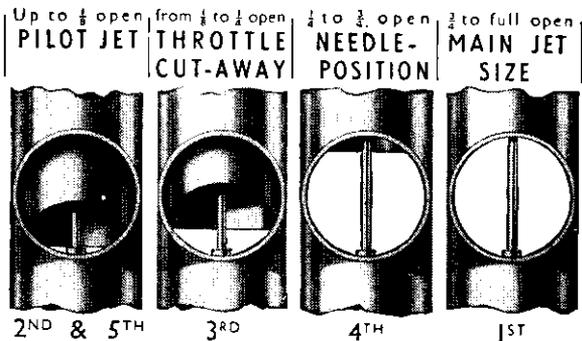
#### 3rd THROTTLE VALVE CUTAWAY.

With the throttle valve about  $\frac{1}{4}$  open (marking the twist grip if necessary in order to readily find this position whilst riding) note whether there is any spitting (indicating weakness) or jerky running under load (indicating richness). In the former event try screwing in the pilot air screw slightly and if this is ineffective, a throttle valve having less cutaway, i.e., stamped with a lower number and the reverse for jerky running.

#### 4th THROTTLE VALVE NEEDLE.

With the throttle about  $\frac{3}{4}$  open and the needle in a low position try the machine for acceleration. If the results are poor and partially closing the lever provides improved conditions, raise the needle a notch or two until the best position is found.

### PHASES OF AMAL NEEDLE JET CARBURETTER THROTTLE OPENINGS



### SEQUENCE OF TUNING

Fig. 27

**5th RE-CHECK IDLING.**

To ensure that subsequent adjustments have not upset the condition.

**114. MAINTENANCE**

Clean periodically by dismantling and washing in clean petrol, cleaning out all holes by blowing. Whilst dismantled examine throttle valve needle and float needle for wear and all fibre washers, renewing as necessary. Check that throttle valve is not unduly worn in the mixing chamber body.

**115. RICH MIXTURE**

Indicated by black exhaust smoke, excessive soot on plug, lumpy running, petrol blown back from air intake.

Assuming that carburation has previously been satisfactory, suspect:—flooding due to punctured float, dirt on float needle seating or worn needle or seat. Worn throttle valve needle or needle jet, air cleaner choked.

**116. WEAK MIXTURE**

Indicating by spitting back, poor acceleration, overheating, erratic slow running or improved performance with air lever partly shut.

Again assuming carburetter has been correctly set, suspect:—fuel blockage, either main supply or within carburetter. Worn inlet valve guide, air leaks at engine carburetter connection, worn throttle valve, loose jets.

## TYRES

**117. MAINTENANCE**

Always keep tyres at the correct pressures, (see data page at front of book). Remove any stones which may be embedded in the tread. Replace valve dust cap if lost.

**118. REMOVAL**

Deflate tube by removing valve cap and core. Remove rim nut and security bolt nut if security bolt fitted. Push the beads of the cover down into the well of the rim at a point opposite to the valve. Insert a small tyre lever between the bead and the rim near to the valve. Ease the bead off the rim using a second lever inserted a short distance away. Repeat until one bead is free of the rim.

Remove security bolt and tube, and remove the second bead in a similar manner.

**119. FITTING**

Fit rim band. Dust tube, beads and rim with French chalk. Slightly inflate tube and place within cover on top of wheel with valve in line with hole in rim. Fit the underneath bead by hand, completing the operation with levers. Thread valve and stem of security bolt through appropriate holes. Fit second bead starting opposite valve. See that security bolt and tube are not being pinched between cover and rim. Inflate. Fit rim nut and security bolt nut. Adjust pressure to manufacturer's recommendation and fit dust cap.

## ELECTRICAL SECTION

The essentials of this simple form of lighting and ignition consist of the following units.

**Alternator.** For the generation of Alternating Current.

**Rectifier.** For conversion of A.C. to Direct Current to enable battery to be charged.

**Battery.** For current storage.

**Coil.** For conversion of low tension voltage to high tension.

**Distributor or Contact Breaker.** To control the timing of the high tension voltage to the sparking plugs (ignition timing).

**Switch.** For control of ignition and lighting.

**120. ESSENTIAL MAINTENANCE**

**Battery.** Inspect regularly and frequently and maintain acid level to top of separators by addition of distilled water.

**Wiring.** Keep all connections and terminals tight and ensure cables are clear of moving parts. Examine carefully stop and tail lamp leads for being securely held against the mudguard, particularly after removal and replacement of the mudguard tail piece.

**Distributor.** Check points for correct gap and cleanliness. Lubricate auto advance mechanism and contact breaker cam and pivot.

