

**1962  
Maintenance Manual  
and Instruction Book**

FOR  
**THE UNAPPROACHABLE**

**Norton**  
REG. TRADE MARK

**MOTOR CYCLE**

**Models No. 50, ES2, 88, 99,  
650 and Sports Specials**

Publication P106

*Price 4s. 6d.*

**NORTON MOTORS LIMITED**  
**BRACEBRIDGE STREET, BIRMINGHAM, 6**  
**ENGLAND**

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# DATA

**IDENTIFICATION MARKS.** Engine No. and Prefix numbers stamped on driving side of crankcase below cylinder base flange. Frame No. stamped on left hand frame gusset below battery box. Should be the same as the Engine No. Quote fully when writing or ordering spares.

	Model 50	Model ES2	Model 88
Bore ... ..	71 mm. (2.795")	79 mm. (3.110")	66 mm. 2.598")
Stroke ... ..	88 mm. (3.465")	100 mm. (3.937")	72.6 mm. (2.859")
Capacity ... ..	348 cc. (21.232 cu. in.)	490 cc. (29.896 cu. in.)	497 cc. (30.384 cu. in.)
Compression Ratio ... ..	7.3 to 1	7.1 to 1	8.5 to 1
Sparking Plug ... ..	KL.G. FE75 or FE80 Lodge 2HLN. Champion N5.	KL.G. FE75 or FE80 Lodge 2HLN. Champion N5.	KL.G. FE75 or FE80 Lodge 2HLN. Champion N5.
<b>IGNITION TIMING</b>			
B.T.D.C. fully advanced	38° 1/2" 11.88 mm.	38° 1/2" 13.5 mm.	30° 1/4" 6.35 mm.
<b>VALVE TIMING</b>			
Tappet clearance cold	Marked on all engines. Mesh gears and sprockets as instructed.		
Inlet ... ..	Push rods to be free to rotate without up and down movement with piston on compression stroke.		
Exhaust ... ..			
			.003"
			.005"
<b>AMAL CARBURETTER</b>			
Type ... ..	Monobloc 376	Monobloc 376	Monobloc 376
Main Jet ... ..	210	270	240
Throttle Valves ... ..	3 1/2	4	3 1/2
Needle Jet ... ..	106	106	106
Needle position ... ..	2	3	2
Pilot Jet ... ..	30	30	30
Choke Size ... ..	1"	1 1/8"	1"
<b>ENGINE SPROCKET</b>			
Solo ... ..	17T	20T	19T
Sidecar ... ..	16T and 17 T gearbox	18T	17T
<b>GEAR RATIOS</b>			
Solo ... ..	5.59, 6.8, 9.5 and 14.28, to 1	4.75, 5.8, 8.08 and 12.16, to 1	5.00, 6.1, 8.5 and 12.75, to 1
Sidecar ... ..	6.64, 8.07, 11.3 and 16.97, to 1	5.28, 6.45, 8.97 and 13.45, to 1	5.59, 6.8, 9.5 and 14.28, to 1
<b>CHAINS</b>			
Primary ... ..	1/2" x .305" x 74 rollers	1/2" x .305" x 76 rollers	1/2" x .305" x 75 rollers
Rear ... ..	3/8" x 1/4" x 97 rollers	3/8" x 1/4" x 98 rollers	3/8" x 1/4" x 98 rollers
Distributor/Magneto ... ..	3/8" x 3/2" x 44 rollers	3/8" x 3/2" x 44 rollers	3/8" x 3/2" x 42 rollers
Camshaft ... ..	—	—	3/8" x .225" x 38 rollers
Petrol Tank Capacity	3 1/2 gallons, approx. 16 litres.		
Oil Tank Working Capacity	4 1/2 pints or 2.3 litres.		
Tyre size front ... ..	3.00" x 19"	3.00" x 19"	3.00" x 19"
Tyre size rear ... ..	3.50" x 19"	3.50" x 19"	3.50" x 19"
Tyre pressure front solo...	25 lbs. p.s.i.	25 lbs. p.s.i.	25 lbs. p.s.i.
Tyre pressure rear solo ...	22 lbs. p.s.i.	22 lbs. p.s.i.	22 lbs. p.s.i.
Weight dry ... ..	380 lbs. approx.	385 lbs. approx.	390 lbs. approx.

# DATA

**IDENTIFICATION MARKS.** Engine No. and Prefix numbers stamped on driving side of crank-case below cylinder base flange. Frame No. stamped on left hand frame gusset below battery box. Should be the same as the Engine No. Quote fully when writing or ordering spares.

Model 99	Model 650	Remarks
68 mm. (2.677") 82 mm. (3.228") 597 cc. (36.485 cu. in.) 8.2 to 1 KLG. FE75 or FE80 Lodge 2HLN. Champion N5.	68 mm. (2.677") 89 mm. (3.503") 646 cc. (39.446 cu. in.) 9 to 1 KLG. FE75 or FE80 Lodge 2HLN. Champion N5.	1962 Model 88 S.S., 9.45 to 1. S.S. Models KLG. FE80 or FE100. Lodge 2HLN or 3HLN. Champion N8.
32° .307" 7.8 mm.	32° .343" 8.69 mm.	
.003" .005"	.006" .008"	88 S.S. Model .006" inlet .008" exhaust. When setting tappet adjustment on all twin cylinder models, opposite similar valve to one being adjusted to be exactly wide open.
Monobloc 376 250	Monobloc 376 (twin carbs.) 389 (single). 250 (twin carbs.) 320 (single)	Regard these sizes as min., use one or two sizes larger for prolonged full throttle work.
3 106 3 25 1 1/16"	3 1/2 " " " 3 " " 106 " " " 105 " " 3 " " " 2 " " 25 " " " 25 " " 1 1/16" " " 1 1/8" "	Model 88 S.S. 1 1/16".
20T 18T	21T 19T	Sidecar sprocket sizes are approx. and may vary one tooth up or down.
4.75, 5.8, 8.08 and 12.16, to 1 5.28, 6.45, 8.97 and 13.45, to 1	4.53, 5.52, 7.57 and 11.6, to 1 5.00, 6.1, 8.5 and 12.75, to 1	
1/2" x .305" x 75 rollers 5/8" x 1/4" x 97 rollers 3/4" x 5/16" x 42 rollers 1/2" x .225" x 38 rollers	1/2" x .305" x 76 rollers 5/8" x 1/4" x 97 rollers 3/4" x 5/16" x 42 rollers 1/2" x .225" x 38 rollers	650 American Model 2 1/2 gallons approx.
3.00" x 19" 3.50" x 19" 25 lbs. p.s.i. 22 lbs. p.s.i. 395 lbs. approx.	3.00" x 19" 3.50" x 19" 25 lbs. p.s.i. 22 lbs. p.s.i. 408 lbs. approx.	650 American 3.25" x 19" 650 American 4.00" x 18" 650 American 24 lbs. p.s.i. } S.S. Models see note 650 American 20 lbs. p.s.i. } after Para. 119.

## 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 from the top of the float chamber.

On coil ignition models, turn the ignition key in the top of the headlamp switch in a clockwise direction to 'IGN'. In cold conditions, close or partly close the air lever, this should however, be fully opened as soon as possible after the engine has started.

On single cylinder models 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 2" only. Release the lifter and allow the starter pedal to return to its normal position. A good swinging kick on the starter should set the engine going.

Machines with magneto ignition have a cut-out button for stopping the engine, this is similar to a horn button and is fitted on the handlebar.

With coil ignition machines, 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, either by turning the key to 'EMG' position, when a far more 'hefty' kick is required than when starting normally, or by push starting in say 2nd gear with the switch in the normal ignition position.

When an engine with Lucas equipment has been started in 'EMG' switch position, it must

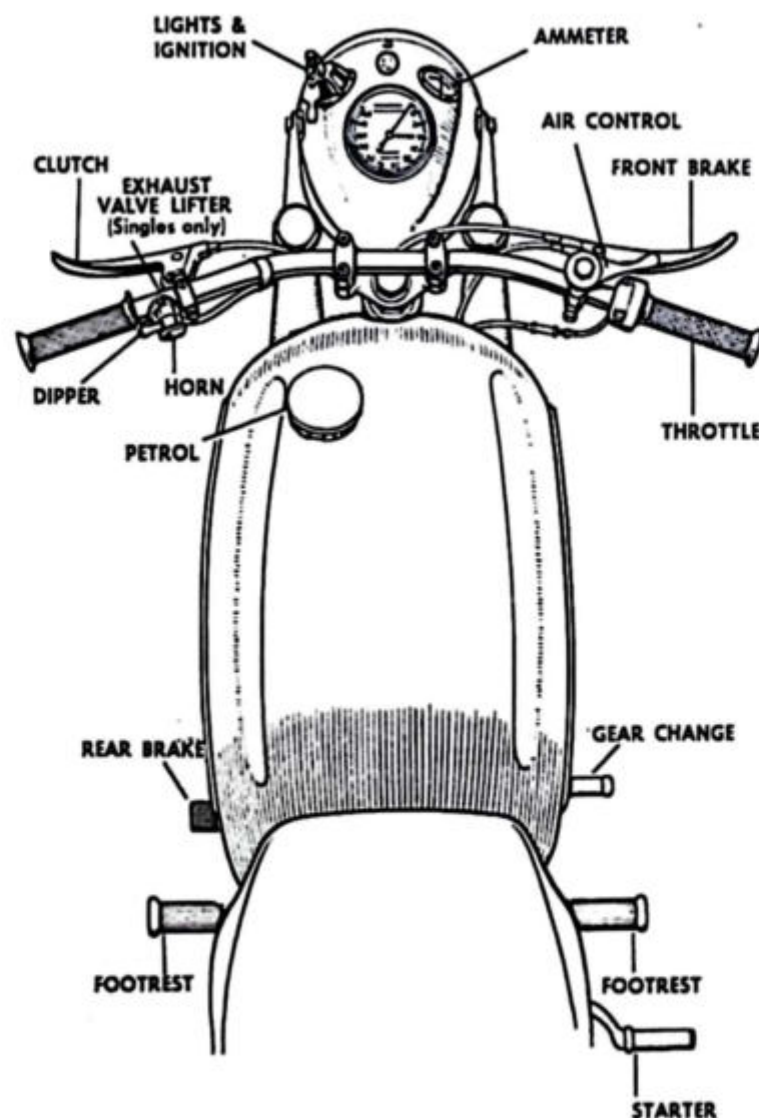


Fig. 1

be immediately switched over to normal 'IGN', otherwise damage to contact points and condenser will result.

A flat battery can be recharged at an increased rate by the procedure outlined under the heading of Increased Charging in the electrical section.

All models provide for a reserve fuel supply. The single petrol tap is of the two positional type, the knurled circular knob being pulled out for normal running and turned and pulled a further amount when the reserve is required. The reserve should supply fuel for about 5 to 8 miles dependant upon how the machine is driven.

## RUNNING - IN

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 oilbath chaincase. Remember to remove the level plug from the chaincase before topping up.

Immediately the engine has been started, remove the oil tank filler cap and check that the oil is circulating. If the machine has been standing, oil should be returning in a constant stream and should be visible on looking in the filler orifice. After a few moments, when the return pump has scavenged the sump clear of oil having collected there during standing, the stream will become intermittent.

The first 1000 miles in the life of a new machine are 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  $\frac{1}{4}$  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.

This does not mean that road speeds should be strictly limited to 30 m.p.h.—a model 50 or ES2 could be run under level conditions at 40—45 m.p.h. and a twin cylinder machine would achieve about 50 m.p.h. on little over  $\frac{1}{8}$  throttle.

A high road speed is not detrimental if it is obtained without opening the throttle wide: for example, when going down hill. Speed can be varied quite appreciably, but the engine must always run lightly loaded.

When the 500 mile figure has been reached, short bursts of higher speed may be indulged in but allow the engine to reach these easily and progressively. When 1200 to 1500 miles have been covered, it should be possible to use the the machines full capabilities with safety.

Over-revving in the lower gears and violent acceleration should be avoided even when the machine is fully run-in—it merely reflects bad riding causing excessive noise and overloading of chains, clutch, gearbox, etc.

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, 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—

- Castrol XXL, for Summer use.
- Castrol XL, for Winter use.

Other very suitable oils for Norton machines are—

- Shell X-100 40 or BP Energol SAE 40 for Summer use.
- Shell X-100 30 or BP Energol SAE 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/Texaco Advanced Havoline 40 for Summer use.
- Regent/Caltex/Texaco Advanced Havoline 30 for Winter use.

These oils should be used in engine and gearbox. They can also be used in the chaincase but here 20 grade can be used if preferred.

For the front fork legs (there should be 5 fluid ozs or 142 c.c.s. in each), one of the following 20 grade brands should be used—

Castrol 'Castrolite', Shell X-100 20, BP 'Energol' SAE 20, Mobiloil 'Arctic', Essolube 20 or Advanced Havoline 20.

For bearings not automatically lubricated, such as steering head and wheels, one of the following good quality greases should be used—

Castrol 'Castrolase' Medium, BP Energrease C3, Shell Retinax A, Mobilgrease MP, Esso Multi-Purpose grease or Regent 'Marfak' Multi-Purpose 2.

Although grease nipples are fitted to the brake cam spindles, it is generally better to periodically dismantle the brakes, clean out lining dust, etc., and grease the spindles and cams lightly by hand and re-assemble. In this way risk of excessive grease reaching the brake linings and impairing their efficiency is avoided.

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 the oil tank after 500 miles. Remove crankcase drain plug on single cylinder models and sump filter on twins 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 2000 miles.	Contact break spindle ES2 and 50 ... ..	Oil
Every 1000 miles.	Control cables ... ..	Oil	Every 3000 miles.	Magneto C.B. rocker arm and cam ring ...	Oil
	Control levers ... ..	Oil	Every 5000 miles.	Gearbox, drain and refill	Oil
	Brake cable 'U' clip ...	Oil		Brake cams, cam spindles and shoe pivot pins ... ..	Grease
	Gearbox, top up... ..	Oil	Every 10,000 miles.	Front forks ... ..	See para. 100
Every 2000 miles.	Oilbath, top up ... ..	Oil		Oilbath, drain and refill	Oil
	Brake pedal ... ..	Grease		Hub bearings, repack ...	Grease
	Brake rod jaw joints ...	Oil			
	Speedo gearbox ... ..	Grease			
	Drain and refill oil tank	Oil			

## 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.

**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 downwards 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 behind handlebar centre. Rotate clockwise to stiffen handlebar movement.

**Exhaust Valve Lifter.** (Single cylinder models only). Beneath left handlebar. Enables engine to be readily rotated by releasing compression. It is important that it is not 'over adjusted' and it should only just lift the valve from its seat.

**Front Brake Lever.** On right handlebar. This is, perhaps, the most important control on the machine and its proper use should be mastered at the earliest opportunity. Because, when the brakes are applied, weight of rider and machine is transferred forward, more braking power can be applied to the front wheel before it will lock than to the rear. On a firm, dry surface, therefore, it will be found that the brake can be applied very hard without risk of locking the wheel. The rear brake should, of course, be applied at the same time, but in the case of an emergency stop you should not withdraw the clutch until the last moment before coming to rest, as otherwise the rear wheel may be locked causing the machine to skid.

The front brake should be adjusted so that the lever comes almost parallel with the handlebar when the brake is hard on and in this way with practice, it will be found that with the brake applied with the fingers, the twist grip can be operated with the inside of the thumb to make downward gear changes.

Different road conditions of course, call for modified braking technique and on a road away from the traffic, the rider should find out for himself how hard the brakes can be applied without locking either wheel. On a very wet road when grease and mud films have been washed away, it will be found that the front brake can be used hard without risk of a skid provided the machine is kept in a straight line. In damp greasy conditions, the brakes should only be 'caressed' and the machine slowed by use of the gearbox. On ice and snow the brakes should not be used at all and the machine should be allowed to roll to rest in a low gear.

When riding in traffic queues with many pedestrians about, you should ride with the front brake lever 'in your hand', you can then apply it as you think instead of having to 'find it' and consequently grab it.

Always remember that you cannot match the stopping power of a modern four wheeled vehicle if you do not use both brakes properly.

**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.** Adjacent to left footrest. It is important that this control should be properly adjusted so that when the brake is quickly applied the wheel is not suddenly locked. The pedal stop should be set so that with the rider normally seated with insteps on the footrests and left foot in a 'normal rotational' position on its rest, the pad is just below the ball of the foot. To apply the brake, it is then merely necessary to 'rotate' the foot to make contact with the pad. If the pedal pad is set too high, it becomes necessary to step on it which is dangerous apart from the rider having to ride 'splayed footed' since his boot must then be alongside the pedal pad instead of above it.

**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.

Sports Special Models and others with Magneto Ignition have a lighting switch giving similar positions but without the ignition switch in the centre.

**Headlamp Dipping Switch and Horn Push.** Combined fitting on inside of left handlebar. Should it be desired to alter the position of this on the bar, it is necessary to drill and tap 5BA. It is desirable that when the dipper switch lever is in the 'UP' position, the main filament should be on, then when the switch lever is 'flipped down' the dipped beam is obtained. Remember that this is a very important control when riding at night and a light 'flicked' the wrong way at a critical moment of dazzle may cause an accident.

If the dip switch becomes non-positive in action, dismantle it and apply a spot of oil to the lever pivot and change over toggle.

## THE ENGINE Twin Cylinder

### 1. ENGINE. LUBRICATION SYSTEM

This is of the dry sump type, the oil flows from the tank to the pump by gravity, assisted by suction from the feed side of the oil pump round the gears and is forced under pressure to various parts of the engine. It then drains to the lowest part of the crankcase and by suction from the return side of the pump, is lifted and pumped back to the oil tank. A connection is taken from the return pipe between pump and oil tank which feeds the overhead rocker gear.

### 2. OIL FILTERS

There are three filters in the lubrication system.

- (1) A coarse mesh filter in the tank itself.
- (2) A small 'cigarette' type filter is incorporated in the pressure release valve on standard models. Removal of the hexagon plug from the rear edge of the timing cover exposes the filter and its attached spring. This filter is not to be found on S.S. models which have the earlier timing cover suitable for rev-meter drive. These have a larger pressure relief valve which can be unscrewed complete from the timing cover and which has a fine mesh gauze over its inner end to prevent foreign matter from causing the valve to stick.
- (3) A large 'corrugated gauze' filter in a bronze plug in the crankcase sump.

The purpose of the tank filter is to ensure that the feed to the engine is never blocked by a large foreign body. It is of coarse mesh and large dimensions so as not to restrict the flow of cold oil. It need not be removed when the oil is changed, it is better on all models to remove the tank complete from the machine and wash it out thoroughly with paraffin or petrol at say every 2nd or 3rd oil change. The filter is then automatically cleaned without removal and does not have its joint disturbed. The relief valve filters need not normally be disturbed except when the engine undergoes a major overhaul.

The sump filter is the most important and should be removed and cleaned when the oil is changed except when a quick oil change is done at a roadside garage with the oil hot.

The filter body has a  $\frac{7}{8}$ " Whit. hexagon and a right hand thread and the gauze is

secured in it by an aluminium washer and steel wire circlip. Dismantle and wash in petrol and examine for metal particles. Take care on re-assembly that the circlip is properly home in its recess.

Note that when the sump filter is removed for cleaning, about  $\frac{1}{2}$  pint of oil will come out and a suitable receptacle should be placed underneath beforehand.

### 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

Maintain at or near the 'Recommended Oil Level' usually indicated by a transfer on the outside of the tank.

If the level is maintained higher than this, the excess may be discharged via the oil tank breather pipe, especially at high speeds and cause over oiling of the rear chain and oil to be deposited on the rear tyre.

Conversely, if the machine is used mainly about town without much high speed work, then the rear chain may not receive sufficient oil. Under these conditions, a higher level should be maintained. See also under 'Chain Maintenance'.

Always run the 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 drain through the pump into the sump.

When this happens, all the oil is returned to the tank in the first few minutes that the engine is running. In some cases after very long standing, there may be so much oil in the sump, that some will be discharged via the crankcase breather before the return pump has fully scavenged the sump.

If the oil level in the tank is allowed to become too low, then there is risk of over-

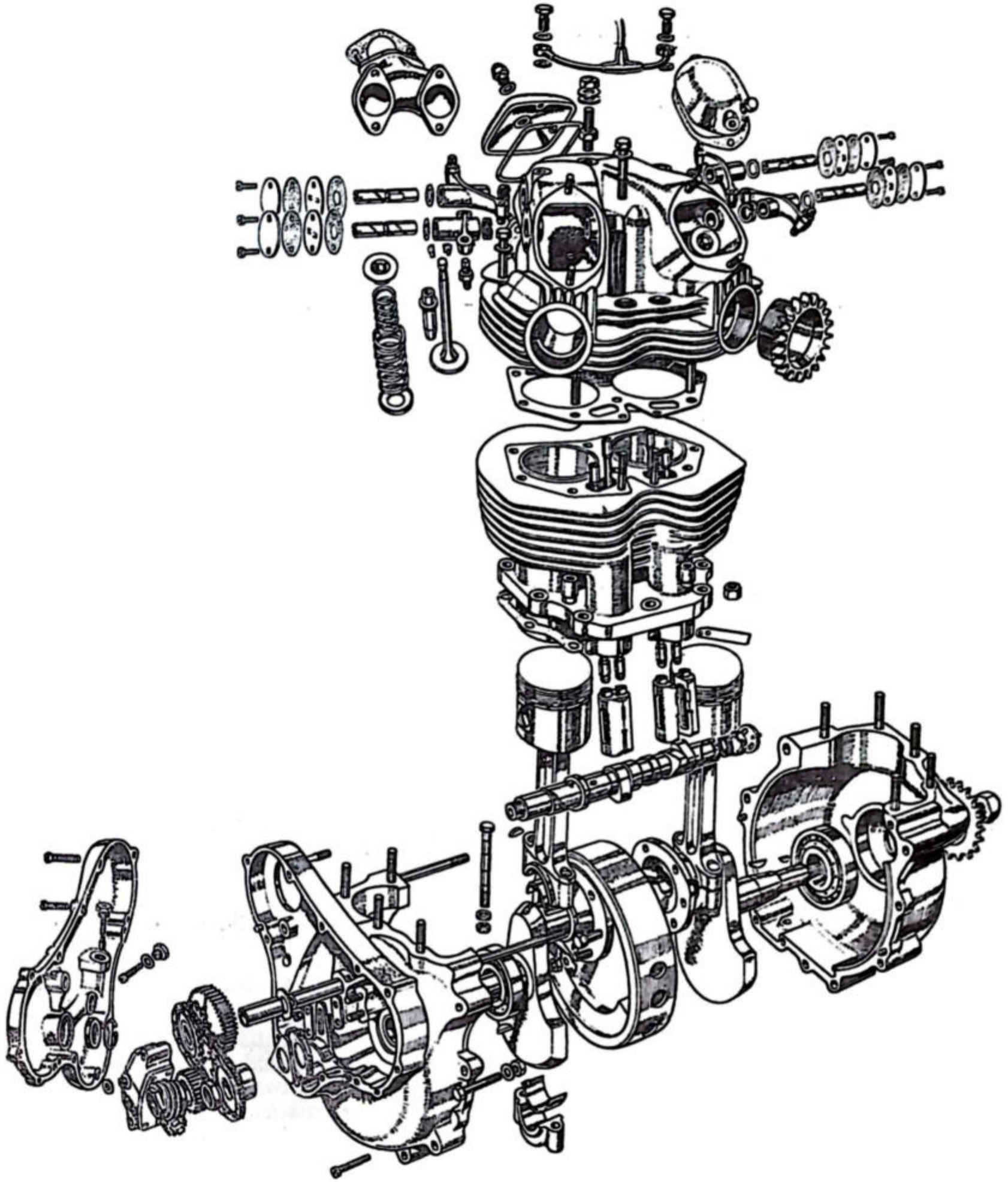


Fig. 2

heating due to the relatively small quantity which is in circulation.

## 5. CIRCULATION OF THE OIL

The 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. 2) 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.n.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. 5 is pre-set and is non-adjustable. A timed breather working at the inner end of the camshaft (Fig. 2) controls the crankcase pressure. Any oil escaping from this source being conducted to the ground.

## 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 orifice. 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.

On S.S. models with the old type timing cover, there is a  $\frac{1}{8}$ " B.S.F. set screw below the relief valve and a pressure check can be made from here using a rocker box banjo bolt which has the same thread, and a suitable banjo with which to connect the gauge. On standard and de Luxe models it is not possible to do this without drilling and tapping the filter holder. A pressure check should be made with the oil 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 and/or grade of oil.

