Villiers

Printed by Eynsham Technical Press (Oxford) Ltd., Eynsham, Oxford

V.E.C. 641

illustrated

Workshop Manual

Villiers

TYPE 225T-2

Mark 4T, 4T/SK & 4T/SRK

TWIN-CYLINDER, TWO-STROKE

ROAD-VEHICLE ENGINES

Price:

V.E.C. 641

Workshop Manual

TYPE 225T-2

Mark 4T, 4T/SK & 4T/SRK

TWIN-CYLINDER, TWO-STROKE

ROAD-VEHICLE ENGINES

Issued by:

THE VILLIERS ENGINEERING COMPANY LTD.
Marston Road, Wolverhampton, England.
Telephone: 22399 (20 lines). Telegrams: Villiers, Wolverhampton

First published 1964

Published by
THE VILLIERS ENGINEERING CO. LTD.
Wolverhampton Staffs. England

Printed by
THE EYNSHAM TECHNICAL PRESS (OXFORD) LTD.
Eynsham Oxford England

CONTENTS

CONTENTS

INTRODUCTION

The Villiers 225T-2 engine, known to users as the Mark 4T, is the second in the family of 250 c.c. twin-cylinder two-stroke road-vehicle engines to be produced at Wolverhampton since the war.

A development of the Mark 2T, it is available in standard motor-cycle trim, with a Villiers flywheel magneto and kick-starter and in three-wheeler trim with Siba Dynastart equipment replacing the Villiers "electrics", but retaining the kick-starter for use in emergency. Three-wheeler engines listed as Mark 4T/SK have uni-directional Siba equipment and those listed as Mark 4T/SRK have a reverse gear operating through the Siba Dynastart, drive being taken through the first of the four gears.

The Mark 4T is a high-performance engine with a firing cycle equivalent to a four-cylinder four-stroke unit. It is a product of high-precision engineering and its performance and dependability will be in direct proportion to the care shown in maintenance.

This manual takes an owner systematically through the dismantling and reassembly of the various sub-assemblies. Where an owner feels uncertain of his ability to strip down and rebuild any particular part of the engine he is advised to have the work carried out by a recognised Villiers service dealer. The service tools referred to in this manual, and all replacement parts and assemblies, are obtainable from any Villiers spares stockist.

Every engine is built to a works' specification, the number of which is stamped on the nameplate fixed to the inner chaincase. This number, together with the engine serial number, must be quoted in all correspondence or enquiries regarding repairs and replacement parts.

It is important that the correct tolerances are maintained and this can only be assured by purchasing and fitting genuine Villiers replacement parts. An illustrated spare-parts list, reference V.E.C.637, can be obtained, price 2s. 6d., from any Villiers spares stockist, or direct from the Technical Publications Department, The Villiers Engineering Co. Ltd., Wolverhampton.

TECHNICAL DATA

Cylinder bore: standard	50 mm.—1·9688 in./1·9678 in. nominal
Cylinder bore: oversize	+·020 in. and + ·040 in.
Stroke	63·5 mm.—2.50 in.
Capacity	249 c.c.—15·2 cu. in.
Compression ratio	8·75 : 1
Engine sprocket: Mark 4T	20 tooth × ⅜ in. pitch
Engine sprocket: Mark 4T/SK & 4T/SRK	25 tooth × ⅜ in. pitch
Clutch sprocket	43 tooth × ⅜ in. pitch
Final-drive sprocket	½ in. pitch (number of teeth depends on Spec. to suit Renold No. 110046 ½ in. pitch × ·305 in. chain)
Final-drive chain line	2 11/16 in.
Internal gear ratios—Mark 4T ...	1, 1·32, 1·9 and 3·06 : 1.
Internal gear ratios—Mark 4T/SK & 4T/SRK	1, 1·556, 2·240 and 4·0 : 1

IGNITION.

Contact-breaker point gap: Mark 4T	·012 in./·015 in.
Contact-breaker point gap: Mark 4T/SK & 4T/SRK	·020 in./·022 in.
Timing before top dead centre ...	26 degrees—·140 in./·170 in.
Sparking plugs	Lodge HH14 or Champion L7

CARBURATION.