**Head Lamp.** Re-align lamp after fitting new main bulb.

**121. IGNITION**

In the "OFF" position when key in top of switch in headlamp lies in line with machine. Turn key in clockwise direction for normal "ON" position. Turn key in anti-clockwise direction for emergency starting, i.e., starting with flat battery. Return key to normal "ON" position when engine running.

Ignition timing must be very carefully set if best conditions are to be obtained: the correct figures are:—

Model 88 — 30° Fully advanced 6° Fully retarded, before T.D.C.

Model 99 — 32° Fully advanced 8° Fully retarded, before T.D.C.

Models ES2 and 50 — 38° Fully advanced 8° Fully retarded, before T.D.C.

See paras. 30 and 59 for timing procedure.

**122. ALTERNATOR. LUCAS R.M.15.**

Since the alternator has no commutator, brush mechanism, bearings, or oil seals, it requires no maintenance apart from occasionally checking that the snap connectors in the three output cables are clean and tight.

The rotor is secured to the mainshaft by nut and key and may be withdrawn when the nut is removed. It may be necessary to

remove the stator (secured by 3 pins) if rotor is tight on shaft. There is no necessity to fit keepers to the rotor poles when the rotor is removed. Wipe off any metal swarf which may have collected on the pole tips and place the rotor in a clean place.

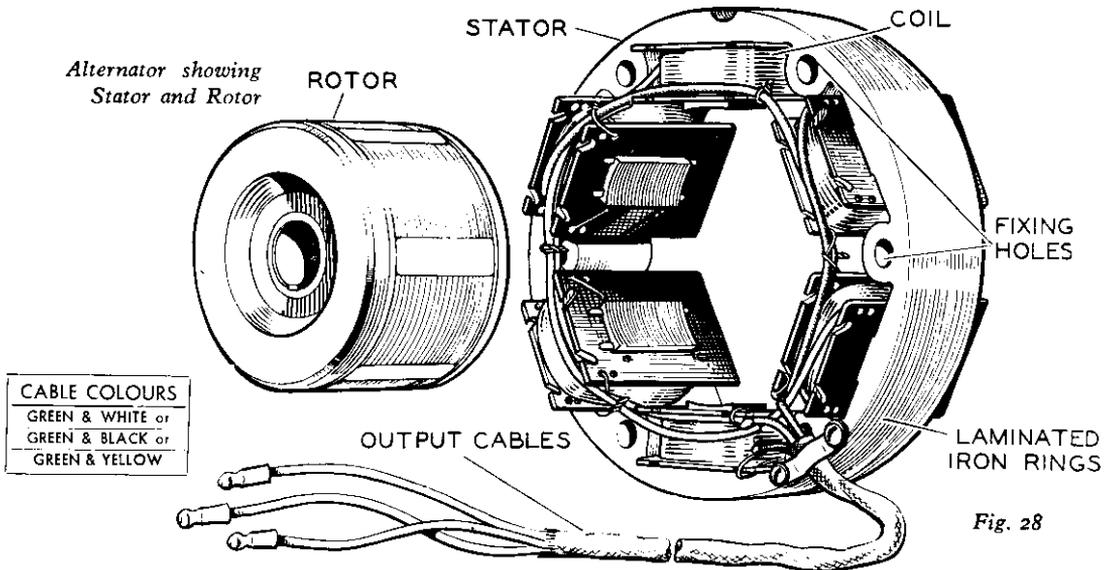
The stator is capable of being fitted into the spigot recess either way round, but will only operate satisfactorily in one position. It is correctly fitted when the edge from which the cables emerge is innermost.

**123. SWITCH**

The switch together with the ammeter and speedometer is carried on the headlamp shell and connections are accessible when headlamp front and light unit assembly are removed. The various cables will be readily recognisable by their coloured sleeving.

**Normal Running.** Under normal running conditions (i.e. ignition switch in IGN position) electrical energy in the form of rectified alternating current passes through the battery from the alternator—the rate of output depending on the position of the lighting switch. When no lights are in use, the alternator output supplies the ignition coil and trickle charges the battery. When the lighting switch is turned, the output is automatically increased to meet the additional load of parking lights and again when the main bulb is in use.

**Emergency Starting.** An EMERGENCY starting position is provided on the ignition switch for use if the battery has become dis-



charged. Under these conditions, the alternator is connected direct to the ignition coil, allowing the engine to be started independently of the battery.

Once the engine is running turn the ignition switch back to the normal running position.