Periodically, when the engine is ticking

over, place a finger over the hole in the return pipe in the oil tank. This will send more 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 if necessary, holding the tap with one whilst releasing the union nut with the other.

Remove the dualseat by releasing the single Dzus fastener at the back, then lift the seat and withdraw rearwards from the two pegs on the frame at the front. These carry the seat by means of rubber bushes secured to its underside.

Release the single rubber band which secures the tank at the rear and unscrew the two inverted bolts at the front.

These have rubber washers above and below the lugs on the frame, the lower ones being in steel cups and the upper ones having a plain steel washer between them and the tank itself.

The bolts are shouldered so that when fully tightened the rubber washers are not over compressed.

The tank can now be lifted clear.

## 8. PETROL TANK—REFITTING

Check that the two rubber pads on which the tank rests at the rear and which are taped to the frame tubes, are so positioned that the tank does not make metallic contact with the frame. Refit the two bolts with their cups, rubbers and washers at the front and pull the rubber band over the hook at the rear.

Refit the petrol pipe and do not over-tighten the union nut as otherwise the tap may unscrew when the pipe is next disconnected. Refit dualseat.

## 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 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 ports 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 box caps taken off and the stud securing the inlet rocker cover also removed, the 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, top and bottom collars, collets and heat insulating washers should be carefully placed on one side so that it may be refitted in the original position.

Note that the inlet valves have appreciably larger heads than the exhausts.

### 12. VALVE GRINDING

Remove all the carbon from the valve heads and stems, polish with emery tape in a drilling machine if available.

Lightly smear the seat portion with medium grinding compound, place the valve in the guide and grind lightly, using a rubber sucker on the valve head or valve grinding tool on the stem. Rotate to and fro frequently lifting the valve to redistribute the compound.

Do not over grind, as soon as the grinding marks make a complete ring on valve and

head cease operations and remove all traces of compound. If the seats are not badly pitted, the use of fine paste only may be sufficient, but if the reverse is the case it may be impossible to obtain a perfect seat by grinding.

The seats will then have to be recut and the valves refaced or renewed.

### 13. VALVES—FITTING

Thoroughly clean valves, seats and ports. Lubricate valve stem and fit valve, fit heat resisting washer, bottom spring collar, springs, and top collar over valve guide. Compress springs 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 removed and fitted with a double diameter drift. This should be of mild steel, 6 to 8 inches long, its smaller diameter should be an accurate fit in the bore of the guide and its outer diameter should be fractionally less than the O/D of the valve guide. The shoulder should of course, be turned square and the pilot or small diameter part should be almost as long as the valve guide itself.

The head must be heated to at least the temperature of boiling water and the old guides can be knocked out. If any work is to be done on the ports, it should be done before the new guides are fitted. In any case re-heat the head before they are fitted. The valve stem diameter new is .309"-.310" and the valve guide bore fitted is .3145"-.3135".

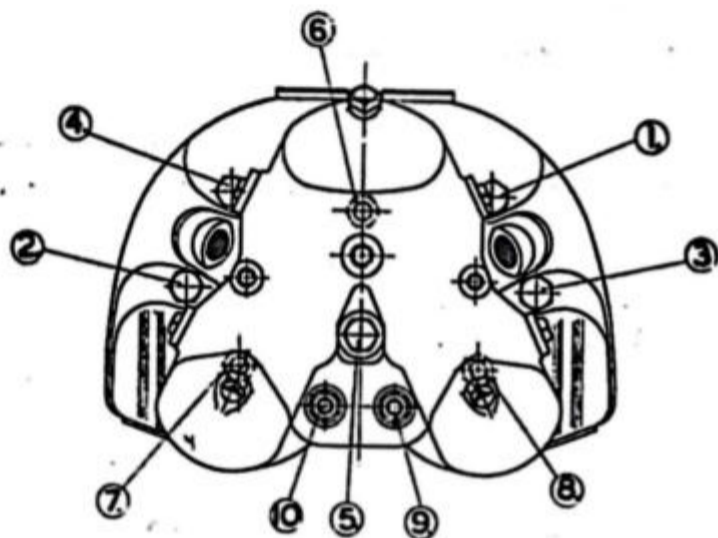
Valve seats must be re-cut when new guides are fitted.

### 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 pushrods are longer than the exhaust, and one of each, i.e., inlet and exhaust should be inserted into each tunnel, the long rods being nearer the centre, see Fig. 2.

Lower the head into position and allow the pushrods 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



**ORDER OF TIGHTENING DOWN CYLINDER HEAD NUTS & BOLTS.**

*Fig. 3*

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 3.

### 16. ROCKER ADJUSTMENT (Tappet adjustment)

Removal of the single nut securing the inlet rocker cover will provide access to both inlet rockers and enable the necessary feeler to be inserted between the rocker adjuster and valve stem end. Rotate the engine until the opposite inlet valve to the one about to be adjusted is exactly wide open. This is necessary because the cams on these engines have quietening ramps and in order to adjust with the tappet clear of the ramp it must be on the centre of the base circle.

To adjust the clearance, hold the squared end of the adjuster by means of the special spanner provided and slacken the locknut. Insert a .003" feeler (.006" S.S. models) and rotate the adjuster in a clockwise direction until the feeler is just pinched, but may still be moved about fairly easily. Hold the

adjuster whilst tightening the locknut and re-check with the feeler. Now rotate the engine until this inlet valve is just fully open and adjust the opposite one.

Refit the rocker cover, ensuring that the joint washer is in good condition and correctly positioned. To adjust the exhaust tappets, remove both exhaust covers, and proceed as described above, setting one adjuster whilst the opposite valve is exactly wide open. Set to .005" except on S.S. models when the clearance should be .008".

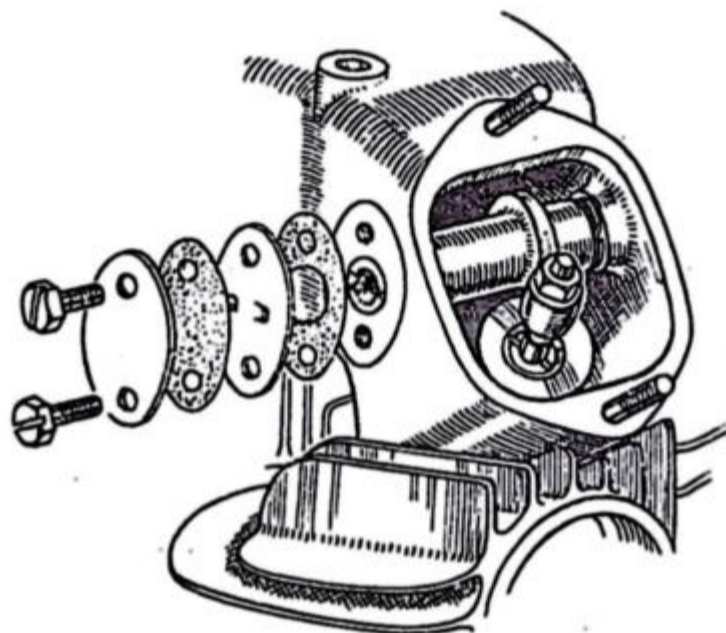
Always re-check with the feeler after tightening the locknut and re-adjust if there is any doubt about the accuracy of the original setting.

For prolonged full throttle work with standard models, it is advisable to set tappets to S.S. clearances, i.e. In. .006", Ex. .008".

### 17. ROCKER REMOVAL and FITTING

Before removing or fitting rocker spindles, the cylinder head should be heated as for valve guide removal and fitting.

Remove inlet rocker inspection cover and cover securing stud. This latter may be with-



*Fig. 4*

drawn by locking two nuts on the outer end and rotating the lower of the nuts which should bring away the stud.

Remove the two screws securing the oval cover plates over the ends of the rocker spindle holes (Fig. 4). 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  $\frac{1}{8}$  in.  $\times$  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 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 screws (Fig. 4).

## 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.

Gudgeon pins can best be removed or fitted by first heating the piston with a 'soft' flame or rag soaked in hot water.

## 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 from .0015" to .0035". 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.

**Fitting instructions for special "Twiflex" oil control ring. 650 c.c. models only.**

1. Make sure the grooves and oil drain holes are quite clean and then wind a rail on to the piston skirt just below the scraper ring groove.

2. Place expander in the groove with its ends butted and in line with pin hole. Great care must be taken to ensure the ends of the expander do not overlap. **THEY MUST BUTT.**

3. Slip the ends of the rail on the skirt into the groove beside the expander. The gap of rail should be 1" to left of butted ends of expander.

4. Do not, at this stage, push the back of the expander into the piston groove. Wind the other rail down over the lands into the scraper groove on the upper side of the expander with the gap 1" to the right of the butted ends of expander.

5. Now work the back of the expander down into the groove between the rails with the thumb nail. Centralise the ring on the piston, but do not move the assembly more than necessary.

6. The ring will now be complete in the groove with the rails supported on the lugs of the expander, and although it may feel somewhat stiff to move in the groove, this can be ignored.

7. Use an ordinary ring clamp to enter piston with rings into cylinder.

8. There is no need to check groove depths.

## 21. PISTONS—FITTING

Fit rings to piston, chromium plated top compression rings are now reversible unless marked 'top'. The 2nd compression ring is taper faced when new and is therefore marked 'top'. The scraper rings are reversible. Rings which have already been run, should always be re-fitted the same way up and on the same piston.

Space 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 having first heated it as described for removal, 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 circlips, make certain that they are properly seated in the grooves.

## 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 screws. This will enable the tappets and plate to be pushed out. 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.

When tappets are correctly fitted their bevelled edges are together and to the front of the engine.

## 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  $\frac{1}{8}$  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 an aluminium or 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

On standard models the pressure relief 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. 5 makes the order and location of the various parts quite clear.

On S.S. models, the earlier type relief valve is used and this can be removed as a complete unit without disturbing the cover.

## 26. OIL PUMP—REMOVAL AND FITTING

Whilst the timing cover is removed, no



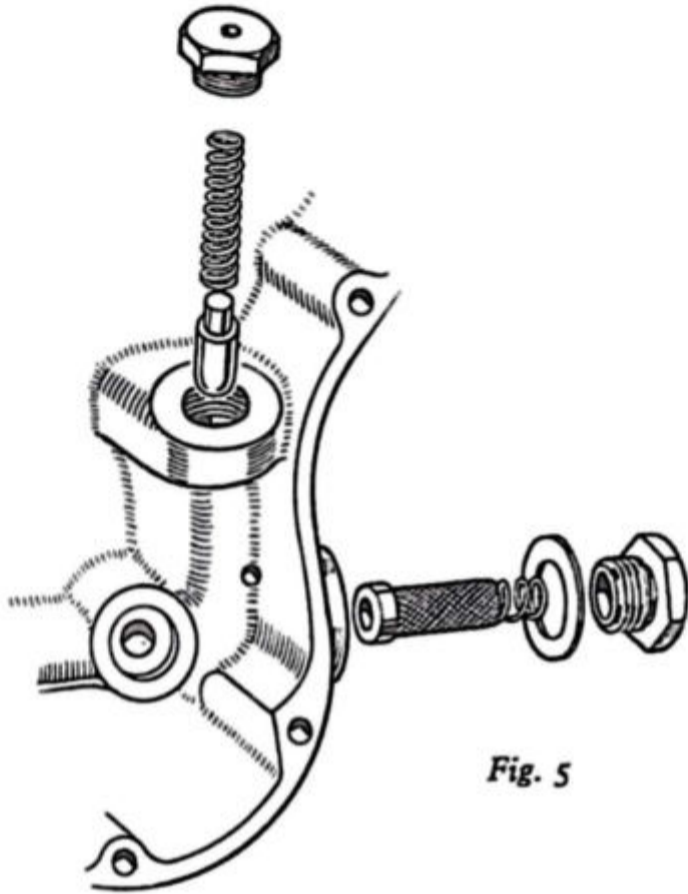


Fig. 5

difficulty should be experienced in removing the oil pump, which is held only by the two nuts, situated one on either side of the pump 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.

Before replacing the pump, clean both faces, fit the pump and nuts (no washers) tightening each nut a turn at a time to ensure that the pump is held down evenly.

## 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.

## 23. TIMING SPROCKETS AND CHAINS—REMOVAL

Before this work is undertaken it is most

desirable to have the use of a cut away dummy timing cover to support the intermediate gear spindle whilst the camshaft nut is slackened for dismantling and for tightening it on re-assembly (R.H. thread).

Also the special Norton timing pinion puller is required if it is intended to split the crankcase and remove the crankshaft assembly.

When removing the chains, it is necessary to withdraw the whole sprocket assembly with the chains in position as both are endless.

This cannot be done until the camshaft chain tension slipper and its clamping plates have been removed, the camshaft nut unscrewed, the oil pump driving worm unscrewed—L.H. thread, and the driving pin removed from the distributor spindle.

Care must be taken in removing and fitting the latter, a  $\frac{1}{8}$  in. parallel pin punch is most suitable and as the pin is driven out the sprocket boss should be supported by a suitable weight from the opposite side. The pin can be used again but it should be replaced with a new one if there is any doubt about the way it fits when it is replaced and re-riveted. Again, when rivetting, a weight such as a second hammer head should be held against one end of the pin whilst the other is being turned over.

Removal of the camshaft sprocket may require the use of a standard type sprocket puller, both this sprocket and the crankshaft pinion are on parallel shafts and not on tapers.

There is a hardened steel washer on the intermediate gear spindle between the gear and the crankcase.

## 29. TIMING SPROCKET AND CHAINS FITTING AND ADJUSTMENT

Fit oil retaining disc, flange to outside, 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 hardened steel washer to intermediate shaft and fit the camshaft key. Rotate engine until the marked tooth on the half-time pinion is at T.D.C. Rotate the camshaft until the keyway is also at approximately T.D.C.

Place the distributor chain (the narrower of the two) on the inner of the two sprockets on the intermediate gear and the camshaft chain on the other. Rotate the gear until the marked space between teeth is at B.D.C.

(because the chains when fitted obscure this mark, mark the tooth on either side of it with crayon or pencil which will facilitate checking that it is correctly meshed with the crankshaft pinion).

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 when the chain is fitted to both sprockets.

Six outer plates inclusively on the camshaft chain should separate these marked teeth. See Fig. 6.

When the chains sprockets and gears are properly meshed, push them home on their shafts, fit camshaft nut, oil pump driving worm and chain tension slipper parts. The thinner of the two clamping plates goes on first with long end down, followed by the tensioner and the thicker plate with long end up. Fit fan disc washers and nuts and tighten lightly. Set camshaft chain tension so that there is  $\frac{1}{8}$  in. minimum up and down movement in the centre of the chain run at the tightest point. Tighten tensioner nuts and re-check. Do not set this chain too tight. Whilst this is being done the distributor sprocket should be pushed over the driving spindle making certain that the copper washer and tubular steel spacer are already on the spindle. Remove the distributor cap and place a finger on the rotor whilst the sprocket is pushed home.

Unlike the camshaft sprocket, it is possible to get the distributor sprocket clear of its spindle and re-mesh it with the chain if necessary without disturbing the intermediate gear.

Fit dummy timing cover and tighten cam-

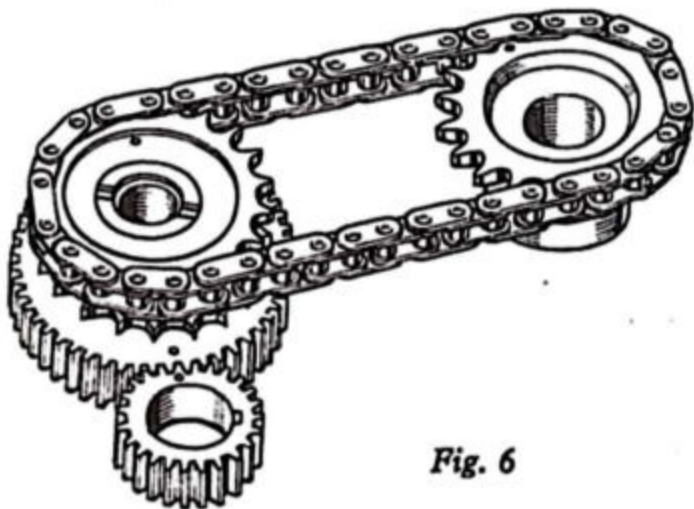


Fig. 6

shaft nut, tighten oil pump driving worm—L.H. thread.

On magneto ignition models, the automatic advance unit and driving sprocket should be meshed with its driving chain at

the same time as the camshaft chain and sprocket assembly is pushed on to its shafts. It should be entered on the magneto armature spindle and the securing nut started a few threads prior to timing as described in next paragraph.

### 30a. IGNITION TIMING— COIL IGNITION MODELS

(see also para. 121)

Before timing the ignition ensure that the distributor driving chain has  $\frac{1}{8}$  in. up and down movement in one run at its tightest point. 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. Set the C.B. points gap to .015" when wide open. To set the timing remove the sparking plugs and rotate engine until the marked tooth on the camshaft sprocket is on top centre position. This will bring the pistons also to T.D.C. with the driving side on the firing stroke. The distributor should now be turned until the brass contact of its rotor is pointing directly downwards. Now note if the driving pin holes in sprocket and spindle line up. If they do not, ease sprocket off spindle and remesh it with the chain to the nearest tooth, push back on spindle and fit driving pin as described in para. 28.

Rotate the engine backwards until the piston is the required amount down the stroke before T.D.C. (see data page). Slacken the pinch bolt on the distributor clamp (this has a captive nut) and turning the rotor clockwise to the advanced position, slowly rotate the distributor body until the contact breaker points just separate. Tighten the clamping bolt and recheck. A thin strip of cigarette paper is useful for determining the exact position at which the points separate or it can be done electrically as follows—

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 other part of engine or machine.

If the contact breaker points are closed, the light will come on and will go out when the precise breaking point is reached.

It is generally better and more accurate to use a timing disc on the crankshaft and time in degrees B.T.D.C. rather than measure

piston travel back from T.D.C. With either method it is equally important that T.D.C. should be accurately determined to start from.

### **30b. IGNITION TIMING— MAGNETO MODELS**

Before timing the magneto, check the contact breaker points gap. It should be .012" plus or minus .001" when wide open. Check on both cams.

Screw up the nut securing the automatic timing device to the armature shaft and check the chain tension. The magneto is flange mounted on three waisted studs which permit of chain adjustment when slackened. The chain should have about  $\frac{3}{8}$  in. whip midway between the sprockets at its tightest point.

Now slacken the nut and continue to unscrew it until it just pulls the A.T.D. off the taper.

Set the piston position as for the coil ignition models that is with the L.H. cylinder on compression stroke, the rearward H.T. lead from the magneto goes to this cylinder. The magneto feeds this lead when the contact breaker rocker heel strikes the bottom cam.

Using a small nut or small wooden wedge, prop the automatic advance unit fully advanced. Rotate the contact breaker with the fingers until a thin strip of cigarette paper can be just withdrawn from between the points. Hold the C.B. still and with other hand screw up the centre nut on the A.T.D. Remove the wedge holding it advanced and tighten the nut preferably with a ring spanner. Replace wedge and check timing on both cylinders. Be particular to remove wedge before fitting timing cover.

### **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 tensioner, sprockets, etc., and oil pump, paras. 24, 26 and 28.

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 drive side crankcase may now be removed by levering gently between the crank cheek and the crankcase inner wall with a flat tyre lever or similar tool. It will take with it the outer race of the roller bearing, leaving the inner race with cage and rollers on the shaft.

Withdraw the camshaft from the timing side case and remove from the bottom of the drive side camshaft bush, the rotary breather valve and spring.

Turn the crankshaft in the timing side bearing to approx. bottom centre and with the lever used for the drive side, attempt to lever the crankshaft out of the timing side ball bearing. If it does not move without undue force, the crankcase will have to be heated so that the ballrace complete will withdraw from the crankcase when the bearing can be levered off the crankshaft.

Shims are no longer used between main bearings and crank cheeks.

The timing side ballrace should be a light driving fit on the crankshaft and if it is found to be very tight, the shaft should be carefully eased down with emery tape. This bearing does not require to be so tight on the shaft as does the roller race on the opposite side because it is finally held endwise when the oil pump driving worm is tightened up. If it is desired to replace the roller race, the drive side crankcase should be heated up over a soft flame, taking care that excessive heat does not reach the oil seal. If the case is then dropped squarely on flat wooden surface, the outer race of the bearing should

drop out. If the case is quickly cleaned the new race may drop into position without reheating.

Reheat the timing side case keeping the intermediate gear spindle as cool as possible and refit the timing side ballrace or fit a new one as required.

With the flywheel assembly thoroughly cleaned, mount drive side crankcase inside up on wooden blocks sufficiently high to give clearance between mainshaft and bench when the crankshaft is in position. Smear joint faces of both halves of case with good quality jointing compound such as 'Wellseal', pour a little clean engine oil over rollers and cage of drive side bearing. Fit crankshaft into drive side case. Fit rotary breather valve, spring and camshaft into bush in drive side case, making certain that the dogs on the valve are engaged with the slots in the camshaft end. Do not turn camshaft until the timing side case is fitted and pushed home.

Timing side crankcase can now be fitted engaging two top studs in drive side case and camshaft in timing side bush.

Dependant upon how tight the timing side mainshaft is in the ballrace, this side of the case may require to be tapped home with a hide or wooden mallet.

Pinch the two halves of the case together with nuts on two top studs and use two other studs as near opposite as possible. Check that the camshaft is free to rotate which will prove that the rotary valve is properly positioned.

It will not be possible to check crankshaft end float if the timing side shaft is very tight in the ballrace but with the bolts tight and the crankcase cold there should be about .005" to .008" end float.

To check, mount crankcase on wooden blocks drive side uppermost. Fit nut to drive side mainshaft and with hide or copper hammer drive crankshaft assembly hard down towards timing side.

Set up a dial test indicator with its spindle on the end of the shaft. Set it to read zero. Now with levers under the mainshaft nut or under an old alternator rotor secured by the nut, lever on suitable packing pieces to 'pull' the crankshaft towards the dial indicator. Note reading.

End float is not critical but connecting rods should be fairly accurately centralised in cylinder bores. If for any reason, they are not, shims are available from the spares department.

To complete, fit remaining crankcase

bolts and screws and tighten fully.

### 33. BIG END BEARINGS—RENEWAL

The necessity for big end bearings renewal will be apparent by a thumping noise from the region of the crankcase, when the engine is pulling, and by a very low oil 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.

Although the 650 cc. models have larger big end bearing bolts, the same torque setting is used and has been found satisfactory.

**NOTE—Big end nuts should not be used again if they are not tight on threads.**

### 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 rods are removed it may be found desirable to renew the small end bushes. Should this be the case, the rods should be returned to the Service Department for the work to be carried out. In this way they will be reamed square with the big end eyes. (Note—on 650 cc. models the gudgeon pins bear direct in the small ends of the dural connecting rods).

### **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 bearings in crankcase, it is wise to check their fits on the respective mainshafts. The timing side ball bearing

should be a good push fit, its inner race is finally held endwise by the assembly on the shaft secured by the oil pump worm. The inner race of the roller bearing on the driving side mainshaft requires to be a light driving fit.

If the bearings are too tight, ease the shafts down carefully with emery tape.

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

To remove the bush from the gear, 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 threaded 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 and large washer to the bolt and tighten. As the nut is tightened the bush will be withdrawn.

Fit new bush in reverse manner or press home carefully in a plain jaw vice. Ream to .5620"/.5625" after fitting.

In the unlikely event of the intermediate gear spindle requiring renewal, it should be drifted out of position whilst the crankcase 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 partially 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 REFITTING**

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).