#### 124. EMERGENCY CHARGING

Should the battery become run down it is possible to obtain a temporary boost during daylight running by a simple wiring alteration. Tucked away beneath the seat and on top of the battery box is a group of three rubber covered snap connectors coloured light green, or green and white, dark green or green and black and green and yellow.

Disconnect the green and yellow and dark green connectors and reconnect dark green alternator cable to the green with yellow harness cable, and the green with yellow alternator cable to the dark green harness cable. Do not interfere with the light green cable. The ammeter will indicate a heavy rate of charge and care must be taken not to overdo this treatment, or the battery will be damaged and acid spilled over the machine.

#### 125. RECTIFIER

A selenium type rectifier for conversion of A.C. current to D.C. is housed beneath the tool tray. This unit should require no attention whatever apart from occasional checking that the terminals are tight, particularly the earth lead.

The efficiency of the rectifier is affected by the tension in the central bolt, which is pre-set and locked by a nut. Avoid over-tightening the fixing nut or holding the locknuts during tightening.

#### 126. COIL

A fluid cooled coil of orthodox type is attached to the offside top frame tube by a bolt and clip. Like the rectifier the coil should only require occasional checking for tightness of both mounting and terminals.

#### 127. DISTRIBUTOR (Models 88 and 99)

Chain driven from the intermediate timing gear, the driving sprocket is located on the distributor spindle by a parallel peg, upon removal of which the sprocket may be withdrawn. Removal of the single bolt holding the clamping flange to the inside of the timing cover extension allows the distributor complete to be extracted, providing that the

cover carrying the plug and coil leads has already been removed by springing off the two clips holding it to the distributor body. Routine maintenance can be carried out without removing the distributor body.

**Contact Breaker Setting.** Check the contact breaker after the first 500 miles running and subsequently every 6,000 miles.

To check the gap, remove the sparking plugs, rotate the engine slowly until the contacts are seen to be fully open, and insert a feeler gauge between the contacts. The correct gap setting is 0.014" to 0.016" when the gauge should be a sliding fit.

To adjust the gap, keep the engine in the position giving maximum contact opening and slacken the screw securing the fixed contact plate. Insert the screwdriver between the two studs on the base plate and the notch in the fixed contact plate, and adjust the position of the plate until the correct gap is obtained. Tighten the securing screw and re-check the gap.

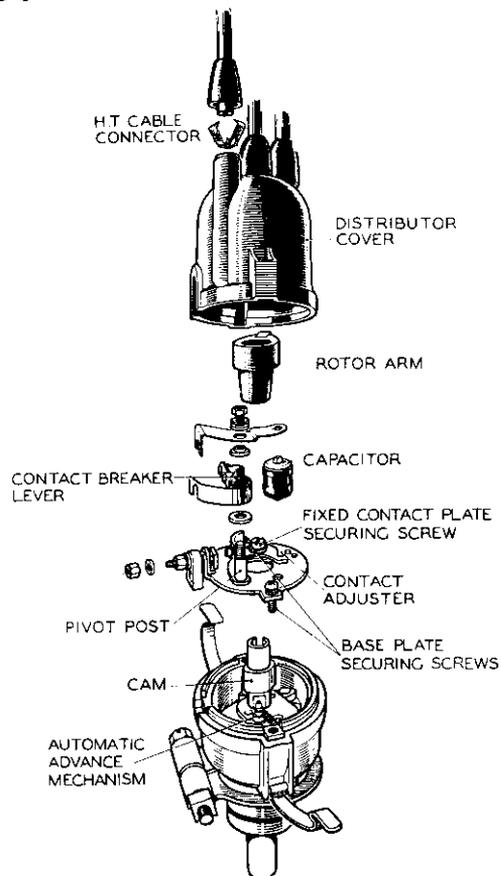


Fig. 29

**Lubrication and cleaning.** To be carried out every 6,000 miles. Remove and clean the distributor cover. Pay particular attention to the spaces between the metal electrodes in the cover, and check that the small carbon brush moves freely in its holder.

Lift off the rotor arm, and unscrew the two screws securing the contact breaker base plate. Remove the base plate and lubricate the automatic advance mechanism with clean engine oil, paying particular attention to the pivots.

Re-fit the base plate and rotor arm.

Examine the contact breaker. The contacts must be free from grease or oil. If they are burned or blackened, clean with fine carborundum stone or very fine emery cloth, afterwards wiping away any trace of dirt or metal dust with a clean petrol-moistened cloth.

Contact cleaning is made easier if the contact breaker lever carrying the moving contact is removed. Before re-fitting the contact breaker lever, lightly smear the cam and pivot post with clean engine oil.

**No grease or oil must be allowed to get on or near the contacts.**

After cleaning, check the contact breaker setting.

## 128. CONTACT BREAKER UNIT (Models 50 and ES2)

Chain driven from the inlet cam spindle, the sprocket is held on a taper and secured with a central bolt. Removal of the sprocket and the single bolt holding the clamping flange to the housing allows the complete contact breaker assembly to be withdrawn providing that the coil wire has been disconnected from the terminal on the base plate. Normal routine maintenance can be carried out without removing the contact breaker.

### Contact Breaker Setting

Check the contact breaker points after the first 500 miles running and subsequently every 6,000 miles. To check the gap, remove the sparking plug and rotate the engine until the points are seen to be fully open and insert a feeler gauge between the points. The correct gap setting is 0.014" to 0.016" when the gauge should be a sliding fit.

To adjust the gap, keep the engine in the position giving maximum contact opening and slacken the screw securing the fixed contact plate. Insert the screwdriver between the

two studs on the base plate and the notch in the fixed plate and adjust the position of the plate until the correct gap is obtained. Tighten the securing screw and re-check the gap.

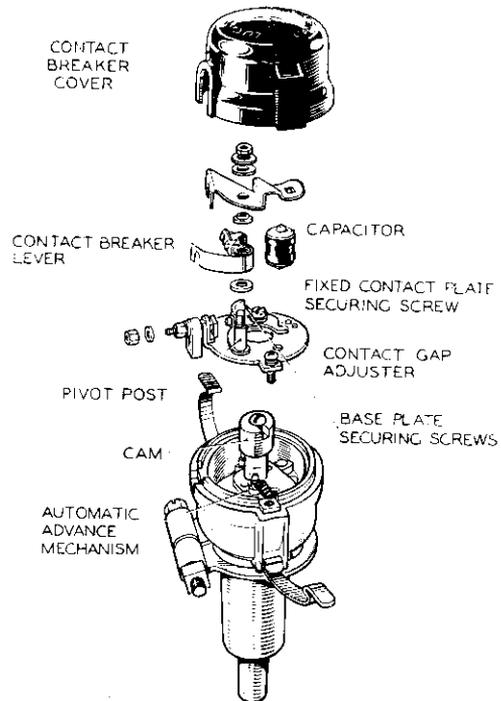


Fig. 30

### Lubrication and cleaning

To be carried out every 6,000 miles. Remove and clean the cover. Unscrew the two screws securing the contact breaker base plate. Remove the base plate and lubricate the automatic advance mechanism with clean engine oil, paying particular attention to the pivots. Refit base plate.

Examine contact breaker points, they should be free from grease or oil. If they are burned or discoloured, clean with a fine carborundum stone or fine emery cloth. Wipe away all traces of dust and dirt with a petrol moistened, lint free cloth.

Cleaning of the contacts is made easier if the lever carrying the moving contact is removed. Before it is re-fitted the cam and pivot post should be lightly smeared with oil.

Finally re-check the setting and ensure no grease or oil has found its way onto the points.

**Renewing High Tension Cables.** Replace the high tension cables when these show signs of perishing or cracking, using 7 mm. p.v.c. or neoprene - covered rubber ignition cable. It is advisable to fit new H.T. cable connectors when renewing the ignition cables.

**129. BATTERY—Lucas PUZ7E/11**

When examining a battery, do not hold naked lights near the vents as there is a danger of igniting the gas coming from the plates.

Remove the vent plugs and see that the ventilating holes in each are quite clear.

Remove any dirt by means of a bent wire.

A clogged vent plug will cause the pressure in the cell to increase, due to gases given off during charging, and this may cause damage.

Make sure that the rubber washer is fitted under each vent plug, otherwise the electrolyte may leak.

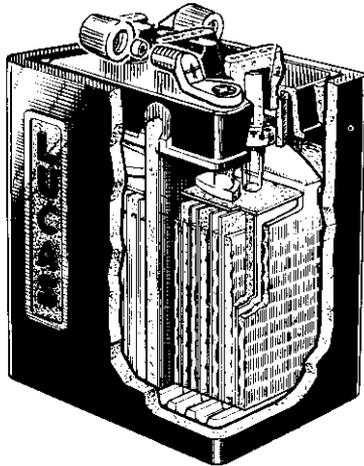


Fig. 31

**Battery—Topping-up**

About once a fortnight or more often in warm climates check the level of the electrolyte in the battery cells and add distilled water as indicated in para. 120.

Wipe dirt and moisture from battery top.

**Checking Battery Condition**

The state of charge of the battery should be examined by taking hydrometer readings of the specific gravity of the acid in the cells.