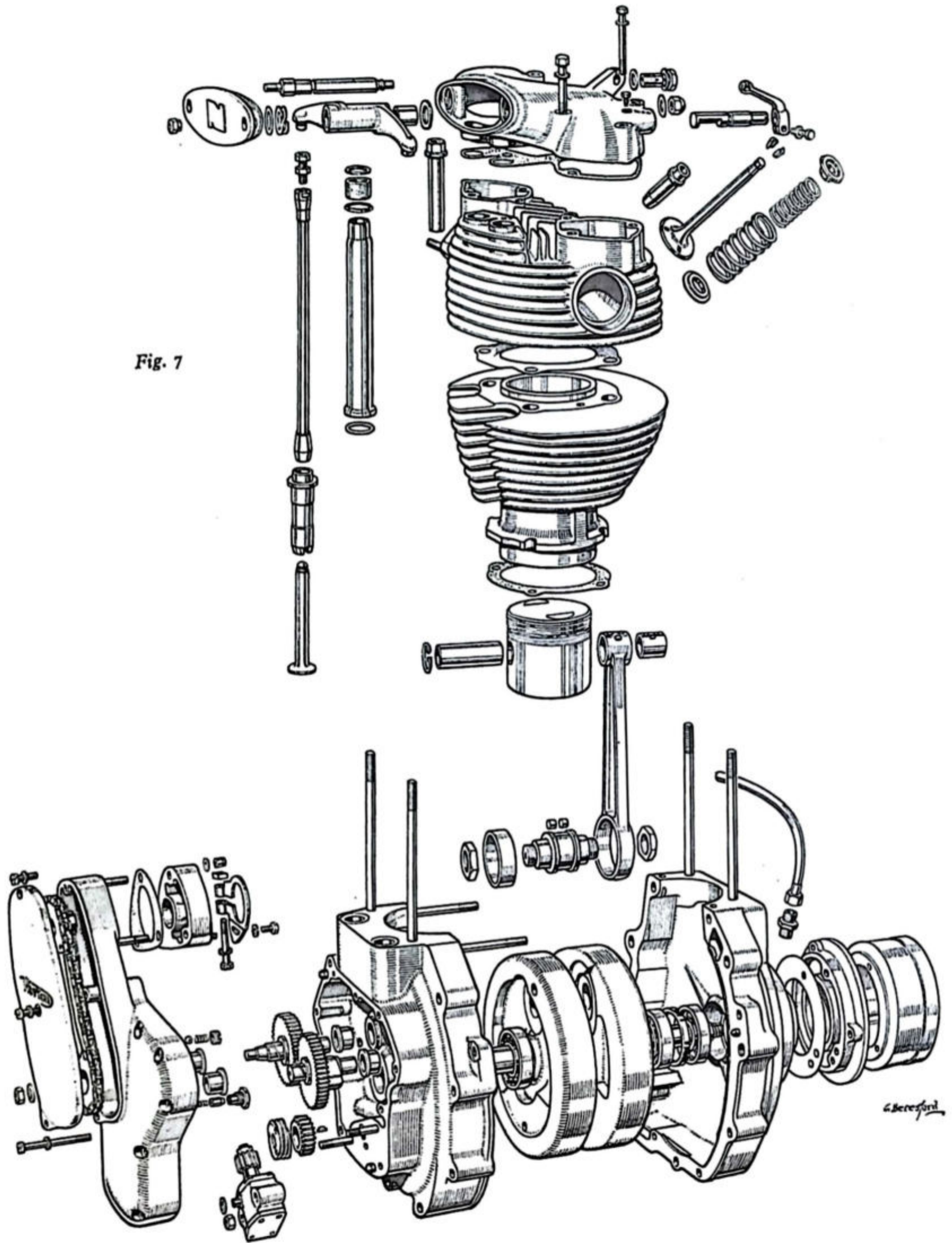


Fig. 7

## 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 the suction from the feed side of the oil pump, round the gears, and is forced under pressure to the big end bearings with a by-pass to the rear cylinder wall.

Oil by-passing a relief valve in the timing cover adequately lubricates the timing gear before returning to the sump.

The sump is then scavenged by the larger capacity return side of the pump and the oil is returned to the tank. A connection in the return pipe between pump and tank feeds the overhead valve gear.

#### 41. THE FILTER

This filter is identical with the one described in paragraph 2 (1) of Engine lubrication system, models 88, 99 and 650 and the same remarks regarding cleaning it and removal of the oil tank during oil changes apply. Should it be necessary to remove it, the rubber or plastic pipe should be removed and a ring spanner employed. It should be noted that the filter occupies a higher position in the tank than does the drain plug and therefore small particles of foreign matter are trapped in the bottom of the tank until such time as the drain plug is removed.

#### 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

See para. 4. THE ENGINE, models 88, 99 and 650.

#### 44. 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 the 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. spring chambers drains back through drilled holes in the cylinder head and barrel.

Oil is fed to the contact breaker 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 near side of the rocker box, taking care not to lose the fibre or copper washer from either side of the banjo. Disconnect exhaust valve lifter cable from lever and completely release the 9 bolts holding the box to cylinder head. 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 push rods now protruding from head. To remove the cylinder head, remove the exhaust system complete, slacken the air filter clip (when fitted) on the carburetter air intake, and remove the two nuts securing the carburetter flange. Remove the air filter, followed by the carburetter. Disconnect H.T. lead from sparking plug. Slacken each of the four cylinder head nuts and completely remove.

**NOTE**—A plain steel washer is fitted beneath the cylinder head nuts.

Tap beneath the inlet port with wooden 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.

The barrel need not be removed for de-carbonisation, as the piston crown can be readily cleaned with the barrel in position and piston on top dead centre. Should it be decided to take off the barrel, rotate engine until piston is around bottom centre position and lift off the barrel; avoid tearing paper washer if possible. Immediately the barrel is removed, cover crankcase mouth with clean rag to prevent the 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 of 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 and guides; if free, do not touch guides, unless they are badly worn.

If guides and valves show no sign 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 and use fine only if the seats are not pitted.



Place valve in guide and rotate to and fro with either a rubber sucker on the head of the valve or a valve grinding tool on the stem. Lift the valve off the seat frequently whilst grinding to redistribute the compound.

Do not overgrind valve seats (a wide seat is not necessary but the exhaust can be wider than the inlet to give a better heat path). When the seat is ground sufficiently, that is when the valve and seat show 100% contact, remove all traces of grinding paste from seat, valve and port. Use a small piece of rag for this purpose and place in a waste bin immediately so that there is no risk of some other engine part being wiped with it afterwards.

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 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 and drain holes are not obstructed.

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 pushrod cover tubes are seating correctly between the tappet guide collar and the

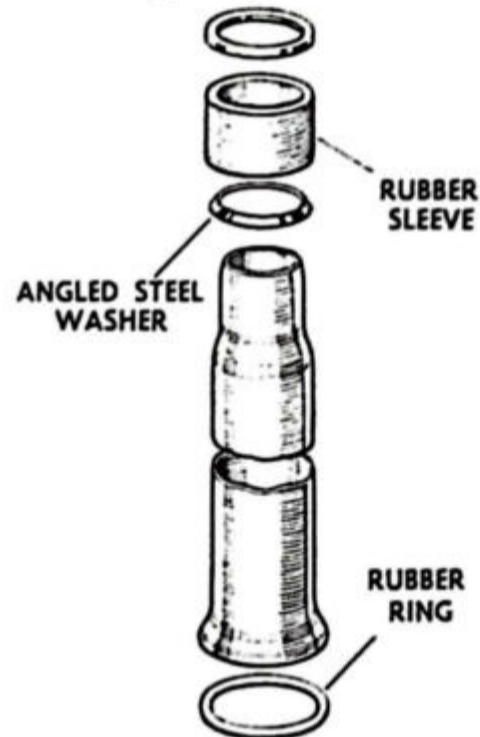


Fig. 8

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.

Fit cylinder head nuts and lightly pinch each one. Finally, tighten 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.

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 and 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

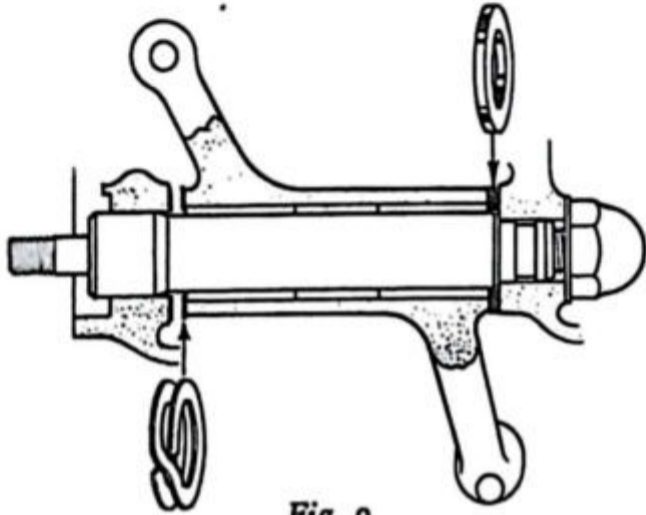


Fig. 9

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 renewing 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  $\frac{1}{8}$  in. 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 a steel shim fits between the double spring washer and the aluminium spindle boss in the box at the push rod side and the much thicker thrust washer fits at the valve side.

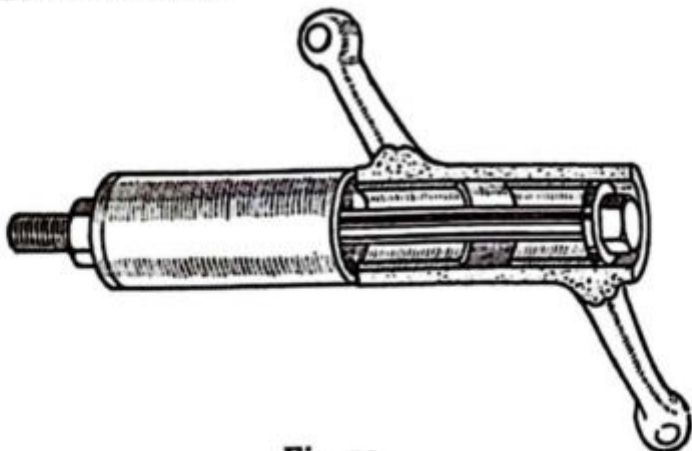


Fig. 10

Obtain a bar or tube smaller than the large spindle hole—push rod side. Insert this far enough into the hole to allow the shim and spring washer to be placed over it.

Carefully position rocker over the end of the bar and push it approximately into position, centralise washers as near as possible. Remove bar, smear spindle with oil and insert from push rod side. Using soft punch tap spindle part way through rocker.

Push rocker over by hand to compress spring washer 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.

With hand pressure on rocker, again compress spring washer. This will enable the thrust washer to be positioned on the full diameter of the spindle which can now be tapped fully home. Ensure that the rocker is free to move, fit copper washer and dome nut and tighten.

### 53. TO ADJUST TAPPETS

Release the middle hexagon—the locking nut—by placing one spanner on the flats on push rod end—and the second on the locking nut ( $\frac{1}{4}$ " Whit.).

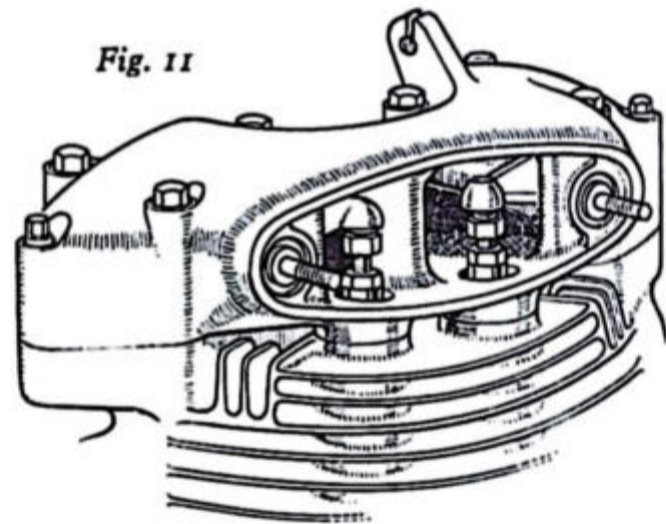


Fig. 11

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.

When adjusting the exhaust tappet, set on the slack, rather than on the tight side. Check tappets immediately there is any sign of loss of compression.

#### 54. REMOVAL OF PISTON and 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	...	.010"—.012"
Scraper	...	.010"—.012"

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 or has worked loose in the eye of the connecting rod, it should be replaced.

By far the best way of doing this is to return the connecting rod to the Service Department for the bush to be renewed and reamed square with the big end eye of the rod. Of course, this necessitates dismantling the bottom half of the engine and splitting

the flywheels, but if the small end bush is badly worn, then it would be a good thing to examine the big end bearing at the same time.

Should it be necessary to replace the bush without splitting the flywheels, it can be done but great care is necessary to ensure that it is fitted and reamed as square as possible. To withdraw the bush from the 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 threaded 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 that no strain is taken by the rod. Fit new bush in the same manner, taking particular care that it starts square. Drill the oil holes. Use an expanding reamer and ream in stages to size. Work from both sides and support rod whilst reaming. Gudgeon pin should be a running fit in the small end and the piston. Size of bore of bush fitted —.8745" to .8750".

#### 57. REMOVAL OF TIMING PANEL

Remove chain cover held by 3 cheese headed screws. Remove sprockets with chain in position. If difficulty is experienced, a withdrawal tool should be obtained. The cam spindle sprocket is held by taper and key; the contact breaker shaft is not keyed. Re-

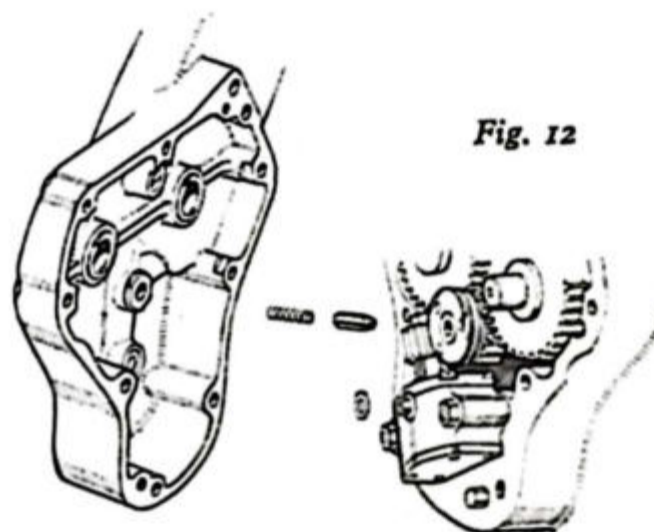


Fig. 12

move 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 hexagon headed screws are inside the contact breaker 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  $1/64$ ". 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 screw. 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

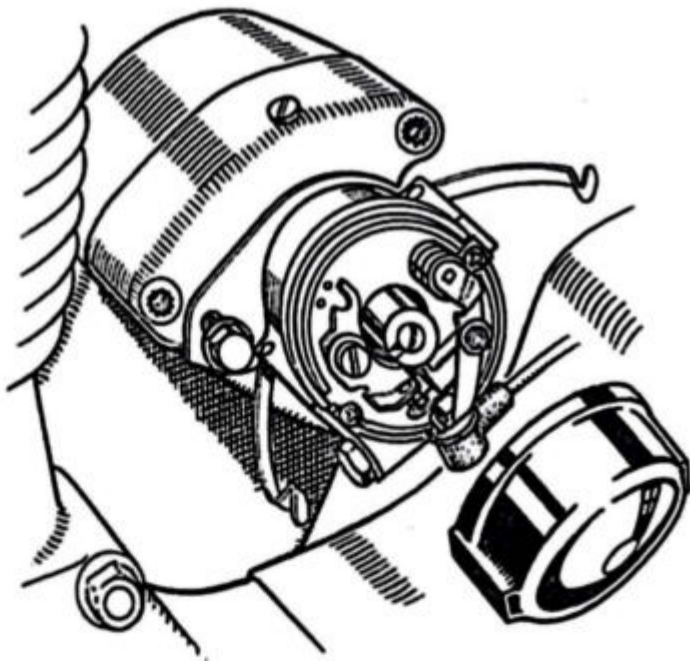


Fig. 13

holding the distributor housing to the timing cover extension and move the housing on its studs until there is about  $1/8$ " whip in the chain. Tighten the three nuts.

Set the contact breaker points to .015" when wide open. Set the piston on T.D.C. both valves closed. Slacken the contact breaker sprocket screw 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 from 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. Slacken the clamping bolt and rotate as necessary to obtain these conditions. **DO NOT ATTEMPT TO ROTATE THE SQUARE NUT ON THE CLAMPING BOLT.**

Rotate engine backwards until piston is  $38^\circ$  before top dead centre. With a small screwdriver in the slot in the cam end (not in 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**. If a suitable peg spanner is not available, it can be unscrewed with a hammer and blunt-ended punch.

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

Withdraw pinion from timing side mainshaft 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 should be extracted by heating the case using a soft flame or immersing in boiling water.

Now with a soft drift or hide hammer, drive on the tappet feet to start the guides moving out. As soon as there is sufficient room, lever out by means of the flange on top of the guide.

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.

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**

Deal with one half of the crankcase at a time and heat up with a soft flame taking care not to concentrate great heat in one area. Knock the case, joint face downwards on a flat wooden surface, when the bearings should fall out.

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

The bearings should be a 'light driving fit' on the shafts and should be checked before assembly. If they are over tight, ease the shaft down carefully with emery tape.

Heat the halves of the crankcase as for removal and press the ball bearing lightly into the driving side of the case. Fit the spacer ring next to the ball bearing. Press the outer race of the roller bearing up against the spacer with its flange towards the spacer.

To the timing side case fit the outer race of its roller bearing again flanged side first.

#### **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 driving 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 be relined 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

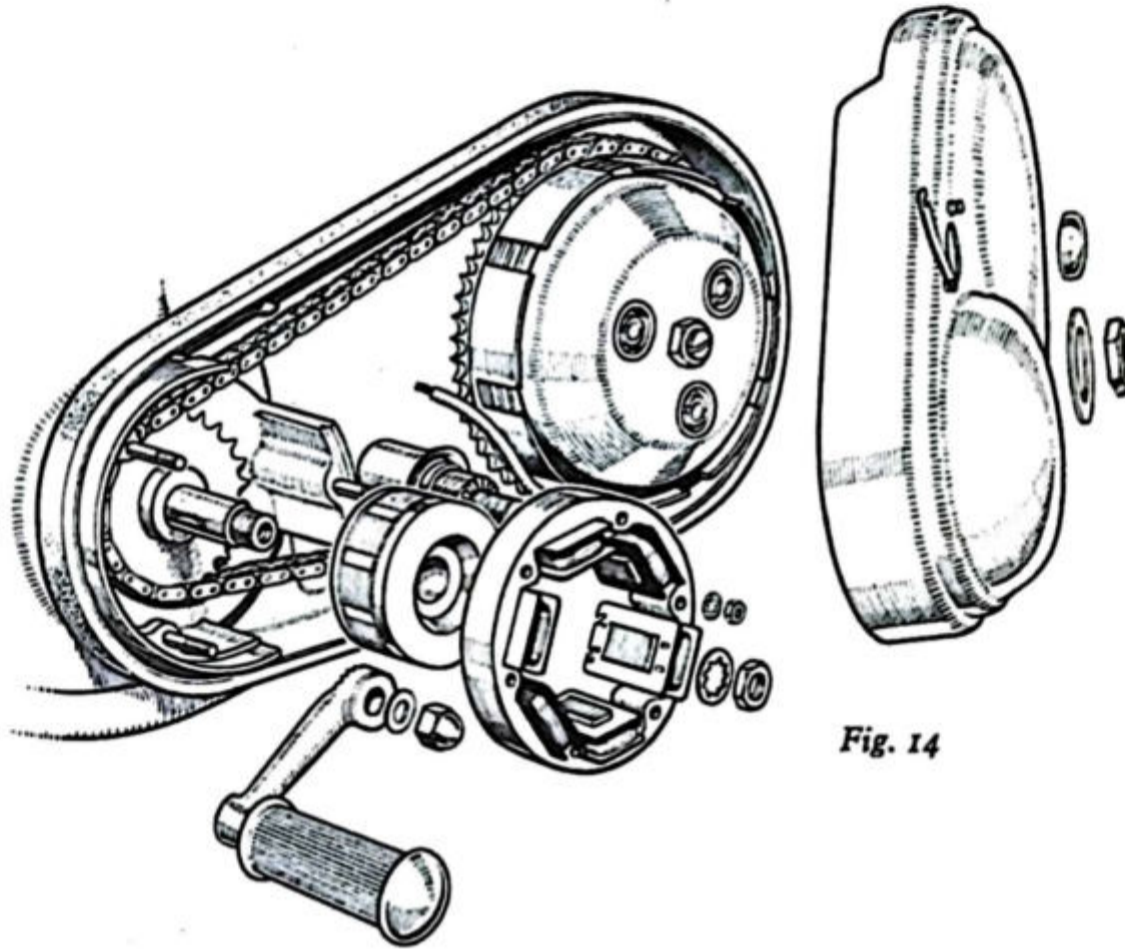


Fig. 14

### 71. CHAIN ADJUSTMENT

If maximum chain life and minimum power loss is to be obtained, chains must be run in correct adjustment and be properly lubricated.

The gearbox pivots on its lower mounting bolt and there are elongated holes in the mounting plates for the top bolt so that the box can be moved back and forward to adjust primary chain tension.

A drawbolt fitted to the gearbox top bolt has a  $\frac{1}{8}$ " Whit. hexagon nut on either side of a stop rivetted to the offside mounting plate.

**Primary Chain.** To tighten the primary chain therefore, remove the chaincase inspection cap, slacken forward drawbolt nut and run it back with the fingers one or two threads. Slacken top gearbox bolt ( $\frac{1}{8}$ " Whit. hex.) and slacken only slightly, bottom bolt ( $\frac{3}{8}$ " Whit. hex.). With a spanner on rearward drawbolt nut, pull gearbox back until the chain is tight. Now slacken rearward nut a few turns and tighten the forward nut so that it pushes the gearbox forward until there is  $\frac{1}{2}$ " to  $\frac{3}{4}$ " up and down movement in the run of the chain midway between the sprockets. Tighten top and bottom gearbox bolts and

operate kickstarter to check for tightest point of chain tension. There should be  $\frac{1}{2}$ " up and down movement minimum. Set on the slack rather than the tight side with the primary chain. Tighten the forward drawbolt

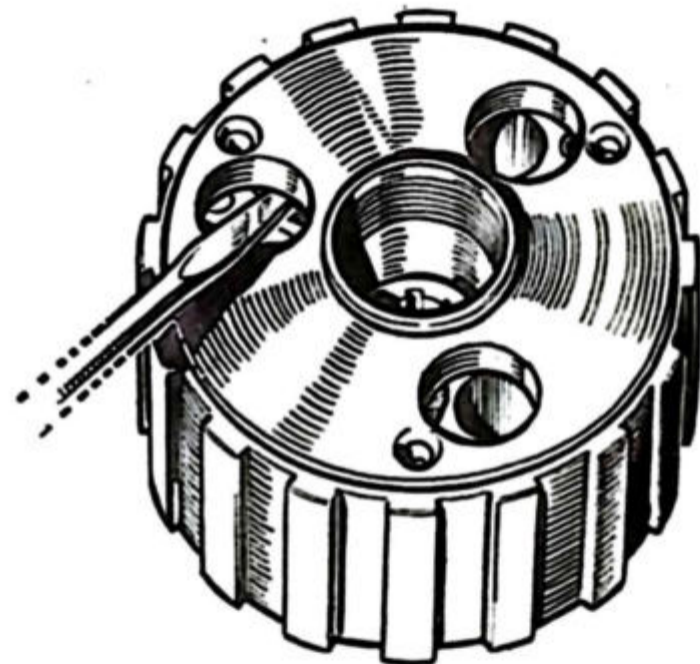


Fig. 15

nut against the stop so that it tends to push the gearbox forward all the time and tighten the rearward nut just sufficiently to prevent it becoming lost. In this way backlash in the

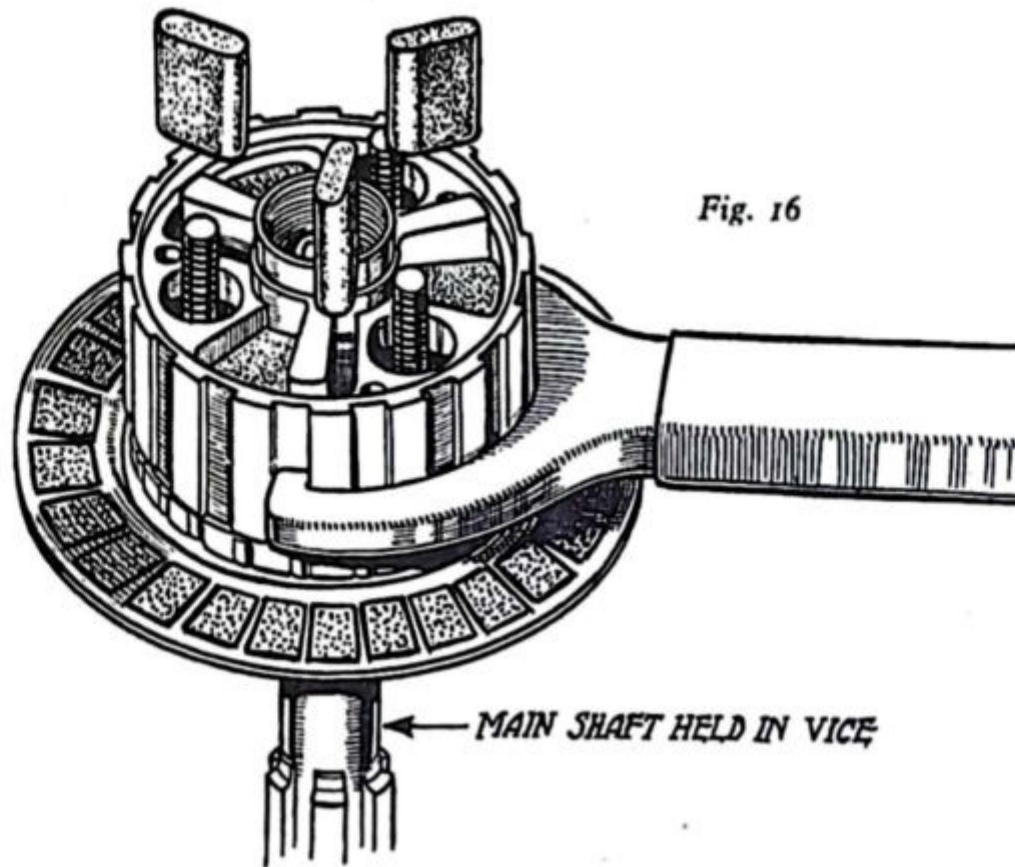


Fig. 16

adjusting mechanism will be all taken up so as to hold the gearbox forward against the greater pull of the rear chain.