The specific gravity readings and their indications are as follows:

1.280—1.300. Battery fully charged.

About—1.210. Battery about half discharged.

Below—1.150. Battery fully discharged.

These figures are given assuming the temperatures of the acid is about 60°F.

Each reading should be approximately the same.

If one cell gives a reading very different from the rest, it may be that the acid has been spilled or leaked from this particular cell, or there may be a short circuit between the plates.

This will necessitate its return to a Repair Depot for rectification.

Wipe the top of the battery to remove all dirt or water.

**Note.**

Do not leave the battery in a discharged condition for any length of time.

If a motor cycle is to be out of use, the battery must first be fully charged, and afterwards given a refreshing charge about every two weeks.

**Earthing Connections**

Before disconnecting the battery, note which terminal is connected to the machine and reconnect accordingly.

**Charging**

If the previous tests indicate that the battery is merely discharged, and if the acid level is correct, the battery must be recharged from an external supply.

**130. HEADLAMP**

The headlamp which carries also the switch, ammeter and speedometer, incorporates a Lucas light unit.

A group of snap connectors within the headlamp and accessible when the light unit has been removed greatly facilitates headlamp removal.

### Setting

Check the setting of the lamp. Stand the machine about 25ft. from a light coloured wall and adjust the headlamp position until the main driving beam is projected straight ahead and parallel to the ground, the centre of the beam being the same height as the headlamp centre.

### Bulb Replacement

To remove the headlamp front, slacken the screw at the top of the lamp and lift off the front rim complete with light unit assembly. The pilot bulb is carried in a small metal plate in the base of the lamp body. The plate must be slid out in order to replace the bulb. To replace "pre-focus" bulbs, twist the back shell in the centre of the reflector back in an anti-clockwise direction and pull off. The bulb may now be removed from the rear of the reflector. Place the correct bulb in the holder, engage the projectors on the inside of the back shell with the slots in the bulb holder, press home and twist in a clockwise direction. To replace headlamp front, locate the bottom of the light unit assembly in the lamp body, press into position and tighten locking screw.

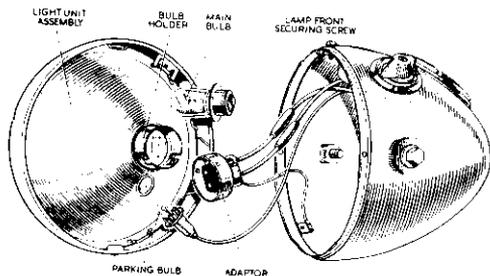


Fig. 32 Light Unit—bulb removal

### Note

It is important that only genuine Lucas bulbs should be used as replacements, in order to ensure accurate and correct focusing.

Main bulb Lucas No. 373  
6 volt 30/24 watt. Pre-focus cap.  
Pilot bulb Lucas No. 988.  
6 volt 3 watt. Miniature bayonet cap.

### 131. TAIL, STOP AND NUMBER PLATE LAMP

This lamp is fitted with a double filament bulb having a 6 watt filament to provide the normal rear and number plate light and an 18 watt filament controlled by the rear brake.

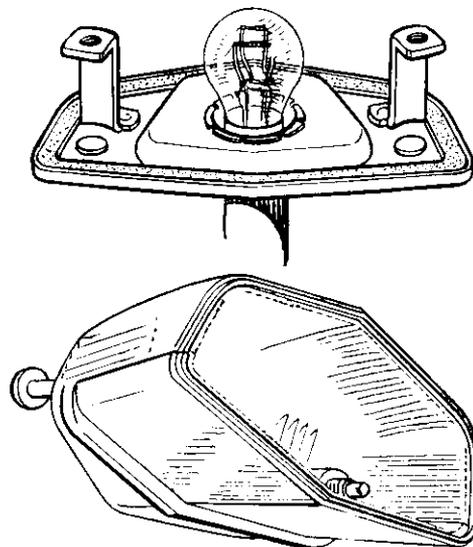


Fig. 33 Tail, Stop and Number Plate Lamp

To obtain access to the bulb, remove the two securing screws and the plastic cover.

The bulb cannot be incorrectly fitted into the holder.

The correct bulb is a Lucas No. 384, 6 volt 6/18 watt.

### 132. CABLES

To connect cables to battery, unscrew knurled plastic nut and withdraw the collet. Bare about one inch of cable and thread through knurled nut and collet. Bend cable strands back over small end of collet. Draw back into nut and tighten nut on terminal.

Snap connectors, i.e., rubber covered push-pull connections are used liberally throughout the electrical circuit and appear when connected as a small rubber sleeve or bunch of sleeves when grouped. Disconnect by pulling apart and re-connect by holding in cable pliers the metal nipple soldered to cable end. Hold rubber covered portion in fingers and press cable home with pliers. Ensure rubber sleeves always covering metal portions of connectors when in use.

### 133. LIGHTING SWITCH

The switch together with ammeter and speedometer is carried in headlamp shell and connections are accessible when headlamp front and light unit assembly is removed. The various cables will be readily recognisable by their coloured sleeving.

### 134. HORN

Electric horns are adjusted to give their best performance before leaving the works and will give a long period of service without any attention.

If the horn becomes uncertain in action, or does not vibrate, it has not necessarily broken down.

The trouble may be due to a discharged battery or a loose connection, or short circuit in the wiring of the horn.

The performance of the horn may be upset by the fixing bolt working loose, or by the

vibration of some part adjacent to the horn.

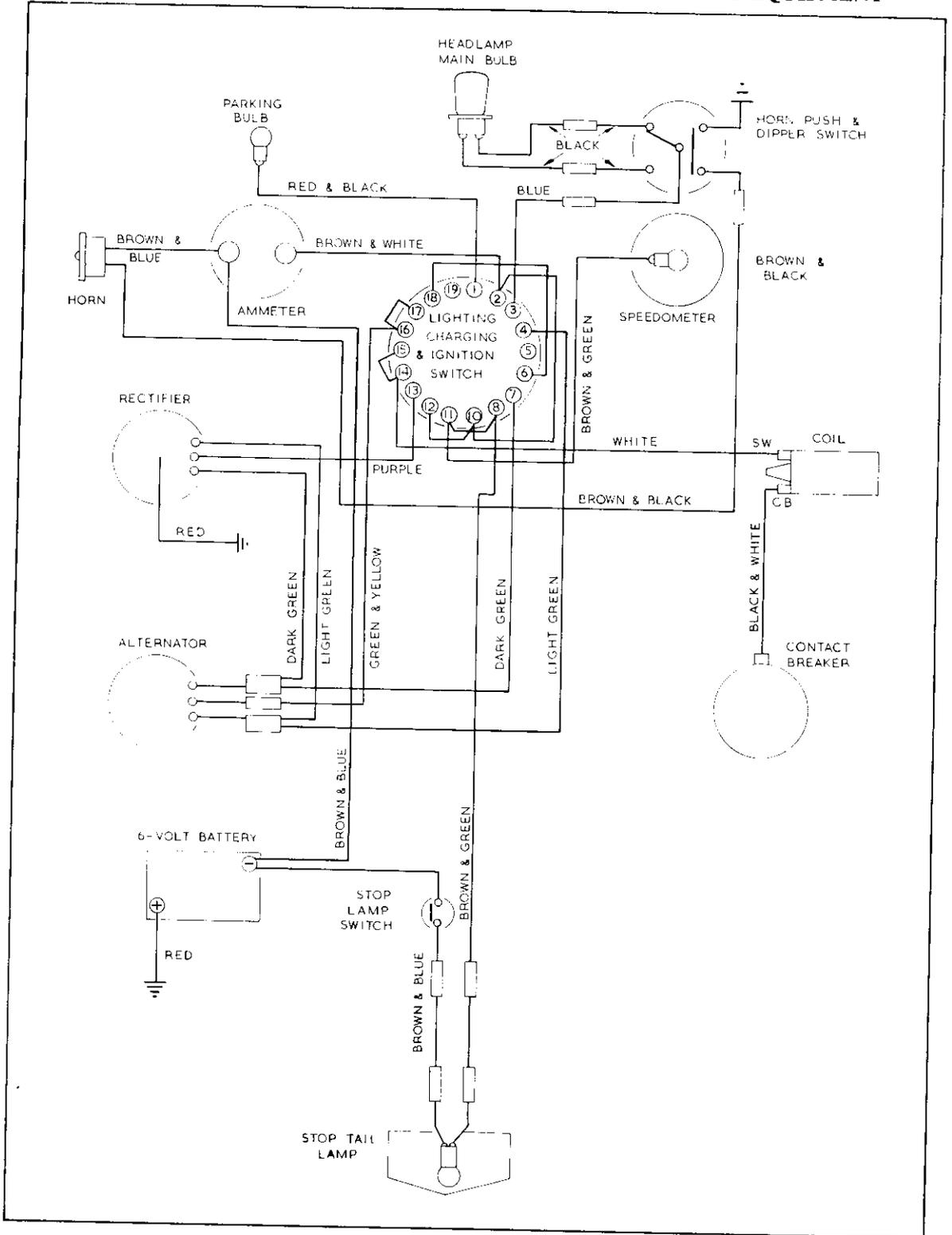
To check this, remove the horn from its mounting, hold it firmly in the hand by its bracket, and press the push.