The pull of the rear chain, always greater than that of the primary, can move the gearbox back after say, a jerky start, or a very quick gearchange up or down, or when rider and passenger sit on the machine, if the rear chain tension has been set too tight with the weight of the machine only on the wheels.

The important point to remember in view of this is that any final adjusting movement should always be in a forward direction.

**Rear Chain.** Before adjusting the rear chain make certain that the front is adjusted as described above.

Check that the ends of the rear wheel adjuster screws are hard up against the collars on the rear wheel spindle nuts and then slacken the spindle nuts ( $\frac{1}{2}$ " Whit. hex). Do not slacken fully but about half a turn so that the spindle will not move about too easily in the fork ends.

Slacken the adjuster screw locknuts ( $\frac{1}{8}$ " Whit. hex.) and count the number of flats you unscrew each adjuster ( $\frac{1}{8}$ " Whit. hex) so that you move the spindle back the same amount each side, and thus maintain wheel alignment.

WITH THE REAR SHOCK ABSORBERS COMPRESSED TO MID-STROKE there should be  $\frac{3}{4}$ " to 1" up and down movement in the run of the chain mid-way between the sprockets. At this point the chain is at its tightest.

Obtain assistance if necessary to hold the shock absorbers down—it will help if it is done single handed—to set the shock absorbers to the softest position and sit astride the rear number plate cuff (taking care not to break the tail lamp), with the machine off the stand, of course. The tension of the chain can now be checked with the left hand. Check for the tightest point as described for primary. Tighten wheel spindle nuts and adjuster locknuts, holding the adjusters themselves with a second spanner if necessary to prevent them screwing in and thus away from the wheel spindle, as the locknuts are tightened.

After adjustment of rear chain, check rear brake adjustment as, of course, this is altered by movement of rear wheel spindle.

Check wheel alignment, preferably with a straight edge, and note that because the rear tyre has a greater cross section than has the front, when the wheels are in line, a straight edge placed squarely on the side of the rear tyre at two points, should pass the front tyre leaving a small gap (usually about  $\frac{1}{8}$ " to  $\frac{3}{16}$ ") at two points, and when the straight edge is transferred to the opposite side of the machine, these gaps should be the same.

Should this not be so, note whether chain requires to be tightened or slackened, slacken wheel spindle nut on appropriate side and by means of adjuster, move wheel in required direction.

Tighten all nuts and check again.

If the chain has been slackened off, and to ensure that the rear spindle is hard up against



the adjusters, place a hammer shaft, or piece of wood between rear tyre and offside pivoted fork tube (swinging arm). 'Lever' wheel over towards nearside and tighten offside nut.

Pull wheel forward on nearside by 'squeezing' lower run of chain against pivoted fork tube with left hand whilst tightening spindle nut with right. (If the machine has a full chaincase, it is possible to apply some weight to the top run of the chain through the inspection orifice and obtain the same effect).

**Rear Chain Lubrication.** This is by oil vapour fed to it by the oil tank vent pipe which is connected to the forward end of the chainguard or chaincase. The amount of oil the chain receives will vary according to the way the machine itself is used. For example, with a normal oil level in the tank, and using the machine for a ride to work or short trips about town, the chain may not receive much oil, but if long fast runs are undertaken, it will certainly receive more which may become too much if a long full-bore run is made on say, a motorway. It will help to use a higher oil level in the tank for short journeys and a lower one for very fast ones, remembering that with a very low level there may be overheating at very high speeds due to the smaller amount in circulation.

On twin cylinder models, the crankcase breather pipe is normally diverted to the ground with a rubber extension of 8" to 10" long leading to a point near the centre stand pivot. This can be removed by taking out the single screw which secures it to the back of the

crankcase, the copper part can be straightened out somewhat (but not fully) and the rubber part shortened so that it discharges on to the rear chain at a point where it passes over the gearbox axle sprocket, and the pipe re-fitted. This, of course, will feed more oil vapour to the chain. On models 50 and ES2 the pipe is so positioned as standard. See notes at end of book. Oil Tank.

**Chain Hints.** CHAINS SHOULD NEVER BE RUN OVERTIGHT. It is better to run them on the slack side provided they are not so slack that they make contact with the inside of their cases or guards.

If the primary chain is run too slack an intermittent metallic tap will be heard as the lower run 'flips' upwards and strikes the underside of the tube in the chaincase which surrounds the footrest hanger. When this happens, of course, the chain should be adjusted up.

There should always be sufficient oil in the front chaincase for the lower run of the chain to 'dip' as if the chain is run for only a short distance with insufficient oil, it will overheat and wear rapidly and oleate of rust formed in its bearings will give the remaining oil a 'cocoa like' appearance.

Most riders are aware that when the springclip is fitted to the connecting link, its blind end should be fitted pointing in the direction in which the chain travels. Many do not seem to know however, that the spring is not flat, but has a concave and convex side. It should be fitted blind end forward and

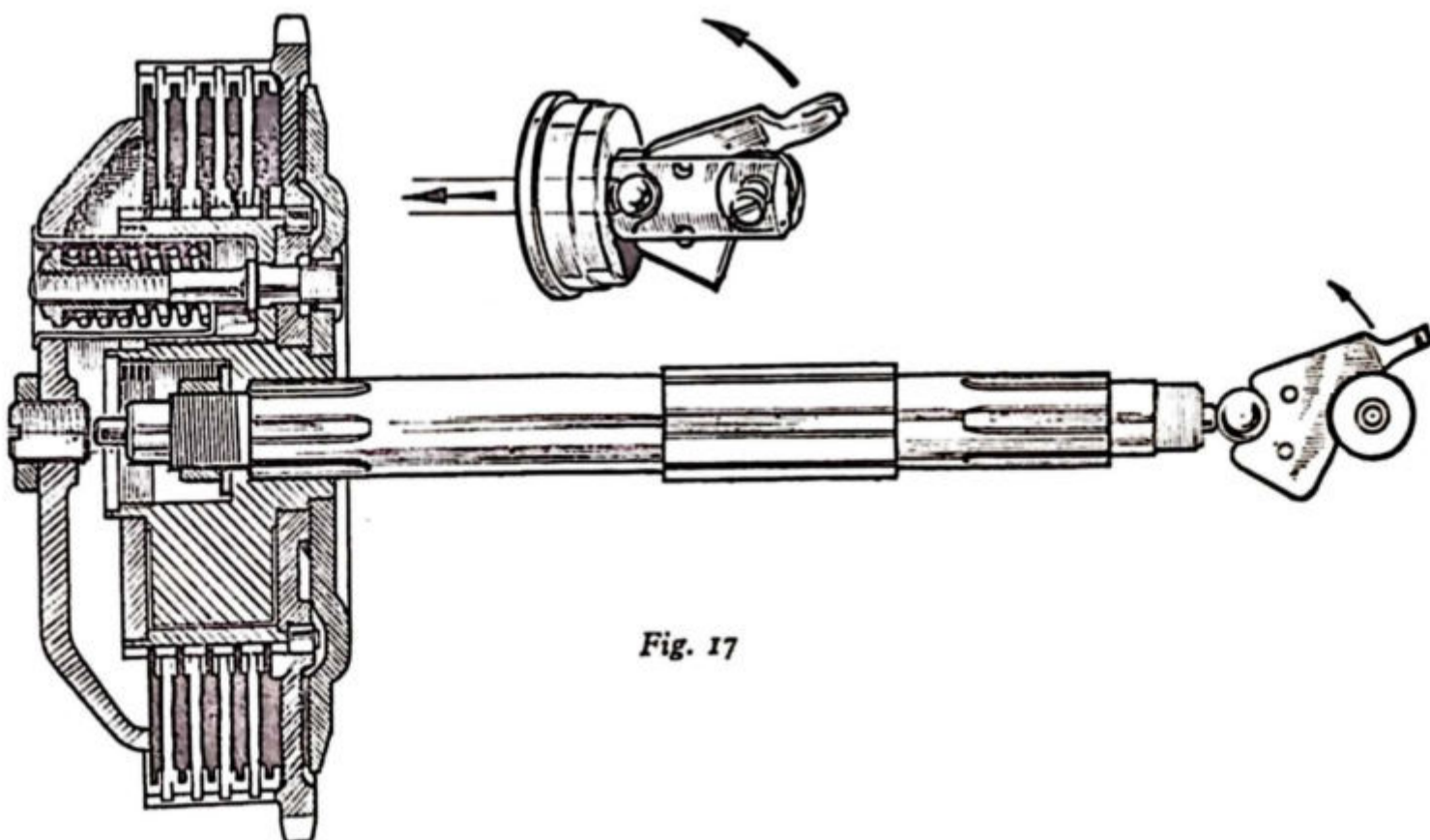


Fig. 17

convex side out so that it holds the side plate snugly up against the bushes of the inner links.

Rear chain life can be increased by removing the chain, say every 1000 miles (for this purpose keep an old chain to join on to the present one and run round the sprockets whilst the chain is removed). This will greatly facilitate removal and refitting.

Wash the chain thoroughly in paraffin and after allowing the paraffin to dry off, immerse the chain in lubricant which has been heated in a container until liquid. After about 10 minutes immersion during which the chain is moved about with a stick to 'work' the joints and ensure penetration of the lubricant, the latter is allowed to cool with the chain still in it. After cooling the chain is removed and the surplus grease wiped off. The chain can then be refitted to the machine after cleaning the chain wheels.

It should be noted that not all greases are suitable for heating to thinness without deterioration, and when purchasing the purpose for which the lubricant is required should be stated, as special ones are marketed for the job.

It is useful to know the extent of chain wear, and wear up to  $\frac{1}{4}$ " per foot of chain length is accommodated by the depth of hardening of the bearing surfaces, and when this limit is reached, the chain should be replaced.

The test should be made carefully to ensure an accurate result. The chain is first washed in paraffin to ensure all joints are free and laid unlubricated on a flat board. If it is anchored at one end by a nail, the necessary tension to pull it out to its fullest extent can be applied with one hand, whilst measuring between the centres of the bearing pins.

## 72. CLUTCH ADJUSTMENT

The clutches of all these machines have bonded on friction material and it is bonded to the driven plates instead of inserts in the driving plates and chainwheel as on earlier models.

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

With the control cable adjuster slackened off, there should be about  $\frac{1}{8}$ " free movement in the small operating lever in the kickstarter case. This is illustrated on the extreme right of Fig. 17. If there is more or less than this, the primary chaincase outer half should be removed (para. 73).

Now release the locknut ( $\frac{1}{8}$ " Whit. hex.) on the adjuster screw in the centre of the aluminium pressure plate and set the screw as necessary. If it is first screwed in until it is hard on the pushrod and then slackened back half a turn this should give about the right amount of free movement in the lever as described.

Tighten the locknut and adjust the cable so that there is about  $\frac{1}{8}$ " free movement at the handlebar lever. The clutch pressure plate should now come off squarely and rotate true laterally when the kickstarter is operated with the clutch withdrawn. If it does not do so, adjust individual springs to obtain this result.

If the clutch is dismantled for any reason such as cleaning of the plates, check that the nut securing the clutch centre to the gearbox mainshaft is tight before refitting the pressure plate and springs, etc.

If a replacement handlebar lever is fitted at any time, make certain that it has the correct centres for cable nipple and fulcrum pin these should be  $\frac{7}{8}$ ".

## 73. REMOVAL AND REFITTING OF OIL BATH

Remove the brake pedal by withdrawing the jaw joint pin and unscrewing the grease nipple from the pedal boss. Take care whilst doing so not to push the pedal down farther than it normally travels as otherwise the pedal return spring housed in the pedal boss will be strained and require to be replaced.

Remove the left hand footrest and the large nut screwed on to the footrest tube ( $\frac{1}{2}$ " Whit. hex.). 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 carefully through the grommet in the inner chaincase until the stator can safely be rested on the rear engine plates. Remove mainshaft nut and rotor from mainshaft.

Remove primary chain and withdraw engine sprocket using sprocket puller. Remove the three clutch spring nuts, springs and cups and clutch pressure plate.

Engage top gear and obtain assistance to hold the rear wheel while the clutch retaining nut is being slackened. The rear brake can be held on with a ring spanner on the cam spindle nut.

With the clutch centre nut removed, the clutch itself can be withdrawn, it is on a

parallel spline but if tight, a special withdrawal tool can be obtained from the Service Department.

Remove the three countersunk 'Allen' screws securing the stator housing to the crankcase. The inner chaincase is now held by three screws at the front end, by the nut on the nearside gearbox bottom bolt and by the nut on a hexagon spacer stud on the nearside engine/gearbox 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 spring on the chain connecting link with its closed end pointing in the direction of travel of the chain and with its convex side out. Do not fit outer portion until clutch has been adjusted (para. 72). Note that the rubber sealing band has a thin lip on one edge only. This should be on the outer diameter of the band and towards the outer cover. If the band has stretched it is permissible to cut a piece out and join with wire provided the joint is positioned on the top side 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 be distorted. Usually one or two threads only should protrude through the nut.

#### **74. CLUTCH—TO DISMANTLE**

Remove the outer portion of the oil bath (para. 72). Remove clutch spring adjuster nuts with divided screwdriver, or use a small screwdriver on one side only. There is a locking 'pip' under the head of these screws and considerable torque may be necessary to get over it during the first one or two revolutions.

Pressure plate will now come away, remove clutch plates, and note that the first driven plate has bonded friction material on one side only and must therefore always be the end plate.

Disconnect primary chain and remove clutch chainwheel. Engage top gear and unscrew clutch centre nut. R.H. thread,  $\frac{1}{8}$ " Whit. hexagon box spanner required. Remove nut and single spring washer. Clutch centre can now be withdrawn from splined gearbox mainshaft.

To dismantle the clutch centre and examine the shock absorber rubbers, 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).

At the works, the rubbers are removed by mounting the clutch centre on an old mainshaft held in a vice and with a special 'C' spanner on the splines of the centre the large rubbers are compressed whilst the small ones are removed first.

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 ones have been withdrawn.

The body is then removed from the mainshaft, the 'spider' or shock absorber centre is taken out and the body turned upside down on the bench.

The three nuts on the spring studs should then be removed when the backplate, roller race, race plate and body can be separated.

If a spare mainshaft and special 'C' spanner are not available, the rubbers can be removed from the shock absorber with the clutch centre on the mainshaft of the machine.

A spare 'driven' clutch plate is necessary on which should be welded a piece of steel tube for a handle about 24" long. (This is a useful tool to have in the workshop in any case as it provides a good means of holding the clutch centre whilst the centre nut is tightened or slackened).

Top gear should be engaged and the rear wheel stopped with the brake, or a rod passed through the spokes of the wheel which must be held on a spoke nipple hard up against the rim and then allowed to come up against the tubes of the pivoted fork (swinging arm)—remove rear chaincase or guard as necessary.

Now using the tool as described turn the clutch centre to compress the large rubbers and 'pick' out the small ones. The large ones will now come out easily and the body dismantled as described above.

#### **75. EXAMINATION OF CLUTCH PARTS**

Examine the driven plates with their bonded on strips of friction material and ensure that none are missing. Clean them thoroughly with petrol and a stiff brush. Place the plain driving plates together and check that they are flat. These should be of the 'pin point planished' type—that is they should have small 'pop' marks all over. Plates

so treated will stand high temperatures without buckling.

The splines on the body and the bonded plates which drive the body rarely show any signs of wear, but the tongues on the plain driving plates may be worn and may have cut slots in the chainwheel. This wear obstructs the free movement of the plates when the clutch is operated, this can be rectified by carefully filing or grinding the tongues on the plates square also the driving edge of the slots in the chainwheel.

The only effect this will have on the clutch is a slight amount of backlash, when the clutch is engaged or disengaged.

Examine roller race, rollers and cage, examine the race plate, face and bore for wear by the clutch body centre or 'spider'. Examine the shock absorber rubbers, they may have become soft or cracked. Examine the 'spider' itself for wear on race plate and cover plate diameters also the internal splines for any fractures.

## 76. ASSEMBLY OF CLUTCH

Fit race plate to clutch body, ensuring that the holes in the plate are in line with the holes in the body, and the spring studs an

easy fit. Fit roller cage, rollers and back plate. Fit shock absorber centre or 'spider' in body and lock up nuts on studs. Fit large rubbers followed by small ones. Fit cover plate and three screws (these may be countersunk or have cheese heads). See illustration for correct position of large and small rubbers. Test roller race for freeness on its track, and apply a little medium grease or anti-centrifuge grease.

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

Fit sprocket to body, revolve sprocket on race to check free movement, fit plates as follows:

First a double sided bonded driven plate followed by a plain driving plate and so on in alternate order until the last bonded plate which is single sided is fitted. This, of course, should present its plain steel side to the pressure plate.

Fit clutch to gearbox mainshaft, fit spring washer and nut, engage top gear and tighten nut.

Fit clutch push rod, clutch pressure plate, spring cups, springs and spring adjuster nuts. Screw up nuts until studs come up just flush with end of nuts, and adjust as necessary to ensure square withdrawal of pressure plate.

# GEARBOX

## 77. REMOVAL FROM FRAME

With this frame it is not possible to remove the gearbox as a separate unit and if, therefore, it becomes necessary to remove the gearbox shell, then 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.

## 78. OUTER COVER, REMOVAL

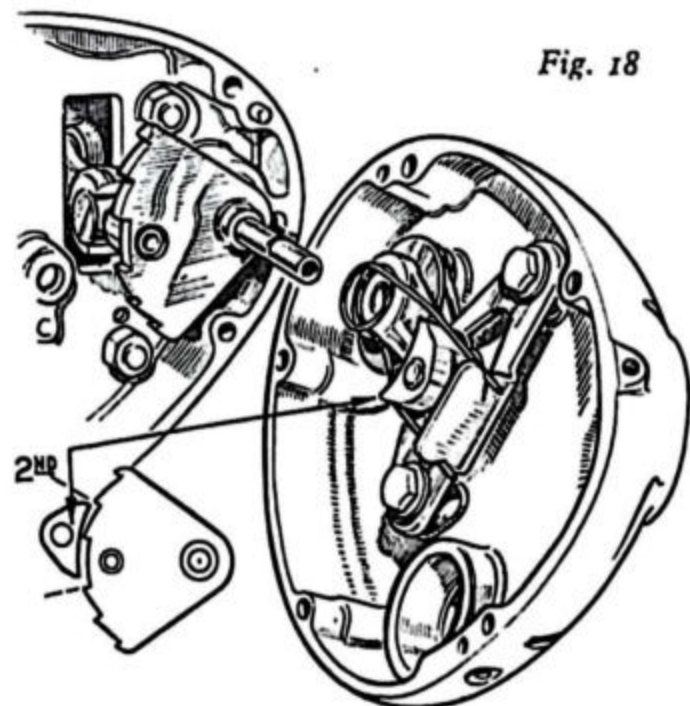
Remove the kickstarter crank by unscrewing the pinch bolt taking it right out and pulling off the crank. Remove gear indicator by unscrewing the centre bolt from the positive spindle. Remove oil filler and inspection plate and disconnect clutch inner wire from operating lever.

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.

## 79. OUTER COVER, FITTING

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



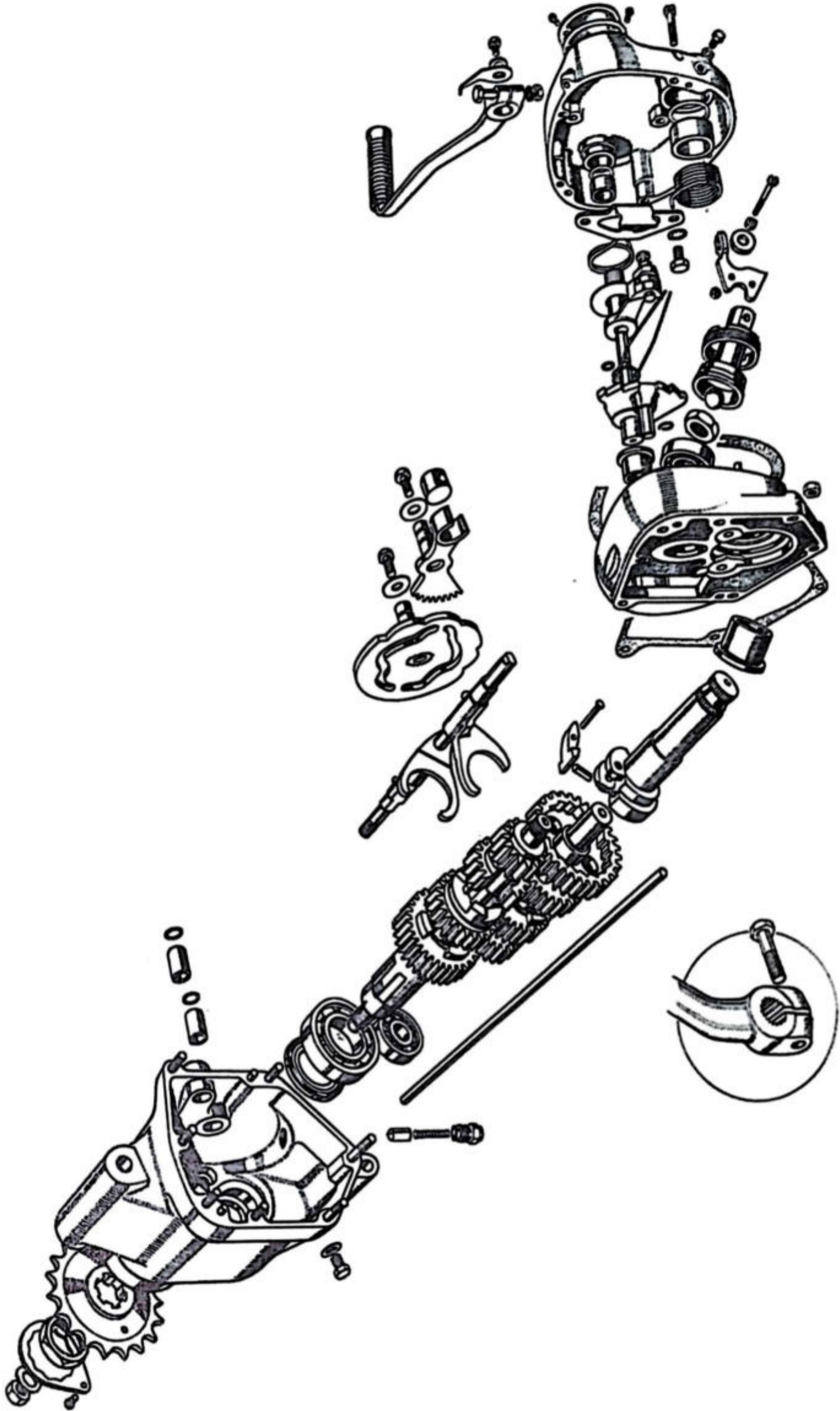


Fig. 19

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 springlegs 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. Before unscrewing locking ring securing clutch withdrawal device, mark rotational position of lever slot on end cover just outside lock ring. Otherwise it is unlikely that operating lever will be at correct angle for cable entry when outer cover is fitted.