If the note is still unsatisfactory, the horn may require adjustment and should be taken to a Lucas Service Station.

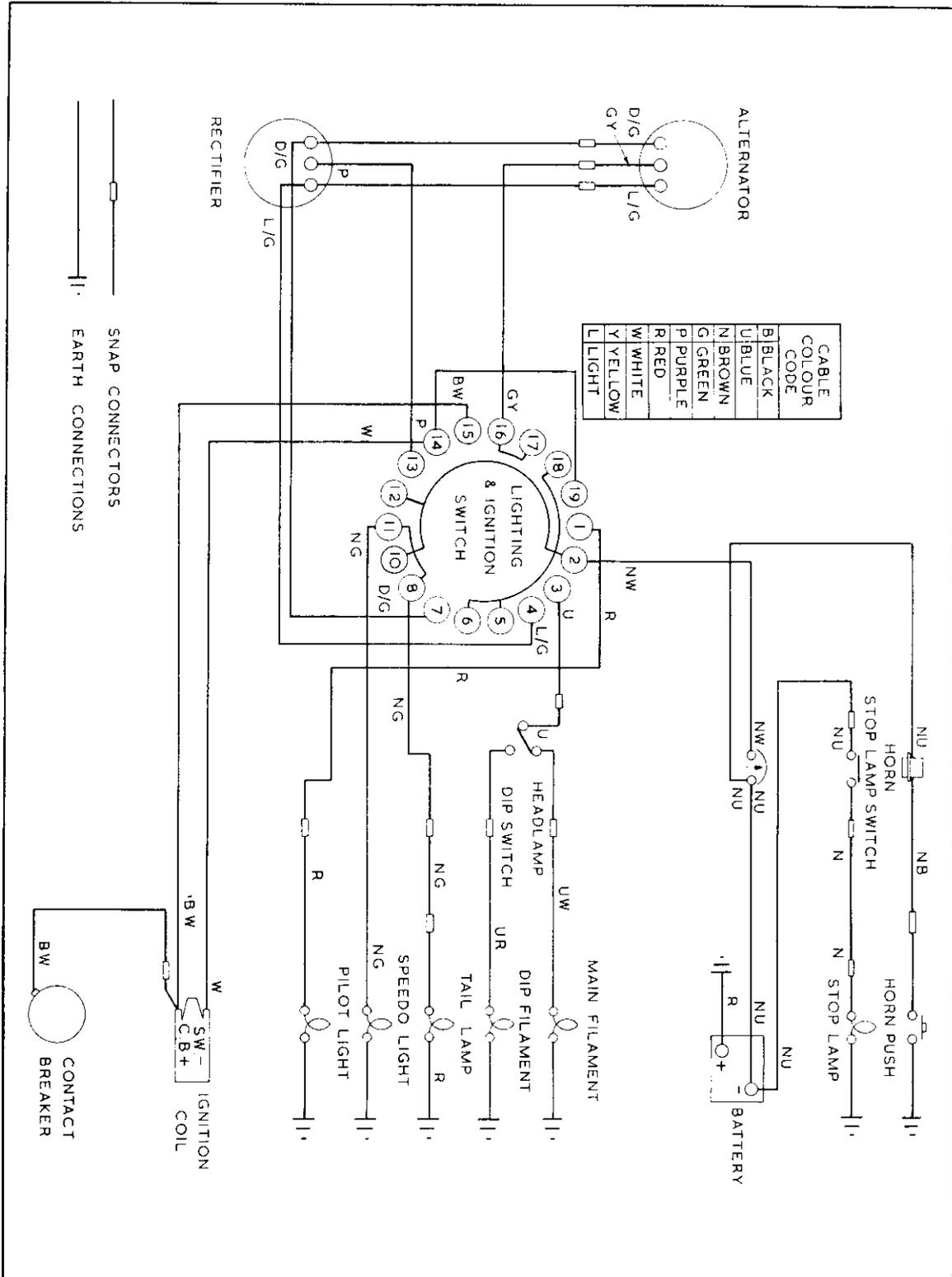
### 135. SPARKING PLUG

Clean periodically by dismantling and removing all carbon from the electrodes. Scrape inside of plug body clean of carbon, re-assemble and set gap at .015in.—.020in.