Unscrew lock ring (R.H. thread) and remove operating lever body ensuring that  $\frac{1}{2}$ " steel ball does not become lost. Unscrew mainshaft nut now exposed (R.H. thread).

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 the 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.

If kickstarter crank has been positioned on its splines in a too near vertical position, a large waded foot may have inadvertently held the crank far enough back whilst riding for the pawl to run continually in mesh with the ratchet annulus in the 1st gear wheel. Both these parts should therefore, be examined for wear.

## **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 the 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 on 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 shell. This serves as a bush for the camplate indexing plunger and spring which will come away with it when the nut is unscrewed.

Remove the two hexagon headed set screws 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 screws are removed. Both cam plate and quadrant are carried in bronze bushes which should be checked carefully for wear, as wear here can contribute to uncertain indexing of gears which may eventually allow them to jump out. Note that an 'O' ring is fitted on each of the spindles at the outer end and under the securing washer.

Should these bushes require replacement, they can be pressed or drifted out, preferably heating the shell first.

### 88. FITTING CAM PLATE

Place the quadrant in position and secure it with its bolt and washer. 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 screw and washer should be fitted and tightened. Fit indexing plunger, spring and plunger bush.

### 89. FITTING GEARS INTO GEARBOX

Fit the main gearwheel, it does not have any shims as had the earlier Norton/Burman type, make sure spacer which bears on oil seal is in position as the sleeve of the gear passes through the bearing in the shell. Fit the axle sprocket, tighten the nut, fit locking washer and set screw.

Check the fit of the layshaft in the ballrace in gearbox shell—it should be a hand push fit. If it is tight, ease the end of the shaft down with emery tape.

Fit third gear wheel (free pinion) 20T to layshaft followed by fixed pinion 18T. This must be fitted with its flat side to the free pinion and its slightly raised centre to the ballrace. Fit layshaft in gearbox. Oil mainshaft on plain portion and fit in sleeve gear.

Set the cam plate in neutral position, i.e. with indexing plunger in the shallow groove. Fit the selector fork to mainshaft third gear (21T) and fit to mainshaft, meshing it with the layshaft gear already in position. Fit the other selector fork to the layshaft second gear (24T). Fit this to layshaft, engage pegs on selector forks with slots in cam plate, fit selector fork spindle and screw home. It is not difficult to fit this spindle, even with the gearbox in the frame, use a screwdriver if necessary to 'lift' the inner selector fork into position whilst the spindle carrying the outer fork is passed through it.

The selector forks are identical and can, therefore, be interchanged but it is advisable

to replace them in their original positions.

Fit mainshaft free pinion, mainshaft fixed pinion and low gear wheel to layshaft. There are no shims.

Fit end cover taking care that joint washer is undamaged and properly positioned.

Fit remainder of parts as described in para. 85 inner cover assembling, and para. 83 inner cover fitting.

Finally, remember to refill the gearbox with oil to correct level—preferably on high side rather than low.

## WHEELS, HUBS & BRAKES

### 90. FRONT WHEEL REMOVAL

Place machine on centre stand, remove split pin from brake control clevis pin and withdraw pin. Unscrew cable adjuster from brake plate. Unscrew wheel spindle nut (R.H. thread) and release pinch stud nut in L.H. fork end.

Take the weight of the wheel in left hand and withdraw spindle by means of a tommy bar placed through the hole in the head of the spindle. Withdraw spindle and as wheel is removed, take great care not to allow the brake plate to fall from the drum (its bevelled edge can be badly damaged if it is allowed to fall). Place spindle and dust cover in a clean place to avoid contamination with grit.

### 91. FRONT WHEEL—FITTING

Re-assemble in reverse order, grease spindle lightly. Fit brake plate into drum and as wheel is lifted into forks, position dust cover on L.H. side and make certain that torque stop on brake plate engages slot in R.H. fork leg. Pass spindle through with right hand. Fit and tighten spindle nut. Deflect forks a few times to 'centre' nearside leg on spindle. **NO NOT** overtighten pinch stud nut on L.H. side. The lug on the leg can be broken if this is overtightened. Re-connect and adjust brake cable.

### 92. REAR WHEEL—REMOVAL

Place machine on centre stand, on de Luxe models only remove rear number plate.

Remove the three rubber plugs from off-side rear hub and with box or socket spanner remove three sleeve nuts then exposed.

Unscrew right hand portion of wheel spindle and withdraw. Remove spacer and speedometer drive gearbox and allow the latter to hang on its cable.

Withdraw wheel from brake drum by pulling to offside when it should come clear of brake drum which is left in position.

The standard models do not now have a detachable rear mudguard portion and one

should therefore stand on the nearside and incline the machine slightly towards one on the stand, when the wheel can be withdrawn with the right hand from the offside.

On de Luxe models, if the tyre is punctured and therefore 'flat' the wheel can be withdrawn rearwards through the space left by the removal of the number plate. With the tyre inflated, it may be necessary to incline the machine as for standard models to get the wheel clear.

If it is necessary to remove the wheel complete with brake, remove chaincase or chainguard and disconnect the chain, remove brake rod adjusting nut but **do not** push the brake pedal down to withdraw rod from roller. Disconnect the 'dead' lead from stop-lamp switch. Disconnect speedometer drive cable, and slacken both sides of the wheel spindle. The wheel should now slide out of the fork ends and be removed as described above but it may be necessary to remove the offside silencer due to greater width caused by the offside portion of the wheel spindle remaining in the hub.

### 93. REAR WHEEL—REFITTING

Reverse dismantling operations and if fitting with brake complete make certain torque stop on brake plate properly engages with slot in left hand fork end. Engage brake rod in cam lever roller and push wheel spindle up against adjuster screws. Position speedometer gearbox for correct cable take-off angle and tighten both sides of spindle. Connect speedometer drive cable—do not overtighten gland nut.

Fit rear chain taking care to fit clip to connecting link as described in para. 71—Chain Hints. Check rear chain tension.

Fit chaincase or chainguard. Adjust rear brake. Re-connect stop switch 'dead' lead. On de Luxe models refit number plate.

When fitting rear wheel only with brake drum already in situ, incline machine as necessary to position wheel under mudguard or tail fairing. Turn brake drum by hand so



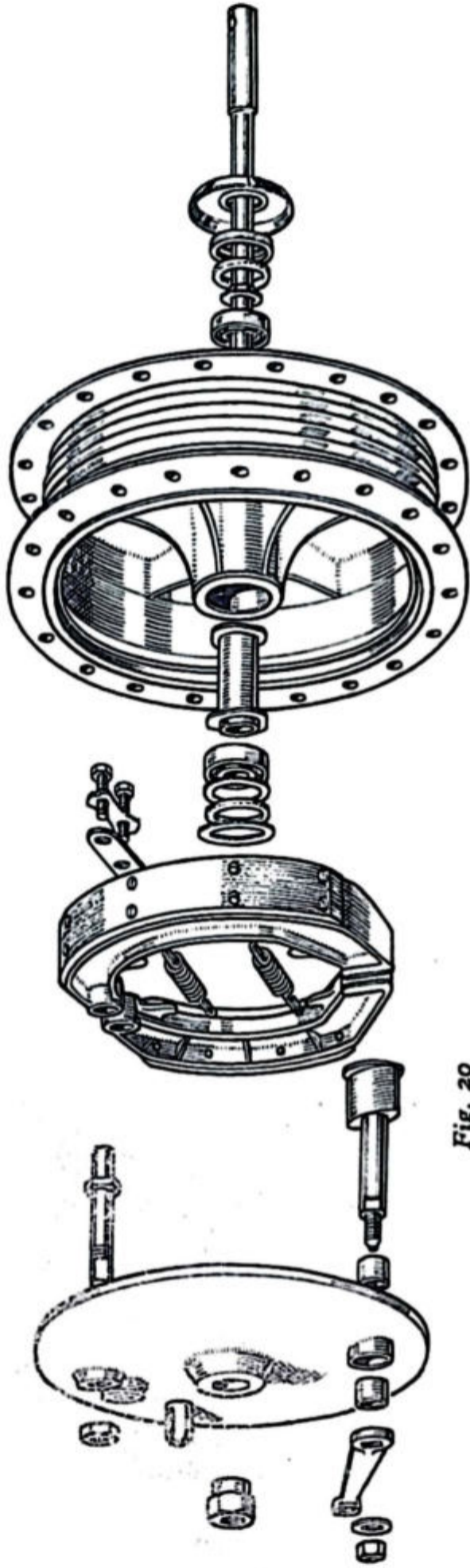


Fig. 20

**FRONT HUB**

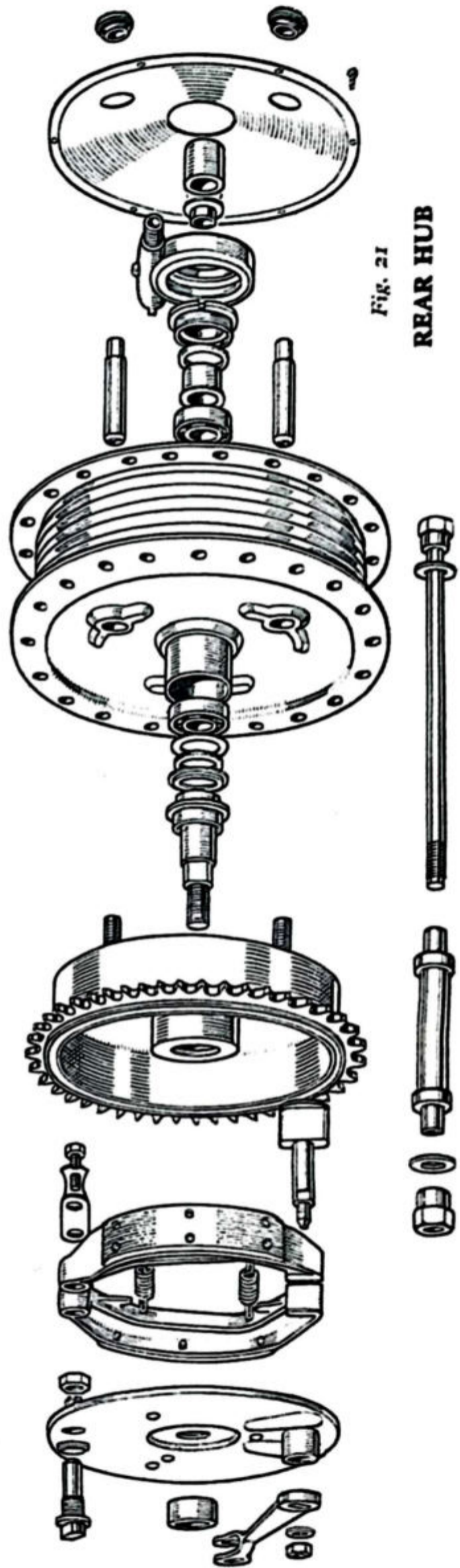


Fig. 21

**REAR HUB**

that one of the three studs is approximately in line with tubes of pivoted fork (swinging arm). This facilitates getting the bearing boss on the hub past the other two studs and fitting the hub to the brake drum. Fit and tighten three sleeve nuts and replace rubber plugs. Fit speedometer drive gearbox taking great care that its driving dogs properly engage with the slots in the hub bearing lock ring. Position spacer and fit R.H. part of divided spindle. Take care that the washer on this passes the end of the adjuster screw in the fork end and that as the spindle is screwed home its head does not catch on the adjuster screw and bend it.

Tighten spindle and on de Luxe models re-fit number plate.

#### **94. REAR HUB—DISMANTLING**

Remove rear wheel (para. 92). Unscrew very carefully the left hand threaded locking ring which drives the speedometer gearbox. Take out distance piece and felt washer.

Now take the rear wheel spindle, leave on it the thick washer and thread over it the dull plated spacer which fits between speedometer gearbox and fork end.

Insert this assembly through the double row ball race at the opposite side of the hub—the brake drum side. Drive on the end of the spindle with a hide hammer or mallet carefully until a stop is felt. This should have commenced to move the single row bearing out of the lock ring side of the hub. It cannot be moved any further with the spindle and spacer because the double row bearing will have come up against a shoulder in the hub.

Remove spindle and spacer and using front wheel spindle, insert threaded end in double row bearing on brake drum side. Hold square and tap gently with mallet when bearing spacer should be driven from inner race of bearing taking with it the single row bearing from the opposite side.

Now insert rear spindle with dull plated spacer through shouldered bearing spacer and pass into hub from lock ring side.

Carefully centre in double row bearing, hold square and carefully drive out. As this bearing comes out it will bring with it steel cup washer, felt washer and pen steel washer.

#### **95. REAR HUB—RE-ASSEMBLING**

Pack bearings with grease, wiping off surplus, Castrolase 'Heavy' is used in the works but medium grades are suitable if care is

taken not to put too much in the hub.

Fit the single row bearing into threaded side of hub, fit shouldered bearing spacer with long end into single row bearing. Fit shouldered distance piece, felt washer and locking ring and tighten. (L.H. thread. Do not damage slots which drive speedometer gearbox).

Press double row bearing into position on opposite side of hub. It can be driven home square by using rear spindle and dull plated spacer, as described for removal.

Fit pen steel washer, felt washer and steel cup or dished washer. Lightly rivet the latter washer into position.

#### **96. FRONT HUB—DISMANTLING**

Remove front wheel (see para. 90). Remove brake plate. Unscrew lock ring (R.H. thread) using a peg spanner or if not available, a hammer and pin punch. If the ring does not move easily, try tapping from different holes and heat the hub with a soft flame such as a gas ring with a low light.

Remove felt washer and distance washer. Now insert front wheel spindle from brake side and drive with hide hammer or mallet. This will move the double row bearing further into the hub and at the same time drive the single row bearing out.

Drive carefully until this bearing just drops clear, if you drive harder the spacer which fits between the bearings will be damaged. Now withdraw the front wheel spindle, pass it through the bearing spacer still in the hub and holding it central, drive the double row bearing out. This will take with it the large steel washer, felt washer and pen steel washer.

#### **97. FRONT HUB—RE-ASSEMBLING**

Pack bearings with grease as for rear hub. Press single row bearing into position, followed by distance washer with flat side to bearing, felt washer and locking ring, which can be tightened up. Insert distance tube small end first into hub, ensuring that it is right home against the bearing just fitted.

Enter double row bearing squarely into hub, pass front wheel spindle through until it enters opposite bearing. Drive on end of spindle until double row bearing comes up against the distance tube and stops. Fit pen steel washer, this is the small one, felt washer and large steel washer and lightly rivet the latter into position.

#### **98. BRAKES, ADJUSTMENT, Front**

The adjuster situated at the lower end of

the operating cable may be screwed outwards 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' clip 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 drum. Remove nut and washer from cam spindle. Remove cam lever.

Remove springs from shoes. This is best done with a screwdriver placed against one of the spring hooks and held in position with one hand, now knock the screwdriver with the palm of the other hand to push the spring off the lug on the shoe. The spring may fly off so care should be taken that it is not lost.

Turn back the tabwasher and unscrew the two hexagon headed set screws which secure the shoes to the pivot pins. Lift off the pivot pin tie plate and remove the brake shoes.

The cam can now be withdrawn. It may be tight in its bush if the cam lever nut has been overtight as this causes the end of the spindle to become swelled. When this happens the end immediately behind the flats should be eased down with emery tape.

If the cam will pass through the bush but is tight, it can be eased down more easily after removal.

On the rear brake plate only, the cam spindle bush can be removed after unscrewing its locknut from the inside.

### **TO RE-ASSEMBLE**

Polish cam with emery tape to ensure that it is quite smooth, clean and smear spindle and faces with medium grease. Fit cam in brake plate bush. Apply small amount of medium grease to shoe pivot pins and fit shoes to pins taking care to fit them the same way round as originally fitted if they have not been relined. Fit tie plate, tabwasher, and set screws. If one pair of tabs have already been used once, they should be cut off and the washer cleaned up with a file and the opposite pair of tabs used to lock the screw heads.

Fit the shoe springs using a screwdriver with a blade about  $\frac{1}{8}$ " wide.

It is helpful to mount the brakeplate flat in a vice with clamps holding it by the torque stop. Fit the spring over the shoe lug towards one. With screwdriver in right hand, position the loop on opposite end of spring on screwdriver blade. Now with extreme end of blade held flat on lug on shoe, guide the spring down blade and over lug with left thumb. With practice this can be done very quickly. Fit the cam lever, washer and nut.

Note that in the case of the rear brake only, with the cam lever fitted and its nut and washer tight, you cannot remove the shoes or refit them if the linings are in near new condition, as the washer rivetted to the end of the cam prevents the linings passing the water excluding flange on the shoeplate.

## **FRONT FORKS**

### **100. MAINTENANCE**

Replenish damping oil at approximately 10,000 mile intervals or whenever the normal characteristics of the forks appear to have deteriorated.

In this connection it is advisable to change the oil after say the first 1000 miles of a

machine's life when any swarf or other metal particles from the bedding in period will be cleaned out.

Each fork leg has a small cheese headed set screw as a drain plug and with a suitable receptacle placed on the ground, these screws should be removed one at a time, taking care

not to lose the small fibre or aluminium washer which makes the seal.

Now hold the front brake on and move the forks up and down to expel the oil. Allow a few minutes for draining and repeat on the other side.

Next refit the drain plugs with their washers and place the machine on the centre stand.

Unscrew the large filler plug on top of each fork leg and 'pull up' the front wheel to expose the springs. Place a block of wood or similar under the wheel to hold the springs clear. Using two spanners, unscrew the filler plug nuts from top of the damper rods.

Remove the block and allow the forks to move to full extension. Pour in a measured 5 fluid ozs. (142 c.c.s.) of 20 grade oil in each leg. It is permissible to use the same quantity of 10 grade oil if a softer damping action is required.

Because these forks have springs inside the main tubes the oil is slow to run down and patience is therefore necessary when refilling.

Before refitting the filler plugs to the damper rods, make certain that their lock-nuts are screwed down to the end of the thread on the rod. Lock the two together and screw in, and tighten filler plugs.

### 101. STEERING HEAD ADJUSTMENT

With the machine on the centre stand check that the front wheel is clear of the ground. If it is not, pack up the stand with a piece of wood.

It is possible to position the fingers of the left hand at the rear of the steel shroud which surrounds the headlug against the dust cover on the top bearing and against the back of the lug. It may be necessary to remove the petrol tank to do this.

Then with the right hand, take hold of the front mudguard and pull and push fore and aft. If the bearings are slack, movement will be felt between dust cover and headlug.

The ballraces in the head are of the crowded ball type designed to carry an end load. They should therefore be slightly pre-loaded but not sufficiently to prevent the handlebars 'falling' from the central position to either lock when the front wheel is clear of the ground.

To adjust, slacken the plated dome nut on top of the steering column—it is worth while to remove the handlebars from their mounting clips in order to use a good fitting spanner

( $\frac{1}{8}$ " Whit. hex.) of the box or ring type. Slacken only slightly, just sufficient to permit the adjuster nut below the head clip to be moved ( $\frac{1}{8}$ " Whit. hex.). An open ended spanner must, of course, be used for this. A suitable one is available from the Service Department. SPU1/49, price 4s. 3d. This also fits the fork filler plugs which have the same hexagon.

Slacken the nuts on the pinch studs which clamp the fork main tubes in the crown. Adjust as necessary, tighten column nut and check again. When correct adjustment has been obtained, remember to tighten pinch stud nuts.

**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

Place machine on centre stand or on a stout wooden box under engine. Release brake and clutch cables from handlebar levers. Remove handlebar clips and allow bar to rest on tank.

Unscrew both filler plugs on top of fork legs and pull forks and wheel up, placing a block of wood or similar under the tyre to hold the wheel up whilst the filler plugs are unscrewed from the top of the damper rods. A thin  $\frac{1}{8}$ " Whit. open ended spanner is necessary for this along with the filler plug spanner.

Remove filler plugs and their washers. Remove headlamp and allow to hang by the cables. Disconnect front brake cable from brake plate and remove front wheel.

Remove top column nut and give headclip a sharp jar upwards with hide hammer or mallet to free it from tapers on main tubes. Remove headclip followed by top covers with lamp brackets and their rubber washers. (On some 1960 and 1961 machines it is necessary to remove the steering lock stop plate before the steering column can be withdrawn and this applies to 1962 machines if they are fitted with steering dampers either solo or sidecar). This is secured with a single  $\frac{1}{4}$ "  $\times$  .26T bolt with washers, spacer and nut to the trouser plate on the frame immediately below the headlug.

Remove steering column nut and dust cover and carefully withdraw forks.

If the head races require to be removed,

they will spring apart and release the balls if they are driven out by their inner races. They should, therefore, be driven from the edge of the outer race if they are to come out complete. A flat piece of steel  $1\frac{1}{4}$ " long  $\times$  .9" wide  $\times$   $\frac{1}{2}$ " thick with radiused ends and a central hole is used in the works which will pass endwise through the inner race and then lay flat on the inside face of the bearing. A drift with a pilot to pass through the hole in the centre is then used to drive the bearing out by the outer race.

### 103. REFITTING FRONT FORKS

Pack head ballraces with grease and press a felt washer into the side of each. These must be fitted in the side with the wider gap between inner and outer races.

The races must then be fitted in the frame with the felt washers outwards. That is the felts must be visible when the headlug is viewed from above and below.

Ensure that shim washer is in position on base of steering column. Insert steering column through headlug bearings. Fit top shim washer, dust cover and screw down column nut.

Fit lamp brackets, their top rubber washers and headclip. Release nuts on pinch studs in fork crown. Adjust head bearings and tighten top column nut and check that tightening of this does not alter bearing setting.

Pull up forks to expose springs and damper rods. Fit filler plugs and washers to damper rods, first ensuring that the locknuts are already screwed down to the end of the thread on the rod.

Tighten filler plugs to pull main tubes into their tapers in headclip and tighten pinch stud nuts on crown.

It is assumed that the oil in the fork legs has not been drained if the forks were removed complete with mudguard and stays in position. Refit headlamp, handlebars and front wheel and re-connect control cables. Check headlamp for correct height and lateral position of beam.

### 104. FORK LEG, DISMANTLING

The individual legs may be dismantled either with the forks in position in the frame or otherwise.

Having drained the oil, unscrew the filler plug from the top of the 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.

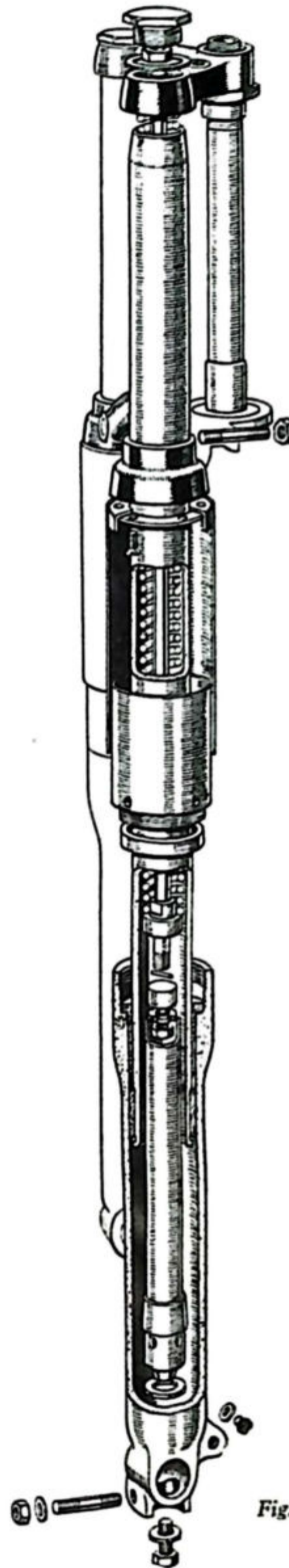


Fig. 22

Release the pinch stud nut on the fork crown and pull jerkily on the fork end when the leg should be withdrawn complete.

If necessary partly replace the filler plug without its washer, screwing it down a few threads and tap it smartly with a mallet or hide hammer to release the leg from the taper in the headclip.

The upper ends of the main tubes may be rusty where they pass inside the top covers (lamp brackets) and this may make them difficult to withdraw. It will help to remove the headclip complete and the covers and clean off the rust with emery tape and smear with oil. Additionally, the slot in the crown where the pinch stud passes through can be expanded slightly with an old screwdriver.

Now with the leg removed, the damper unit and spring complete can be withdrawn by unscrewing the  $\frac{1}{8}$ " Whit. hex. set screw in the bottom end of each fork leg.

A 'C' spanner is required to remove the plated bottom cover which is screwed into the fork end and when this is removed, the fork end can be pulled off leaving the flanged top bush and oil seal on the main tube. The steel bush on the bottom end of the tube is attached by a circlip.

If it is desirable to dismantle the damper unit, the top gland nut should be unscrewed and the rod withdrawn from the cylinder, 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 crosspin, cup and slotted washer to short screwed end of damper rod. Fit and tighten securing nut.

Insert this assembly into the damper cylinder and screw home the top gland nut. Hold the cylinder whilst this is done with a good fitting tommy bar through the holes in the base.

The cylinder can easily be damaged if it is held in a vice. Place fibre washer over extension on damper cylinder and insert in fork end and secure with set screw and thick washer. Fit fork spring over damper rod followed by aluminium centraliser and screw on filler plug locknut, bevelled edge first, right up to end of thread.

Fit steel bush to bottom end of main tube making certain that circlip is properly fitted and not distorted. Fit bronze bush, paper washer and oil seal to main tube. Oil seal should have its spring towards paper washer and flange of bronze bush. Pass damper rod and spring through main tube from bottom end, carefully entering bush and oil seal into fork leg. Using screwed plated cover, push oil seal in square and screw cover home. Do not overtighten this but it can be tightened best after the wheel spindle has been fitted when the leg cannot turn. Lightly grease upper part of main tube and pass through fork crown. A pull through is available if necessary—part No. 13685, price 8s. Lightly clamp pinch stud nuts to prevent legs dropping out if necessary. Pour 5 fluid ozs. of 20 grade oil in each leg (142 c.c.).

Push up fork leg to expose damper rod and spring, fit filler plug washer and screw filler plug up to locknut already on damper rod.

Screw up filler plug nuts to pull main tubes hard up into taper in head clip, make certain head bearing adjustment is correct, tighten nuts on pinch studs in crown.

## **REAR SPRINGING**

### **106. PIVOTTED FORK—REMOVAL AND ASSEMBLY (Swinging arm)**

Remove chaincase or chainguard.

Remove rear wheel complete with brake. Remove bottom shock absorber attachment bolts, nuts and washers, and swing the shock

absorbers clear. Slacken top bolts if necessary.

Remove nut and washer from one end of pivotted fork bolt on frame gusset plate and withdraw bolt from opposite side. Fork or arm should now be pushed forward to clear gusset plates, turned and withdrawn.

If the 'Clayflex' bearings require to be replaced, the fork should be returned to the works for the old bearings to be removed and new ones fitted.

To re-assemble reverse this procedure, fit and tighten the bottom shock absorber bolts before tightening the fork (arm) pivot bolt on the frame. This will ensure that the 'Clayflex' bearings are clamped in approximately the correct rotational position.

## 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 soft or normal solo position is in use when the abutments spot welded to the damper body are in engagement with the topmost positions on the bottom spring collar which has a scroll or face cam, or when this part is rotated as far as possible in an anti-clockwise direction when viewed from above. 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.

When these units are fitted to the machine it is important that they should be primed first as they will lose their prime if they have been laid horizontally for only a short time.

To prime mount vertically in a vice by the lower mounting lug, set to the soft position, pull down on top cover and remove split collet. Remove covers and spring and now operate damper rod over its full range until smooth even resistance is felt on extension but none at all on compression. If you cannot get this result the damper is faulty.

Refit covers and spring and collets and refit to machine keeping vertical.

## HANDLEBAR FITTINGS

### 108. AIR CONTROL LEVER

To remove the control cable 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 cable, 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 screws on which the levers pivot can

be adjusted to reduce side clearance between lever and fulcrum part of clip as the lower side of each lever is threaded and a self locking nut fitted.

To remove the clutch cable from the lever, take off the inspection cap from gearbox end and with a screwdriver, lift up the small operating lever. At the same time pull the outer cable clear of the handlebar lever.

It should be noted that if replacement levers are at any time obtained, the one for clutch operation with an A.M.C. gearbox should have  $\frac{7}{8}$ " centres between cable nipple and fulcrum screw.

This is not the same on earlier machines with Norton/Burman gearboxes and these require levers having  $1\frac{1}{8}$ " centres.

To remove the front brake cable from the lever, remove the split pin and the clevis pin



Fig. 23

holding the 'U' clip to the brake cam lever.

Now unscrew the cable adjuster from the brake plate and the cable will come clear. 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 the petrol tap 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 and spacer, 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 restricting spring.

### 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 is fitted and secured. Fit float with narrow side of hinge uppermost, replace spacer, and ensure that side cover washer and body are clean and undamaged to obtain a petrol tight joint.



### 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

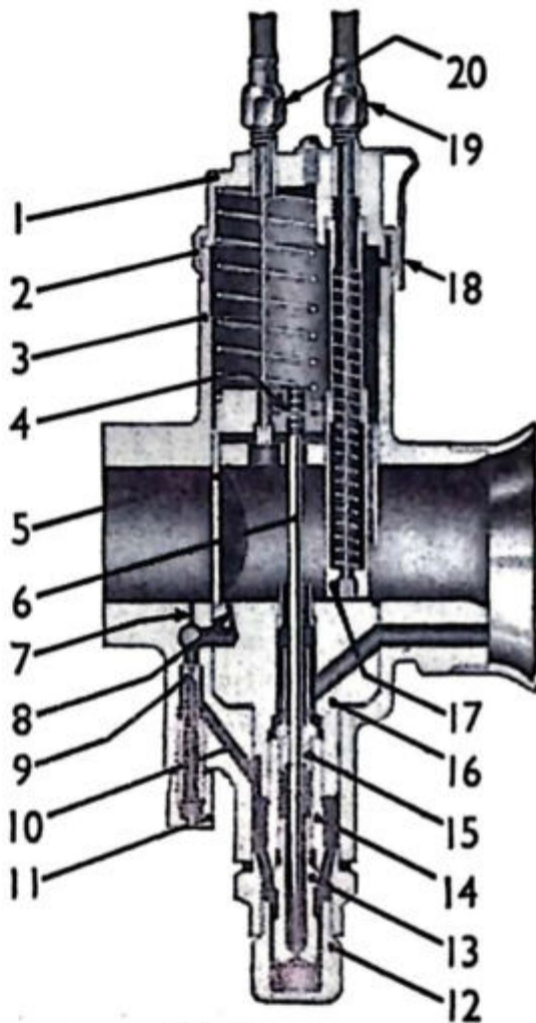


Fig. 24

- |                             |                              |
|-----------------------------|------------------------------|
| 1—Mixing Chamber Top        | 14—Jet Holder                |
| 2—Mixing Chamber Cap        | 15—Needle Jet                |
| 3—Carburettor Body          | 16—Jet Block                 |
| 4—Jet Needle Clip           | 17—Air Valve                 |
| 5—Throttle Valve            | 18—Mixing Chamber Cap Spring |
| 6—Jet Needle                | 19—Cable Adjuster (Air)      |
| 7—Pilot Outlet              | 20—Cable Adjuster (Throttle) |
| 8—Pilot by-pass             | 21—Tickler                   |
| 9—Pilot Jet                 | 22—Banjo                     |
| 10—Petrol feed to pilot jet | 23—Pilot Air Adjusting Screw |
| 11—Pilot Jet Cover Nut      | 29—Throttle Adjusting Screw  |
| 12—Main Jet Cover           |                              |
| 13—Main Jet                 |                              |

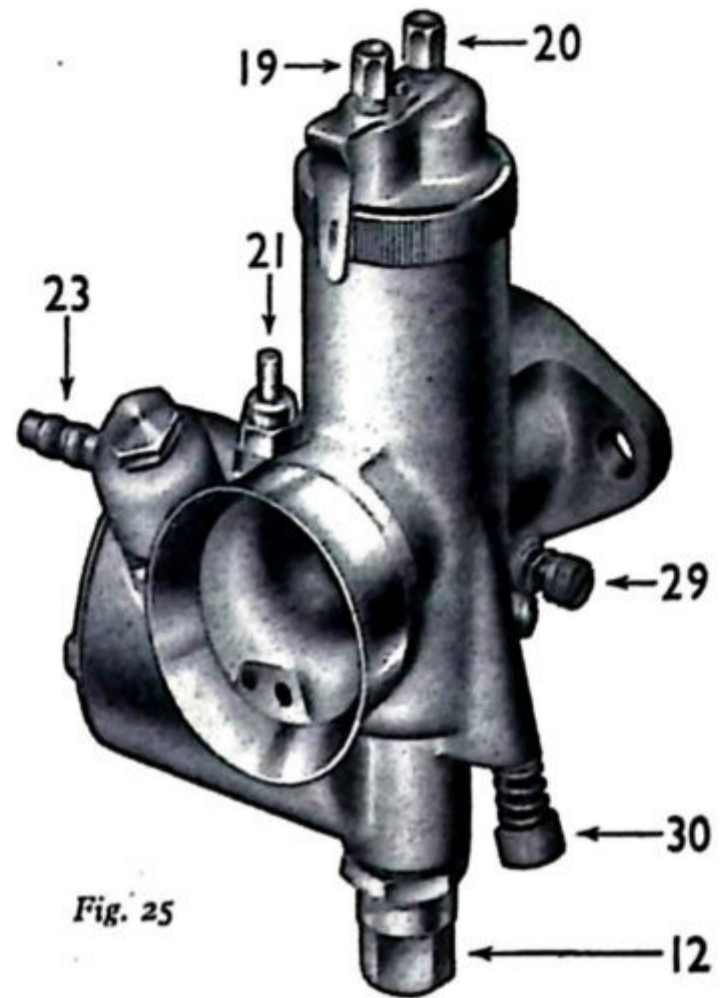


Fig. 25

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.

#### 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**

Indicated 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.

**PHASES OF AMAL NEEDLE JET CARBURETTER THROTTLE OPENINGS**

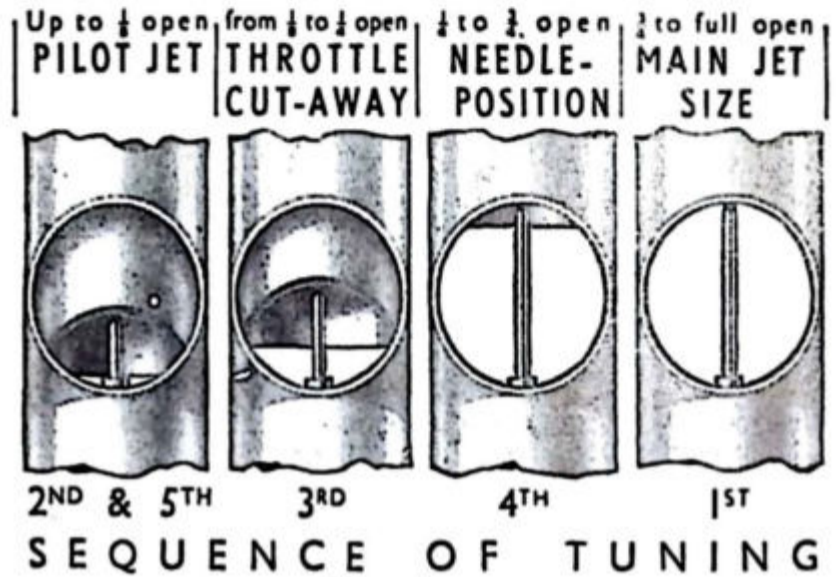


Fig. 26

**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. NOTE—All 650 c.c. and S.S. models are fitted with the Avon G.P. rear tyre and special inner tube.

The manufacturers recommend that under no circumstances should anything other than these be fitted to the rear wheel as replacement.

Pressures recommended below must be strictly adhered to:—

For sustained speeds up to 110 m.p.h. and for short bursts of not more than 2 minutes up to 125 m.p.h.—Front 24 p.s.i.; Rear 24 p.s.i.

For sustained speeds above 110 m.p.h.—Front 24 p.s.i. Rear 30 p.s.i.

Pressures given above are for cold tyres and with rider only.

Valve caps must be securely fitted.

## ELECTRICAL SECTION

All the machines covered by this book have A.C. generators, and all have coil ignition except Sports Special models.

The essentials of this 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.

**Contact Breaker (and Distributor on Twin Cylinder machines).** 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. The level check should be made after the machine has been standing and not immediately after a run when the electrolyte will be gassing and showing a higher level.

On Lucas PUZ7E batteries, after standing, the acid level should be just to the top of the plates, that is just visible when the filler plugs are removed. On Exide 3EV11 and 3EV9 batteries, again after standing, the level should be to but not above the lower of the two lines marked on the case.

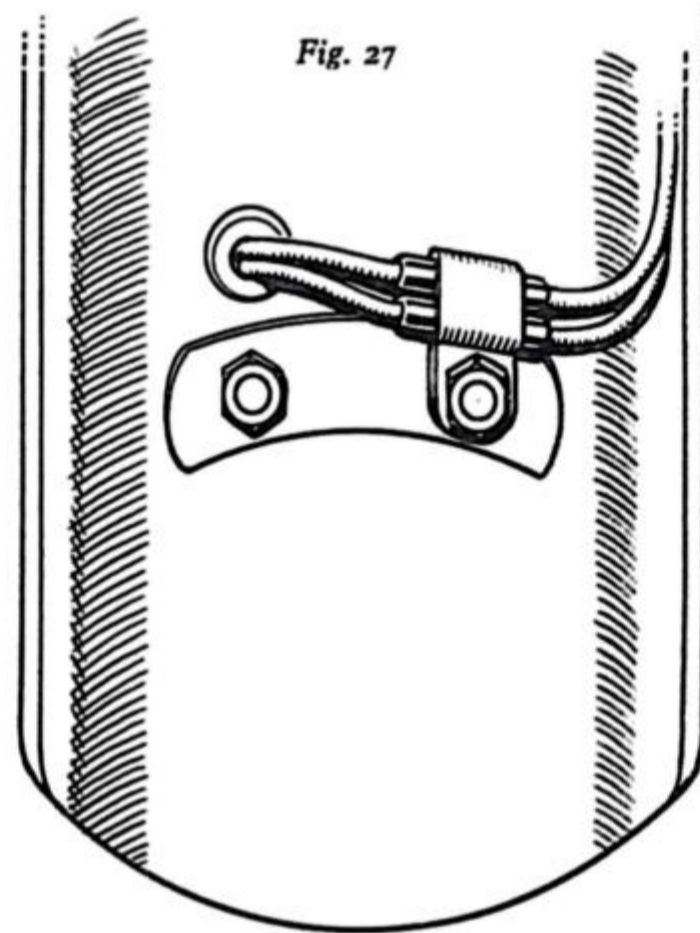
If the levels on either battery are in any way on the high side, there will be risk of overspilling and resultant acid damage to plated and enamelled parts of the machine.

Battery terminals should be kept clean and greased and a periodic check should be made to ensure that the wires themselves are not corroding. On Lucas batteries, clean up the end of the terminal with a smooth file if there is any doubt about the screw on terminal making firm contact. The Exide batteries employ a tag terminal secured with a screw and this must make clean contact with the battery terminal post.

It is well worth while paying attention to these connections as if for any reason, the battery becomes out of circuit, the light bulbs will burn out, even with quite low engine revolutions. **ALL BATTERIES TO HAVE POSITIVE TERMINAL CONNECTED**

TO 'EARTH'.

**Wiring.** Keep all connections and terminals tight and ensure cables are clear of moving parts. Examine carefully stop and tail lamp leads for being properly positioned in the aluminium clip on the left hand side number plate mounting stud. The clip must hold the connectors themselves, and the longer lead which passes round the inside of the mudguard must also be in the clips and not foul the tyre at the front end of the guard where it passes through the grommet.



Any surplus wire on the lamp side of the snap connectors should be 'fed back' through the grommet into the space between the number plate and outside of mudguard.

These remarks regarding stop/tail lamp leads apply to all Standard models. De luxe machines are slightly different and on these it is important that the leads are clipped or taped to the tubular stay which supports the tail portion of the rear fairing.

### **Contact Breaker (and distributor on twins).**

Check points for correct gap and cleanliness. Gap should be set to .015" plus or minus .001" and on twins the setting should be checked on both cams. If, on a twin cylinder model, the settings vary appreciably on each cam, the ignition timing should be checked on both cylinders and this should

not vary more than 2° on one cylinder compared with the other.

To lubricate the A.T.D., it is necessary to remove the cover and on twins the rotor, and then the two Phillips head screws which secure the base plate. The timing will not be lost by removing this plate, but the points gap setting should be checked on refitting.

Lubrication of the driving spindle is usually adequate on twins, but models 50 and ES2 having non-positive lubrication of the driving chain, have a small screw on top of the contact breaker housing. This should be removed and a few drops of engine oil put in every 2000 miles.

**Headlamp.** Set the beam so that with the main filament 'on', it is just below horizontal, with the machine loaded as for the larger proportion of night riding. For example, if most of your night riding is done with a passenger, set the beam with the weight of two people up. The main beam should never be set above horizontal. Do not employ bulbs of greater wattage than those normally fitted, as the generator will then not maintain the battery charge state.

Oil the dipper switch pivot and toggle lever periodically, it can be very dangerous, if this switch sticks and does not make an instant changeover from one filament to the other. It is desirable that the switch is connected so that when its lever is lowered, the dipped beam is in use. Keep the glass of the light unit clean, a thin mud covering very much reduces the light. Check that the light unit is properly 'keyed' in the lamp rim ensuring its correct rotational position for

angle of dipped beam.

## 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. It should be noted that the auto advance unit on the single cylinder models has 15° range (30 crankshaft degrees), whereas on twins, it has only 12° (24 crankshaft degrees).

See paras. 30A and 59 for timing procedure.

## 122. ALTERNATOR. Lucas RM19

Since the alternator has no commutator, brush mechanism bearings or oil seals, it requires no maintenance apart from occasionally checking that its leads are intact and its connectors clean and tight. Examine the grommet in the rear half of the chaincase as if this becomes perished, the leads may chafe on the relatively sharp edge of the hole. There should always be at least .005" clearance between the rotor and the pole pieces

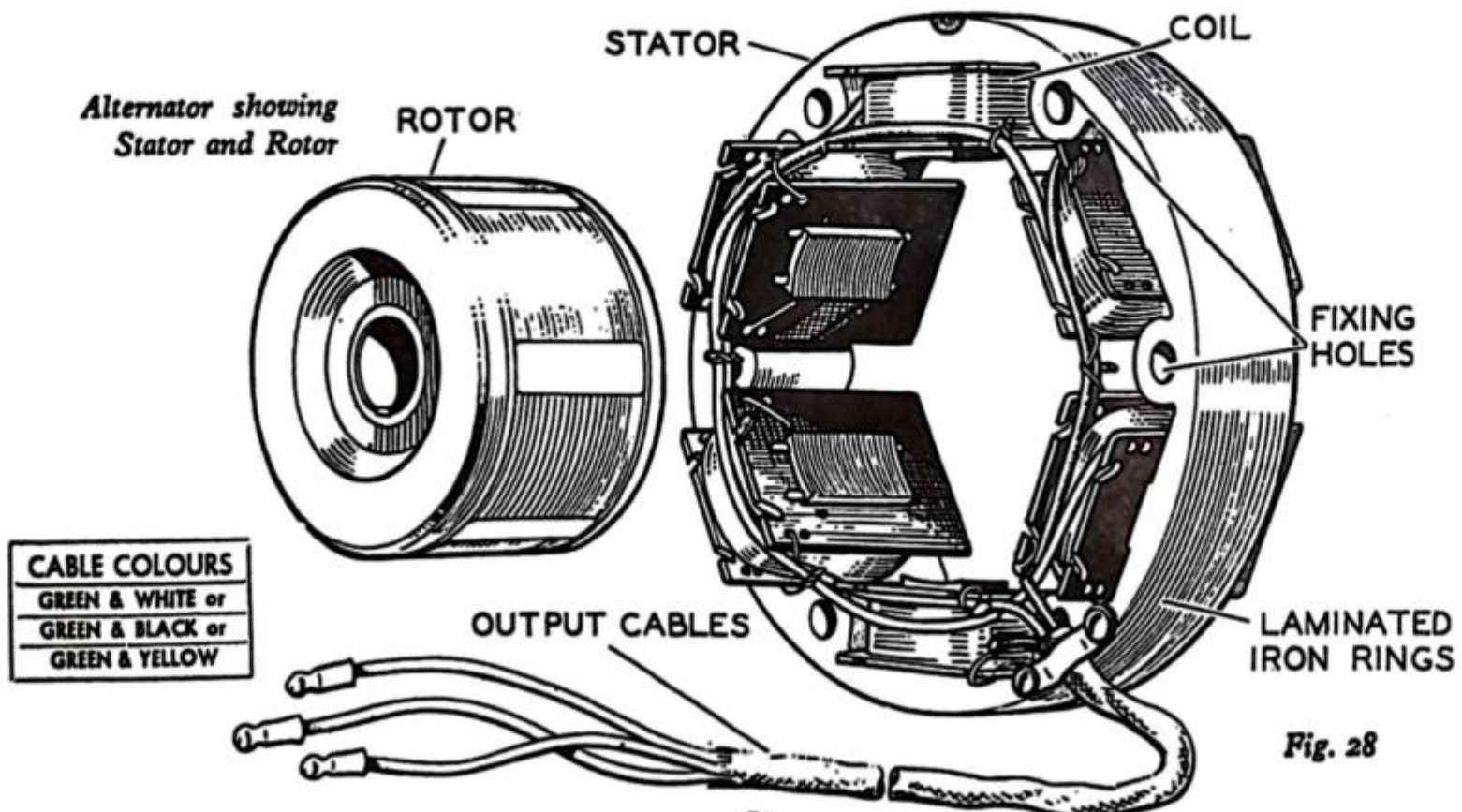


Fig. 28

on the stator and this clearance should be checked whenever the stator is refitted.

Note that the stator should be fitted with the lead take off side towards the primary chain and **not** towards the outer portion of the chaincase.

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 three nuts and fan disc washers) if the rotor is tight on the shaft but the shaft is parallel.

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.

As mentioned above, the stator is capable of being fitted into the spigot recess either way round, but it will only operate satisfactorily in one position. It is correctly fitted when the edge from which the leads emerge is innermost or away from the chaincase outer portion.

Although alternators on all 1962 models are designated RM19, those on magneto ignition models have a stator with a smaller output.

### 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 to 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 (coil ignition models)**

An emergency starting position is provided on the ignition switch for use if the battery has become discharged.

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

When kickstarting with the switch in the EMG position, a considerably 'heftier' kick may be necessary than is the case when making a normal start. If the ignition timing is, for any reason, only slightly out, it may not be possible to obtain an EMG start with the kickstarter.

A push start should then be tried, in 2nd gear with the switch in normal IGN position.

A further point which should be noted is that, if the alternator leads have been changed over to obtain the increased charge rate, it may not be possible to obtain a start in the EMG position. In this case the leads should be temporarily changed back or a push start tried as described above.

### 124. INCREASED CHARGING RATE

Should the battery become run down due to prolonged slow riding in traffic, or during running-in or due to parking with lights on for long periods and whenever a sidecar is fitted an increased charge rate can be obtained by a simple wiring alteration.

The alternator leads after emerging from the primary chaincase, join the main harness by means of a 3-way snap connector. On models 50 and ES2 this is rather out of the way and it may be necessary to remove the battery and battery box in order to gain access to it. On twin cylinder models, it may be clipped to the H.T. leads where they leave the distributor or higher up near the top of the battery box.

The colours are:—Light green or green and white. Dark green or green and black and green and yellow.

Disconnect the dark green or green and black and the green and yellow and reverse these two connectors.

That is connect the green and black alternator cable to the green and yellow harness cable. Connect the green and black harness cable to the green and yellow alternator cable.

With the light switch in the off position, the ammeter should show approx. twice the previous output. When the lights are switched on to either 'pilot' or 'head' however, the output remains as before.

**WHENEVER A SIDECAR IS PERMANENTLY ATTACHED TO ONE OF THESE MACHINES** this alteration should be carried out as otherwise the added consumption of the sidecar lamp or lamps will not be compensated for and the battery will slowly run down.

On a solo machine on a long daylight run

using the increased output, the battery may become overcharged which can result in damage to the battery and damage to plated and enamelled parts of the machine due to acid spillage.