# WIRING DIAGRAM FOR MODELS 88 and 99 ELECTRICAL EQUIPMENT



WIRING DIAGRAM FOR MODELS ES2 and 50 ELECTRICAL EQUIPMENT



## LOCATING AND RECTIFYING POSSIBLE TROUBLES

<i>TROUBLE</i>	<i>POSSIBLE CAUSE</i>	<i>REMEDY</i>
<i>Failure to start.</i>	Over flooding.	Open twist grip and kick vigorously a few times.
	Weak mixture due to failure to close air lever (if cold).	Ensure that air slide falls as lever is shut.
	Broken throttle cable.	Ensure that throttle slide rises as twist grip is rotated.
	Lack of fuel.	Check that there is petrol in tank.
	Failure of fuel to reach mixing chamber.	Check that petrol taps, or tap, is in the "on" position and that petrol is flowing through.
	Contact breaker points dirty or out of adjustment.	Clean carburetter. Remove high tension lead from one plug and hold end about $\frac{1}{8}$ in. from cylinder whilst revolving engine. If no spark, examine contact breaker points, clean, check gap. Check lights.
<i>Firing on one cylinder.</i>	Battery flat.	Change plug. Examine high tension lead, renew if necessary.
	Faulty plug.	Check and clean carburetter. Adjust as in para. 113.
	Faulty high tension lead.	Check joint washer and nuts for tightness. Check plug for tightness.
<i>Erratic slow running.</i>	Water on plug.	Examine and re-grind as necessary.
	Uneven mixture distribution.	Dismantle, check and renew as necessary.
	Pilot air screw requires resetting.	Check and reset as necessary.
	Air leaks from carburetter joint or sparking plug.	Examine and replace.
<i>Loss of power.</i>	Faulty valve seats.	Can often be removed by kicking engine over a few times.
	Worn inlet valve or guides.	Adjust.
	No tappet clearance.	Examine and adjust.
	Broken piston rings.	Examine and make necessary replacements.
	Loose carbon on valve seat.	Trace through and clean out or take any other action necessary.
<i>Excessive oil consumption.</i>	Tight front chain.	Check and adjust.
	Broken piston rings. Worn cylinder block.	Examine and adjust.
	Oil not returning to tank, due to:— Stoppage in oil way; pump drive failed; pump gears fouled by foreign matter.	Examine and make necessary replacements. Trace through and clean out or take any other action necessary.
<i>Engine runs harshly.</i>	Tight chains.	Check and adjust.
<i>Engine cuts out at large throttle openings.</i>	Dirt in carburetter.	Dismantle and clean.
	Dirt in filters.	Remove petrol taps and clean.
	Dirt in petrol tap.	Change condenser, clean contacts.
<i>Loss of oil pressure.</i>	Condenser broken down.	Drain and refill with fresh oil of correct grade.
	Oil overheated or unsuitable.	Examine and renew.
	Oil pump nipple washer failed.	Examine and renew.
	Timing side oil seal worn or collapsed.	Examine, clean and free off.
	Pressure release valve plunger stuck.	Examine for foreign matter.
	Pump failed.	

## LOCATING AND RECTIFYING POSSIBLE TROUBLES

TROUBLE	POSSIBLE CAUSE	REMEDY
<i>Inefficient Brakes.</i> (Front or rear)	Grease on lining.	Examine and wash in petrol. Do not wash in paraffin.
	Tightness in mechanism.	Make sure that cam is free in its own bearing and pedal is not binding on spindle due to mud.
<i>Slipping clutch.</i>	Cable adjusted too tightly.	Re-adjust cable until there is some movement on handle bar lever before clutch operates.
	Plates not bedded.	Examine, rub down on surface plate with emery cloth if necessary.
	Oil on plates (usually caused by over-filling oil bath).	Dismantle clutch plates and wash in petrol.
	Tightness in operating mechanism.	Examine, clean and free off as necessary.
<i>Clutch Hard to Free.</i>	Water in cable.	Lubricate.
<i>Gear Changing Accompanied by Excessive Noise.</i>	Slack rear chain.	Adjust as necessary.
<i>Failure of Footchange Lever to Return to Normal Position.</i>	Broken hairpin return spring.	Remove gearbox cover. Examine spring, renew as required.
<i>Steering Rolls or Wanders.</i>	Loose head adjustment.	Adjust as necessary.
<i>Twist Grip Closes if Released.</i>	Tension requires adjusting.	Screw in adjuster one or two turns.
<i>Steering appears Tight on Corners.</i>	Steering damper binding, caused by bent frame anchor bracket.	Remove anchor bracket and re-set to correct angle.