### 125. RECTIFIER

The rectifier is a device to allow current to flow in one direction only. It is connected to provide full-wave rectification of the alternator output current.

The Rectifier requires no maintenance beyond checking that the connections are clean and tight.

The nuts clamping the rectifier plates together must not **UNDER ANY CIRCUMSTANCES** be slackened as the pressure has been carefully set during manufacture to give correct rectifier performance. A separate nut is used to secure the rectifier to the machine and it is important to check periodically that the rectifier is firmly attached to its mounting point. It should make firm metal to metal contact to ensure a good electrical connection.

### 126. COIL

An ignition coil of orthodox type is attached to a suitable position on the frame by a bolt and clip. Like the rectifier, the coil should only require occasional checking for cleanliness and tightness of mounting and terminals.

### 127. CONTACT BREAKER AND DISTRIBUTOR (models 88, 99 and 650).

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. Behind the sprocket there is a tubular spacer and copper washer on the spindle. Care should be taken that these are not misplaced and when refitting the washer goes on the spindle first.

Removal of the single set screw holding the clamping flange to the inside of the timing cover extension, allows the contact breaker/distributor unit complete to be withdrawn from the housing when the distributor cap has been removed.

It may also be necessary to remove the low tension connection to the contact breaker so that the latter can be turned as it is withdrawn in order that the bolt in the clamp will clear the engine plates. Alternatively, the clamping bolt can be released and the

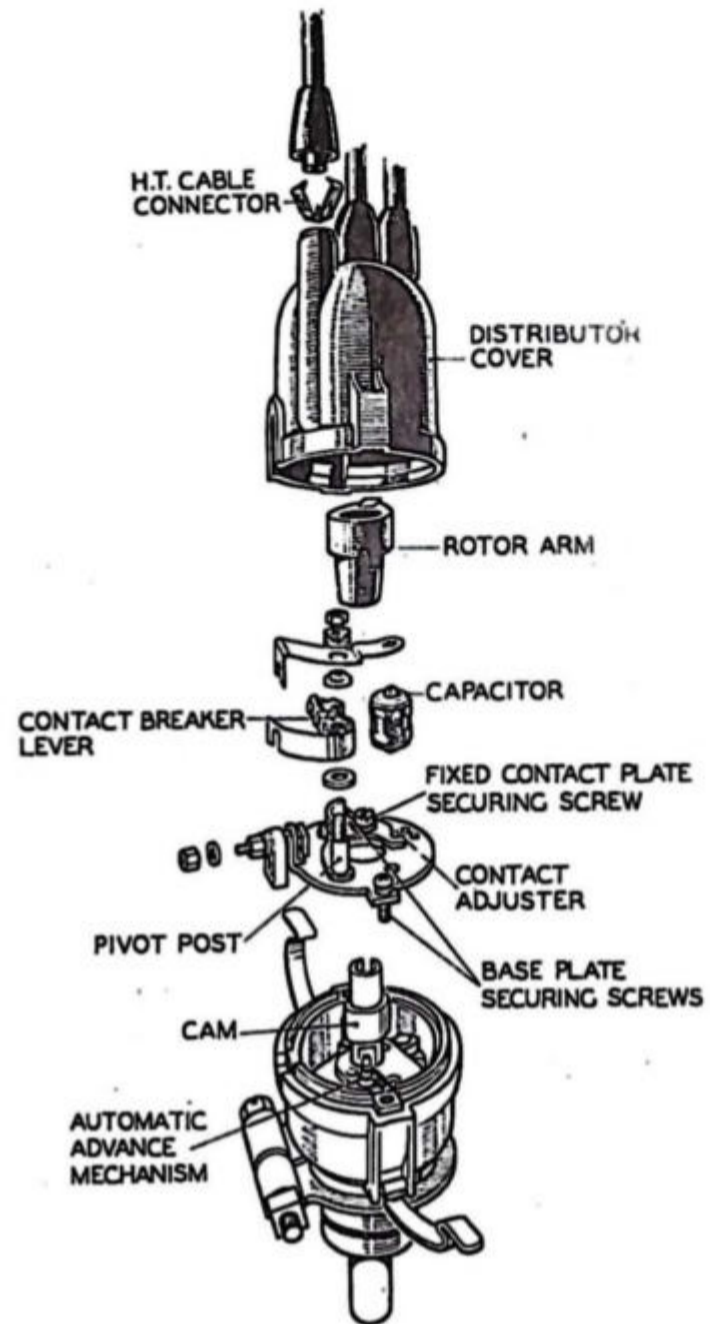


Fig. 29

unit withdrawn leaving the clip attached to the housing by the set screw. Routine maintenance can be carried out without removing the unit from the engine.

**Contact Breaker setting.** Check the contact breaker after the first 500 miles running and subsequently every 6000 miles.

To check the gap, remove the sparking plugs, and rotate the engine slowly until one lobe of the cam is directly under the heel of the rocker arm. In this position the points are wide open and a .015" feeler should be a sliding fit. Take care to enter the feeler square without side influence or an accurate result will not be obtained. The gap should be from .014" to .016" and the setting should be checked on both lobes of the cam.

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

**Lubrication and cleaning.** To be carried out every 6000 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 (Models 50 and ES2)

Chain driven from the inlet cam spindle, the sprocket is fitted on a taper and held with a central set screw and washer.

Removal of the sprocket and the single screw holding the clamping flange to the housing allows the complete contact breaker assembly to be withdrawn provided 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.** This should be adjusted in exactly the same way as those on the twin cylinder models. The points gap is also the same—.015".

**Lubrication and cleaning.** This also should be carried out as on twin cylinder machines but as the driving chain does not obtain the same degree of lubrication on these engines, there is an additional lubricating point.

Removal of the small screw in the top of the housing carrying the contact breaker

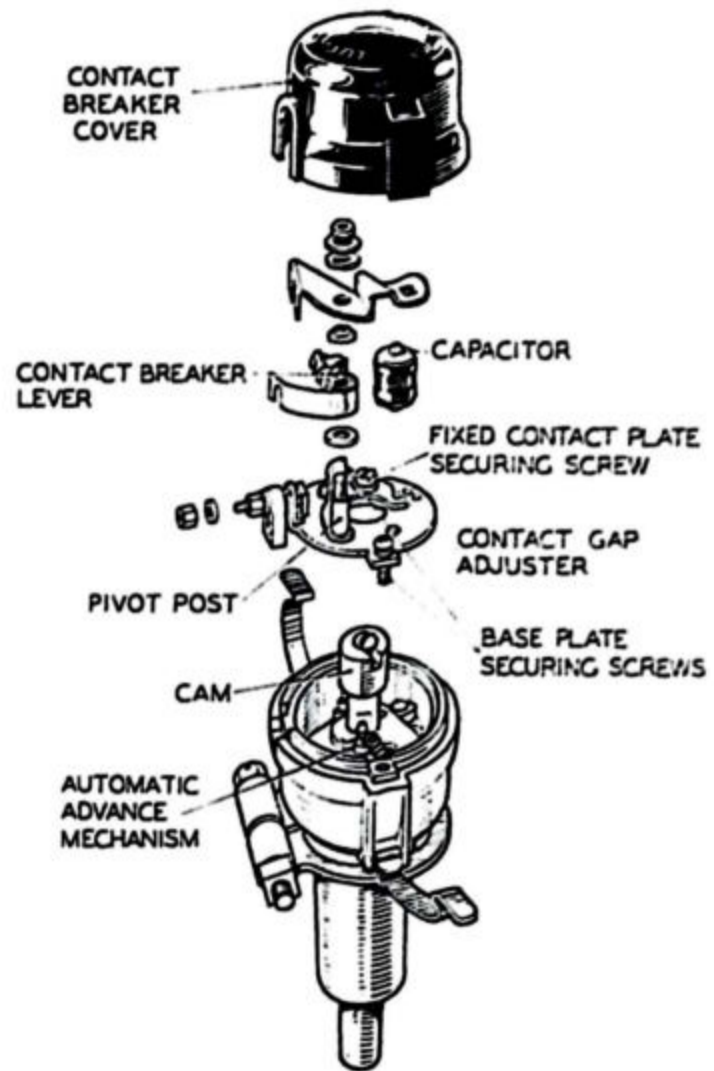


Fig. 30

discloses an oilway into which a few drops of engine oil should be injected every 2000 miles.

**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.

**Battery — Exide 3EV9.** This battery is fitted on de Luxe models and requires similar maintenance to the Lucas one.

All these machines should have the battery positive terminal connected to the frame of the machine, i.e., Positive earth.

See para. 120—Essential Maintenance.

**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.

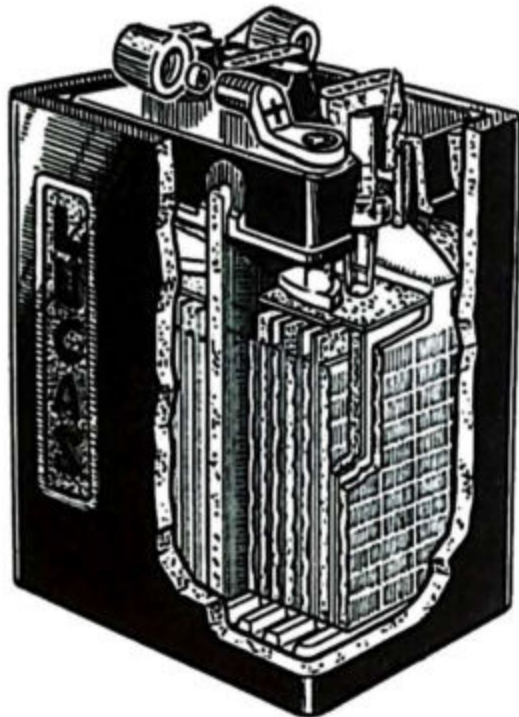


Fig. 31

**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 temperature 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.** The positive terminal must be connected to the frame or earth terminal. The Rectifier will be damaged if a battery is only momentarily connected wrong way round.

**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.

**Setting headlamp beam.** See para. 120.

**Bulb Replacement.** To remove the headlamp front, slacken the screw at the top of the lamp and pull off the front rim complete with light unit assembly.

The pilot bulb holder is a 'spring' fit in the reflector itself and has a 'cushioning' rubber washer which should not be misplaced or lost when the holder is pulled out of the reflector.

To gain access to the headlamp bulb, push on the adaptor and twist in an anti-clockwise direction to take it off. The bulb can now be removed from the rear of the reflector.

Place the correct replacement bulb in the holder, engage the projections on the inside

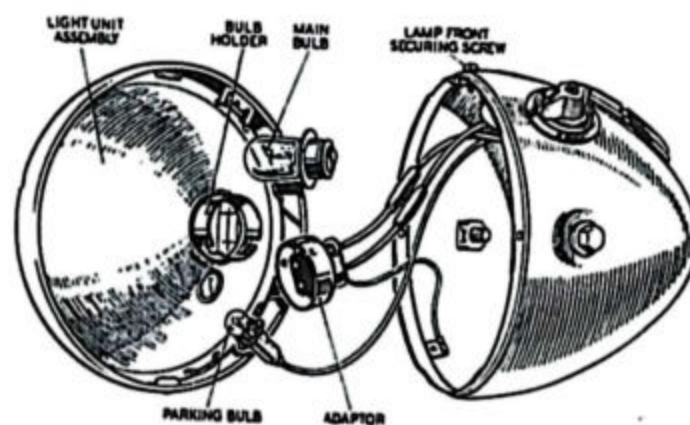


Fig. 32 Light Unit—bulb removal

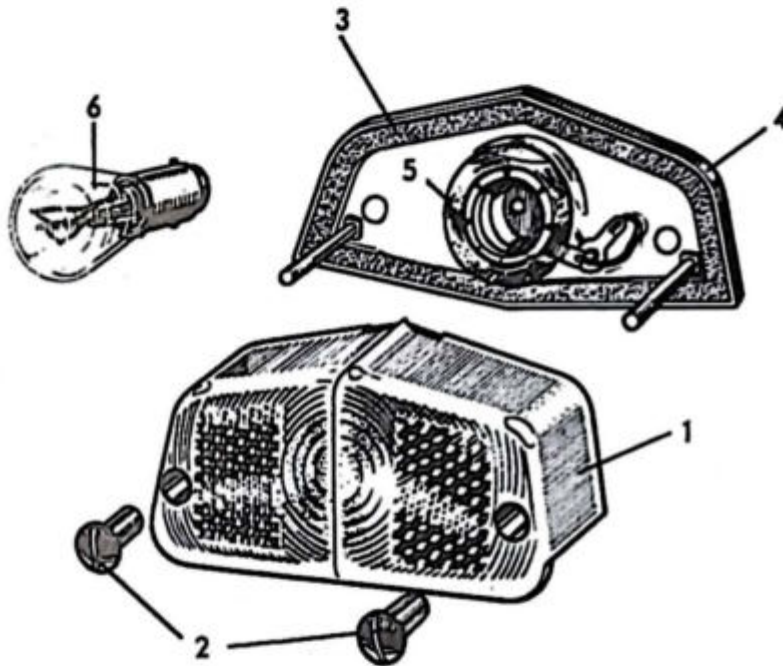
of the adaptor, noting that they will only engage in one position, press on and secure by twisting to the right (turn clockwise).

Lucas replacement bulbs should always be used, the pilot bulb is No. 988—6v. 3w. with miniature bayonet cap. Main bulb No. 373—6v. 30/24w. with pre-focus cap. Stop/Tail bulb Lucas No. 384—6v. 6/18w.



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

This is Lucas No. 564 which incorporates twin 'Reflex' reflectors, thus eliminating the necessity of fitting a separate reflector.



- 1. Lens and Window
- 2. Nut
- 3. Gasket
- 4. Base Assembly
- 5. Grommet
- 6. Bulb

Fig. 33 Tail, Stop and Number Plate Lamp

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

To obtain access to the bulb, remove the two securing screws and the plastic lens complete. The bulb has unequally positioned bayonet pins so that it cannot be incorrectly fitted into the holder.

### 132. CABLES

To connect leads to a Lucas battery, unscrew knurled plastic terminal nut and withdraw collet (small thick washer).

Bare the end of the cable (about  $\frac{1}{2}$ " ) and thread the bared end through the knurled nut and collet. Coil up the surplus wire against the end of the collet, feed back collet and wire into knurled terminal nut and screw on to terminal post firmly. Do not overtighten or the nut may burst.

To connect the leads to an Exide battery, the leads on the machine have soldered on tag terminals. The battery terminals incorporate set screws which should be removed,

the tags threaded on and the screws firmly replaced.

Snap connectors, i.e. rubber covered push-pull connections are used at many points in the wiring system.

They appear when connected as a small rubber sleeve, or bunch of sleeves when grouped. Disconnect by pulling apart and reconnect by holding in cable pliers, the metal nipple soldered to cable end. Hold rubber covered portion in fingers and press nipple home with pliers. Ensure rubber sleeves are always covering metal portions of connectors when in use.

Special pliers are available from some accessory houses for assembling these fittings and they are so constructed that both nipples can be pressed into the sleeve at the same time.

### 133. LIGHTING AND IGNITION SWITCH

The switch is carried in the headlamp shell and connections are accessible when headlamp front and light unit assembly is removed. The cables are identified by various colours.

The switch on coil ignition machines—Lucas PRS8—is complicated and should, on no account be dismantled.

With magneto ignition, fewer connections are involved and a switch similar to those employed on earlier D.C. systems is used.

### 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, say every 3000 miles, and if of detachable type, dismantle and clean thoroughly. Never unscrew the gland nut with other than a ring or box spanner and do not hold the plug in a vice by the gland nut. The plug body itself, may be held in a vice whilst the gland nut is unscrewed with a ring spanner. Clean the electrode insulator with glass paper—not emery cloth and clean the inside of the body with emery tape wrapped round a screwdriver or on an arbor in a drilling machine. Clean the earth points on the body with a wire brush and re-assemble making certain that the gas sealing washer is in position on the insulator and that the central electrode is properly centralised when the gland nut is tightened. Reset gap or gaps as necessary—.015" to .020" for magneto ignition. Gaps can usually be a little larger with coil equipment.

Non-detachable plugs should be cleaned with a wire brush and if they are oiled, flushed out with a small quantity of petrol.

### 136. MAGNETO

**Lucas Rotating Armature. Type K2F, K2FC.** When a magneto is fitted the sole purpose of the alternator is to charge the battery by way of the rectifier.

Most Norton machines are fitted with a centrifugally operated mechanism that automatically alters the point of firing to suit differing engine speeds. Some model 88 S.S. machines, however, have a manual control of ignition timing. Such a control should be moved to the retard position for starting and when the engine labours on a large throttle opening. At all other times the control should be in the fully advanced position.

**Automatic Timing Control.** This employs a driving sprocket carrying a plate fitted with two pins. A weight is pivoted on each pin, and the movement of the weight is controlled by a spring connected between the pivot end of the weight and a toggle lever pivoted at approximately the centre of the weight. Holes are provided in each toggle lever in which are located pegs on the underside of a driving plate secured to the magneto spindle.

This plate is also provided with stops which limit the range of the control. When the magneto is stationary, the weights are in the closed position and the magneto retarded for starting purposes. As the speed is increased, centrifugal force acting on the weights overcomes the restraining influence

of the springs and the weights move outwards causing relative movement to take place between the driving sprocket and the magneto spindle, so advancing the timing. By careful design of the springs, the characteristics of the control can be arranged to conform more closely with the engine requirements than is the case with other types of control.

At 1600 engine r.p.m. the unit begins to advance the timing. At 2000 r.p.m. there can be from 10 to 20 degrees advance, and at 2500 r.p.m. and above, the unit moves to the fully advanced position giving approximately 24 degrees.

When timing a magneto fitted with one of these units, it should be 'propped' in the advance position with a small wooden wedge or a small nut and the timing set to the advanced figure. Particular care being taken afterwards of course, to remove the wedge, and when the nut securing the unit to the magneto armature spindle has been tightened, check that the unit will still move freely over its advance range. The wedge should be removed whilst this nut is tightened and replaced to check the timing only.

**Checking Contact Breaker Gap (every 3000 miles).** To check the contact breaker gap, remove the contact breaker cover and turn the engine over slowly until the contacts are fully open. A flat steel gauge of thickness of .012" to .015" (.305 to 381 mm.) should be a sliding fit between the contacts.

**Adjusting Contact Breaker Gap.** Two types of contact breaker are in service. The present assembly has a fixed contact plate secured by a single screw passing through a slotted hole in the plate. To adjust the gap, slacken this screw and, using a screwdriver move the fixed contact plate until the correct gap is obtained. Tighten the screw and re-check the gap.

**NOTE**—The present contact breaker is interchangeable with the older pattern, provided the present shorter straight-shanked securing screw is fitted in place of the former longer screw, the shank of which has a 17° taper for  $\frac{1}{8}$ " (4.76 mm.) below the head.

The earlier assembly has a contact screw and locking nut. To adjust the gap, slacken the locking nut and turn the contact screw by its hexagon head until the correct gap is obtained. Tighten the locking nut and re-check the gap. Do not overtighten this.

**Lubrication.** The cam ring is supplied with lubricant from a felt strip contained in

a recess in the contact breaker housing. Oil reaches the inner surface of the cam ring by way of a small circular wick passing through the thickness of the cam ring.

Remove the contact breaker cover. Take out the central hexagon headed securing screw and carefully withdraw the contact breaker from the tapered magneto spindle. When the screw is completely clear of the threads, but still in the centre of the contact breaker, it can be used to 'break' the taper by 'levering' sideways with the fingers. The breaker should then come out on the screw.

Withdraw the cam ring. It is a sliding fit in the contact breaker housing.

**NOTE**—If a manual control of ignition timing is fitted, withdrawal and refitting of the cam ring will be made easier if the handle-bar control lever is moved to the half retard position, thus taking the cam ring from its stop peg.

Clean the cam ring both inside and out and lightly smear with Mobilgrease No. 2.

Add a few drops of thin machine oil to the felt strip and to the circular wick.

Remove the contact breaker lever (rocker arm) and smear the pivot with Mobilgrease No. 2 applying sufficient grease to fill the annular groove.

To remove the rocker arm from the present contact breaker, it is necessary to remove the push-on retaining ring and this must not be used again but must be replaced with a new one.

An alternative method of lubrication for this type of rocker arm pivot, is to apply a spot of clean engine oil to the tip of the pivot post. While this will obviate the necessity of removing the arm (lever), great care must be exercised to prevent any oil getting on or near the contacts.

If the arm is removed, care must be taken that the fibre washers fitted on either side of the arm are not misplaced. They are fitted to align the contact points.

The spring should be detached from the 'fixed' end and it has a small buffer spring on the inside and this requires to be fitted with its bent portion towards the centre. Wipe the two leaves of the spring clean and very lightly smear with oil.

To re-assemble, refit in the reverse order. Refit the cam ring, taking care that when manual timing control is fitted that the stop peg in the contact breaker housing and the spring loaded plunger engage with their respective slots.

If an earthing brush is fitted at the back of the contact breaker base plate, see that it is clean and can move freely in its holder before refitting the contact breaker assembly in the cam ring.

Refit the contact breaker assembly, ensuring that the projecting key on the tapered portion of the contact breaker base plate engages correctly with the spindle keyway. Check that the spring does not touch the cam ring.

To remove the rocker arm on the earlier contact breaker, the same remarks regarding the spring and buffer spring apply but to remove the arm from its pivot, it is merely necessary to swing aside the arm or lever retaining spring. There should be a single insulating washer at the base of the pivot post.

**Cleaning.** Every 6000 miles.

Remove the contact breaker cover and high tension pick-up mouldings. Thoroughly clean the inside and outside of the magneto using a clean, dry, fluffless cloth, if necessary, moistening it with petrol to remove any grease from the H.T. pick-up mouldings and contact breaker contacts. Ensure that the pick-up brush moves freely in its holder. Renew the brush if it is worn to  $\frac{1}{8}$ " above the shoulder.

Clean the slip ring track and flanges by pressing the cloth on them while the engine is turned by hand.

Ensure that the gaskets between the pick-up mouldings and the magneto body are in good condition. Examine the contacts when the contact breaker is removed for lubrication. If the contacts are pitted or piled, they should be trimmed with a carborundum stone, silicon carbide paper, or very fine emery cloth.

Contacts do not retain a polished appearance when in use, and if operating correctly, will have a dull grey appearance.

### 137. RENEWING HIGH TENSION CABLES

When the high tension cable shows signs of cracking or perishing, replace it using 7 mm. P.V.C. covered or Neoprene covered vulcanised rubber insulated ignition cable.

Coil and magneto ignition equipped machines use different connections at the ends opposite the sparking plugs.

The coil and distributor H.T. leads have a clamped on connector which has three spikes. With care these can be removed from the old leads and used again but if their con-

dition is in doubt they should be replaced.

Magneto leads have a split copper washer on the end of the wire itself. The insulation on the new wire should be cut back about  $\frac{1}{4}$ "

and the split washer passed over the conductor, the strands of which should now be bent back radially. These can be soldered if desired.

## NOTES

### PISTONS

There are two pistons available for model 88 and three for model 99. These give different ratios according to the year of the engine as follows:

	<b>Model 88 1955/59</b>
Std. Piston 7.6 to 1	High Comp. app. 9 to 1
	<b>Model 88 1960/62</b>
Std. Piston 8.5 to 1	High Comp. app. 9.45 to 1
	<b>Model 99 1956/59</b>
Std. Piston 7.4 to 1	High Comp. app. 8.2 to 1
	Nomad Piston 9 to 1
	<b>Model 99 1960/62</b>
Std. Piston 8.2 to 1	High Comp. app. 9 to 1
	Nomad Piston 10 to 1

It should be understood that the pistons were not altered but that all cylinder heads on 1960 and later engines give a higher ratio by approximately 1.

### CAMSHAFTS

The original 'Daytona' camshaft is fitted to every model 99 and all models 88 from 1956.

Quieting ramps were added to this on all 1959 and later models. From 1960 onwards the same camshaft was used but with flat base tappets.

In 1961 a camshaft giving slightly more lift was introduced on 650 c.c. machines for export. This is now fitted to all S.S. models along with tubular pushrods and special valve springs. It is also fitted to 650 c.c. Standard and de Luxe models.

### CARBURETTORS

When twin carburetors are fitted to models 88 and 99 they require similar settings to those employed with a single instrument.

Model 88 usually has a Main Jet No. 240 and model 99 a No. 250. These should be regarded as minimum sizes if performance is a first consideration and they should be increased to 260 and 270 respectively before undertaking a full bore run on, for example, a Motorway.

### GEAR RATIOS

All machines with A.M.C. gearboxes up to

and including 1959, had a rather large drop in ratio from top to third gear.

To bring these gearboxes into line with 1960 and later machines, it is necessary to replace the main sleeve gear, the layshaft free pinion (3rd gear) and the engine sprocket. The net result of this being chiefly, to lower top gear and allow the twin cylinder engines in particular, to more nearly reach maximum r.p.m. in that gear.

### FITTING SIDECARS TO 'FEATHERBED' FRAMES

We emphasise that if sidecars are fitted to these models without reducing the trail, they will not handle well.

For this reason a special fork crown and column and head clip are available which, because of different dimensions also require new top fork covers with lamp brackets. These parts reduce the trail and with an outfit properly aligned and set up, give very good steering.

This crown and column employs a steering damper with two friction discs which centre on a large diameter boss on the underside of the crown. These parts will not fit the solo crown.

There is also a steering damper for the solo crown which employs a single friction disc of different dimensions and it is therefore important to state for which crown a damper is required when ordering.

Stronger fork springs and rear shock absorber springs are also available, and should be fitted.

Because of the added electrical consumption of a sidecar lamp or lamps, an A.C. generator may not maintain the battery state unless an increased output is obtained as described in para. 124.

### FITTING A FOG OR SPOT LAMP

The correct method is to connect an additional dip switch (i.e. a single pole, two-way switch) in series with the existing dip switch in order to be able to select for operation either the headlamp or the fog/spot lamp,

when the main lighting switch is turned on position 'H'. To do this:

1. Disconnect the feed cable (normally blue) from the centre main terminal of the existing dipswitch.
2. Connect this cable to the centre main terminal of the new switch.
3. Connect one of the two remaining terminals of the new switch to the centre main terminal of the existing switch.
4. Connect the 3rd terminal of the new switch to one of the fog or spot lamp terminals.
5. Connect the other terminal of the fog-lamp to 'earth'—frame of machine.

The advantage of this method of connection is that electrical overloading due to the simultaneous use of headlamp and foglamp is prevented, and, further, the correct distribution of light to suit differing driving conditions is assured.

#### **FITTING RACING FOOTRESTS— REAR SET**

Manx type racing footrests, either folding or fixed can be fitted to Standard featherbed frames. To do so it is necessary to drill a  $\frac{7}{8}$ " hole in the gusset plate of the frame on each side.

Its position is  $1\frac{1}{2}$ " below and  $\frac{3}{8}$ " forward of the centre of the pivoted fork (swinging arm) attachment bolt. It is not correct to drill a hole on the offside to match the standard brake pedal mounting hole on the nearside.

#### **VALVE GEAR LUBRICATION**

On all the machines covered by this book, an oil feed to the valve gear is taken from the return oil pipe between oil pump and tank.

Because the valve gear is at a higher level than the end of the return pipe in the tank, it is necessary to have a restriction in the end of this pipe to create a pressure to force the oil to this higher level.

This restriction may vary slightly in individual tanks and if for this or any other reason, the valves or rockers of a particular engine appear to obtain insufficient lubrication, an oil tank return union adaptor as is fitted to 250 c.c. twins can be interchanged with the existing one. This has a restriction built into its outlet at the tank end and may thus give an increased supply to the valve gear. The part No. is 22148.

#### **VIBRATION**

In cases where vibration seems excessive on single and twin cylinder models, in addition to checking the tightness of all engine/frame attachment bolts, etc., particular attention should be paid to the cylinder head steady attachments.

Due to heat, the enamel may 'give' slightly under the pressure of nuts and washers and lockwashers of the spring or 'fan disc' type also tend to settle down. The nuts and bolts concerned, therefore, should be checked for tightness, especially at the first 500 mile service.

#### **DIFFICULT STARTING—De Luxe Models**

This can be brought about by failure of the extended lever on the carburetter float 'tickler' to actually depress the float when moving within the limit of travel imposed by the slot in the side panel. The remedy is to 'set' the lever slightly at the point where it makes contact with the plunger.

#### **SET SCREWS SECURING BRACKETS TO SILENCERS**

Due to the enamel on the brackets 'giving' slightly under heat from the silencer pommels, the screws tend to slacken during initial mileage. If they are not well tightened by the time 500 miles have been covered, they may be lost. Check with good fitting ring spanner after say, 200 miles, and again at 500.

#### **SETTING TWIN CARBURETTERS**

To do this the engine should be warm and one H.T. lead should be disconnected and the sparking plug removed from the cylinder. When taking the plug out, check that there are not any small stones, grit or dirt in the plug recess in the head which might enter the cylinder.

Now start up the engine on the other cylinder and by means of the pilot air screw and throttle stop, obtain the slowest even tick-over. If you start with the pilot air screw fairly well closed, speed will increase as this is unscrewed. The speed should be progressively set down with the throttle stop. (The pilot air screw enters the mixing chamber body horizontally and the throttle stop screw is the larger one which enters at an upwards angle).

Repeat this procedure on the other cylinder and now when you run on both cylinders, the tick-over may be too fast. Set it down by unscrewing both throttle stop screws a similar

small amount. In effect the engine is now running with both throttle valves resting on the throttle stops, but if there is an unequal amount of backlash in the short throttle cables between mixing chambers and cable junction block, the engine will not open up properly.

You should stop the engine therefore and carefully set the adjusters in the mixing chamber tops so that there is just a trace of backlash when the twist grip is closed. It is advisable to tape these adjusters afterwards with thin strips of insulating tape to prevent them moving due to vibration. Whilst they are not so important, provided they reach the fully open position, the air valves should have their cables adjusted in the same way. Finally check that both throttle valves reach the fully open position and set the mid-way adjuster in the single throttle cable to give a trace of backlash at the twist grip.

Set the twist grip friction device to suit individual requirements.

### **STOP/TAIL LAMP LEADS**

Reference is made to the Electrical Section of this book under Essential Maintenance—Wiring.

Stop/Tail lamps are not fitted to the number plates when the machines leave the works because of risk of breakage in transit. It therefore falls upon the dealer to fit and connect the lamp. It should be connected and the

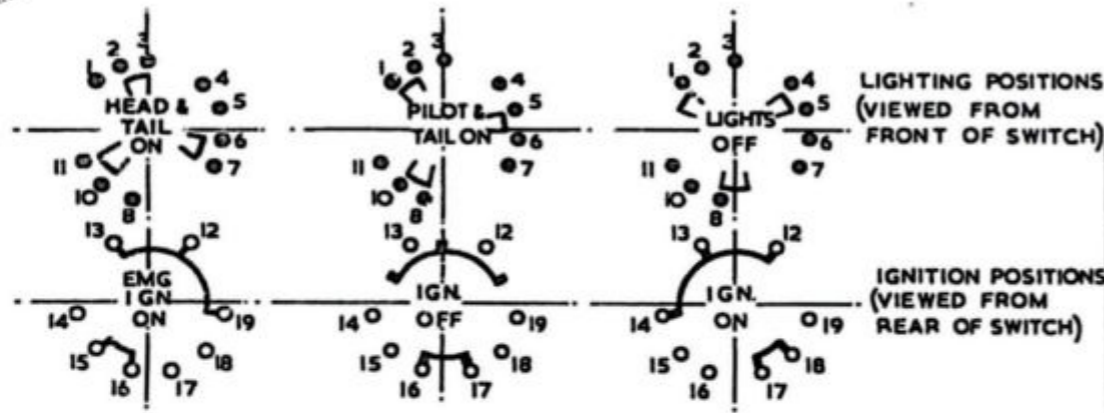
wires positioned as shown in the diagram. The snap connectors themselves must be in the aluminium clip provided and should be positioned horizontally above the left hand number plate stud. Surplus wire on the lamp side should be fed back through the grommet in the guard and then if the long lead is also positioned in the clips in the mudguard no trouble will be experienced due to the rear tyre chafing the wires (see Fig. 27).

**OWNERS SHOULD CHECK THIS WIRING ON TAKING DELIVERY** as if it is not properly carried out there is risk of a short circuit which can cause failure of the lights and also ignition in the case of a coil ignition model.

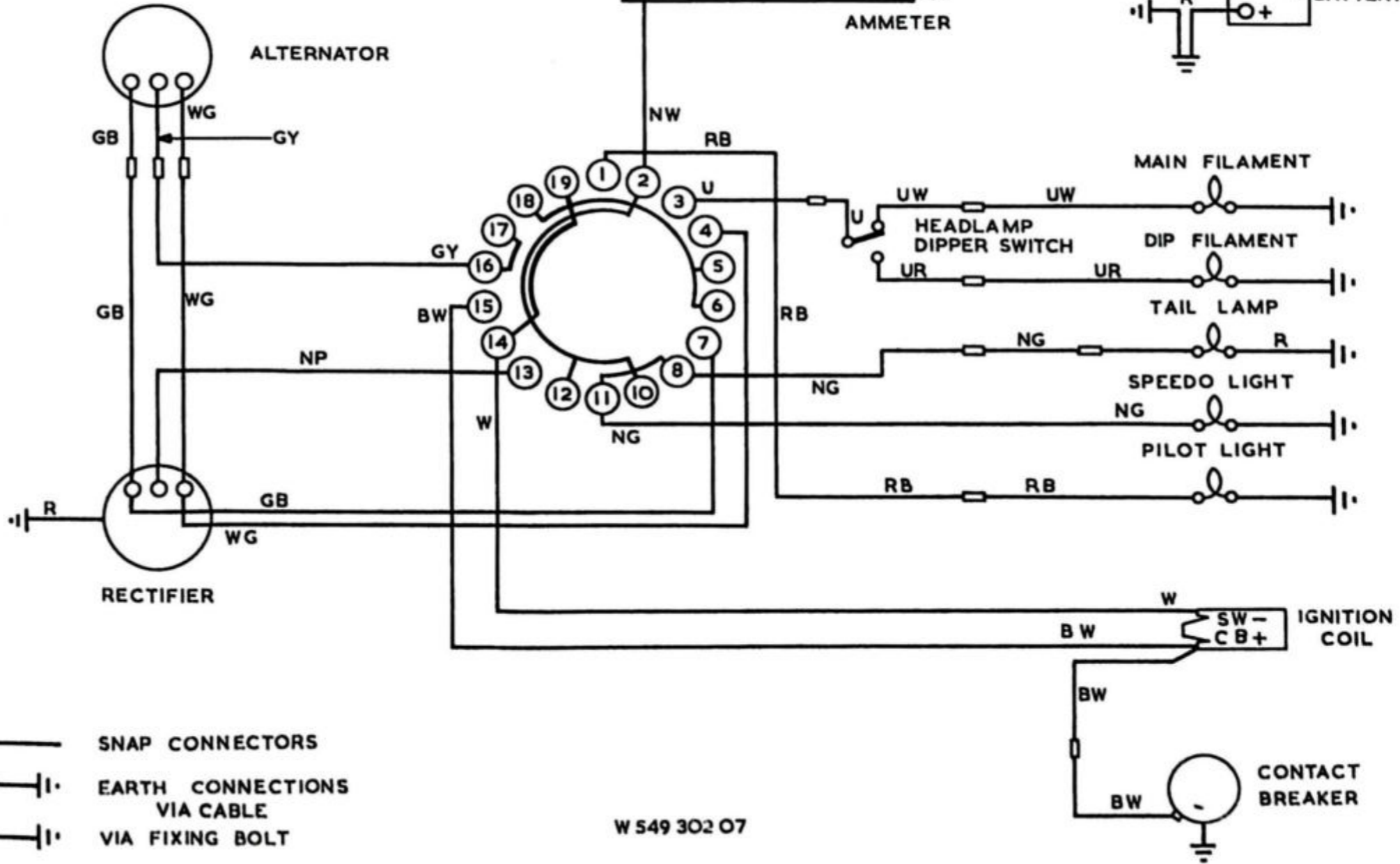
### **OIL TANKS**

Reference is made to Rear Chain Lubrication at the end of para. 71 and the following information given:

Some 1962, 88 and 650 S.S. machines may have a modified oil tank breather system and when fitted, this consists of an oil tank with a vapour tower at the top and the crankcase breather pipe is fed in to the top of the tank so that it discharges downwards away from the top of the tower. A separate connection from the top of the tower is then taken to a welded connection on the rear chainguard. There is thus only a single vent pipe from the oil system feeding the rear chain.



63  
63  
63



- SNAP CONNECTORS
- EARTH CONNECTIONS VIA CABLE
- VIA FIXING BOLT

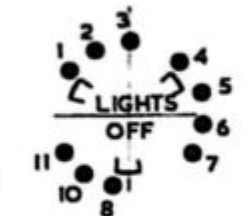
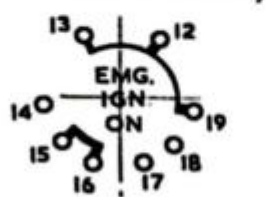
W 549 302 07

ELECTRICAL WIRING DIAGRAM for models ES2 and 50

**LIGHTING POSITIONS**  
(VIEWED FROM FRONT OF SWITCH)



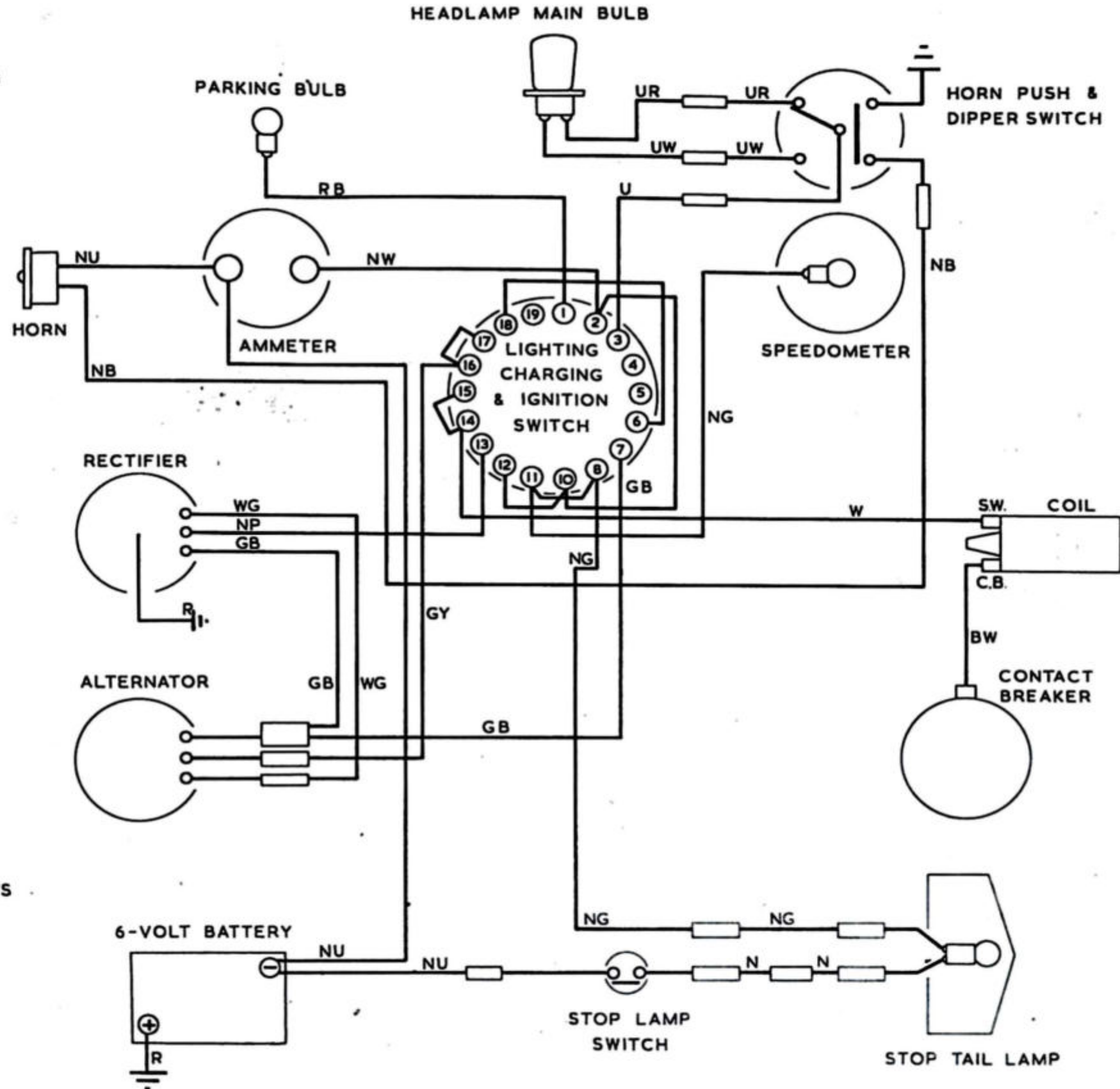
**IGNITION POSITIONS**  
(VIEWED FROM REAR OF SWITCH)



64

- SNAP CONNECTIONS
- EARTH CONNECTIONS VIA CABLE
- VIA FIXING BOLT

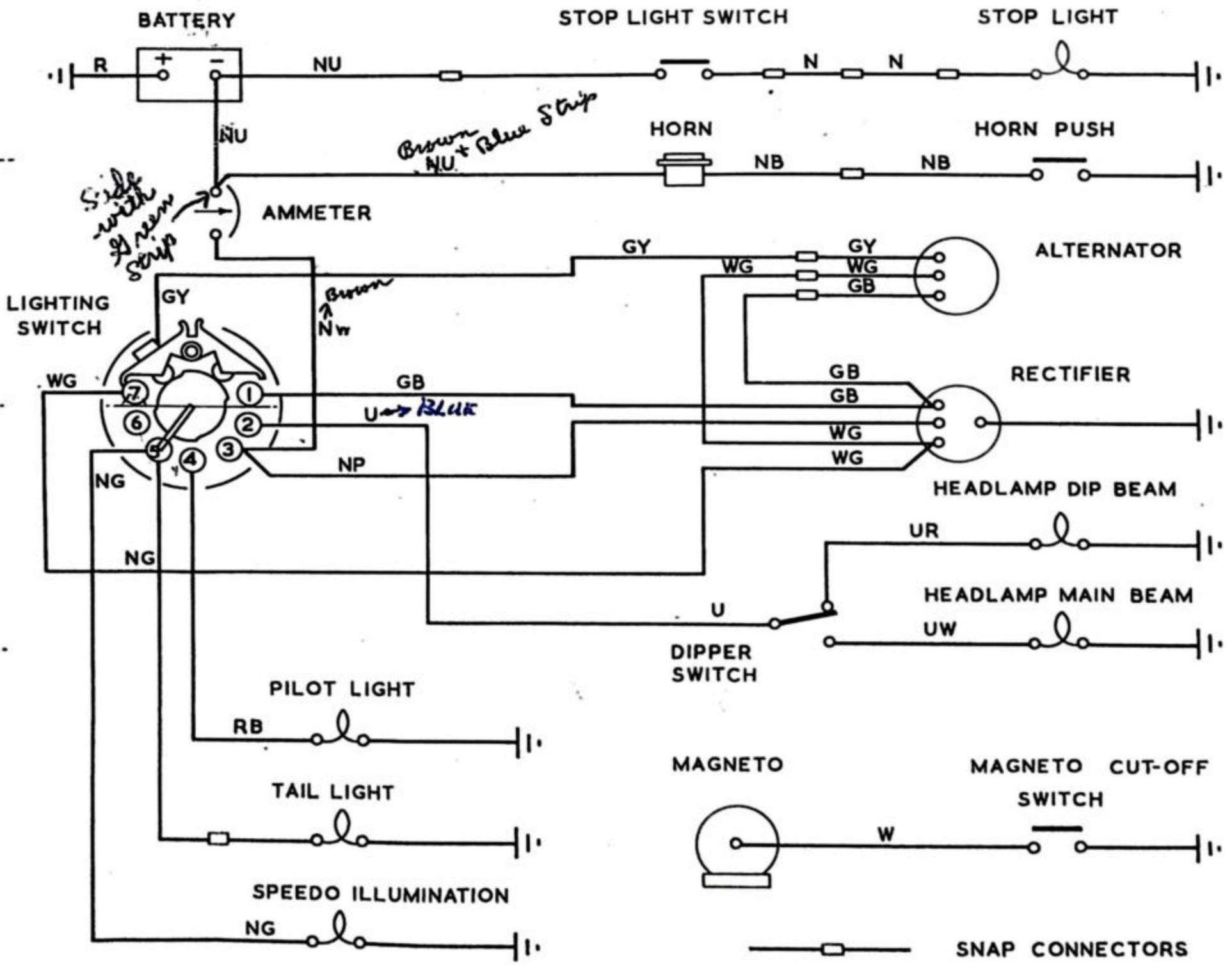
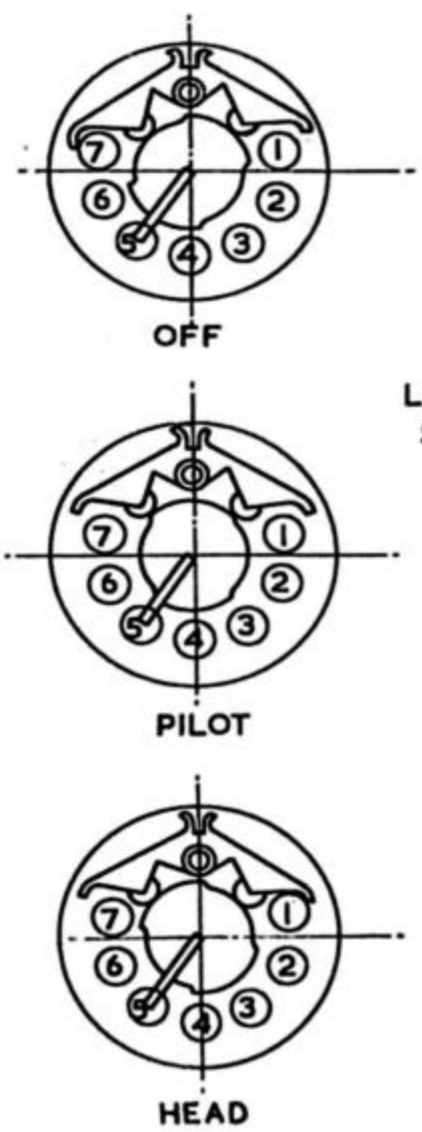
W 549 302 03



ELECTRICAL WIRING DIAGRAM for 650 Std. and de Luxe, 99 Std., de Luxe and S.S., 88 Std. and de Luxe



**SWITCH ROTOR POSITIONS**



W549 499 40

-  SNAP CONNECTORS
-  EARTH CONNECTIONS VIA CABLE
-  VIA FIXING BOLT

## 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
		Clean Carburetter.
<i>Firing on one cylinder.</i>	Contact breaker points dirty or out of adjustment	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.
	Battery flat.	Change plug. Examine high tension lead, renew if necessary.
	Faulty plug. Faulty high tension lead. Water on plug.	
<i>Erratic slow running.</i>	Uneven mixture distribution. Pilot air screw requires resetting.	Check and clean carburetter. Adjust as in para. 113.
	Air leaks from carburetter joint or sparking plug.	Check joint washer and nuts for tightness. Check plug for tightness.
	Faulty valve seats.	Examine and regrind as necessary.
	Worn inlet valve or guides.	Dismantle, check and renew as necessary.
<i>Loss of power.</i>	No tappet clearance.	Check and reset as necessary.
	Broken piston rings.	Examine and replace.
	Tight front chain.	Adjust.
<i>Excessive oil consumption.</i>	Broken piston rings. Worn cylinder block.	Examine and replace as necessary.
	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. } Dirt in filters. }	Dismantle and clean.
	Dirt in petrol tap.	Remove petrol taps and clean.
	Condenser broken down.	Change condenser, clean contacts.
<i>Loss of oil pressure.</i>	Oil overheated or unsuitable.	Drain and refill with fresh oil of correct grade.
	Oil pump nipple washer failed.	Examine and renew.
	Timing side oil seal worn or collapsed.	Examine and renew.
	Pressure release valve plunger stuck.	Examine, clean and free off.
	Pump failed.	Examine for foreign mater.

## LOCATING AND RECTIFYING POSSIBLE TROUBLES

<i>TROUBLE</i>	<i>POSSIBLE CAUSE</i>	<i>REMEDY</i>
<i>Inefficient brakes. (Front and Rear)</i>	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.
	Clutch push rod adjusted 'hard on'.	Re-adjust, para. 72.
	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.