Carburettor: Mark 4T	Villiers S25/6
Carburettor: Mark 4T/SK & 4T/SRK	Villiers S25/11
Taper needle	No. 3½, set to protrude 1·94 in.
Main jet: Mark 4T	180 c.c.
Main jet: Mark 4T/SK & 4T/SRK ...	200 c.c.
Pilot jet	35 c.c.
Throttle	No. 3 cutaway

BALL AND ROLLER BEARINGS.

Crankshaft ball bearing (1)	25 mm. × 52 mm. × 15 mm.
Crankshaft roller bearings (2) ...	25 mm. × 52 mm. × 15 mm.
Mark 4T/SK & 4T/SRK have an additional roller bearing	20 mm. × 52 mm. × 15 mm.
Caged roller big-end assemblies ...	18 – ¼ in. × 5/16 in. rollers
Output sleeve-gear pinion	38 – ¼ in. × ¼ in. rollers
Cam-barrel bearing	24 – 3/16 in. × 3/16 in. rollers
Clutch-sprocket race	24 – 3/16 in. × 3/16 in. rollers

SMALL-END BEARINGS.

Gudgeon-pin diameter	·6250 in./·6248 in.
Gudgeon-pin bush (connecting rod)	·6259 in./·6254 in.

Piston not bushed, supplied to size.

PISTON AND RINGS.

Upper compression ring: standard	1·9685 in. dia.
Closed gap in bore	·093 in./·088 in.
Free gap	·331 in./·307 in.
Piston–peg diameter	·078 in.
Lower compression ring: standard	1·9685 in. dia.
Closed gap in bore	·102 in./·094 in.
Free gap	·377 in./·307 in.
Ring clearance in grooves	·003 in./·005 in.
Piston skirt clearance in bore ...	·0027 in./·0034 in.

Lubrication

ENGINE.

One of the advantages of a two-stroke engine is that it is lubricated by the petroil system, which means that oil pumps and their associate drives, oil filters and sludge traps are dispensed with.

All that is required is the thorough mixing of one part of fresh clean lubricating oil—Villiers recommend Castrol XL (S.A.E. 30)—to 20 parts of petrol and if the mixing is not thorough before it is poured into the fuel tank, blocked carburettor jets and fouled plugs are an inevitable consequence. Moreover, if the oil and petrol are not thoroughly mixed the mixture strength will constantly vary and the engine will be either over-lubricated or starved of lubricant, either of which will have detrimental effects.

The easiest way of ensuring adequate mixing is by using a self-mixing oil. These contain a diluent to enable them to mix easily with the petrol without outside assistance. If, however, a self-mixing oil is used the ratio must be one part oil to 16 parts petrol, the reason for the difference in the ratio being that the self-mixing additive in the oil has to be compensated for.

Probably the biggest danger with the petroil system is to increase the oil content "just for luck". This immediately interferes with the mixture strength, because if more oil is added to the mixture the main jet can only pass it at the expense of petrol, the main jet being calibrated to meter a carefully calculated amount of fuel in a given period to provide the correct carburation. Increase the amount of oil and a lesser amount of petrol passes through the jet. This is tantamount to running on a weak mixture and will cause overheating and could lead to a seizure in the engine. Also the extra oil will cause an increase in carbon deposits in the ports and on the piston. The latter can cause scuffing of the cylinder bore and the likelihood of sticking rings.

What of additives? The major oil companies have devoted much research and money to produce oils for modern engines. Most of these oils contain additives blended in the right amount to give the engine the maximum protection. Adding other compositions to these carefully blended oils is not recommended and the advice of Villiers is to use the oil as supplied.

GEARBOX.

Castrol XL (S.A.E. 30) is also recommended for the gearbox. The gearbox filler plug and dipstick are combined and positioned as shown in Fig. 1. The oil capacity of the gearbox is $1\frac{1}{4}$ pints and the oil level should be maintained to the

notch cut in the dipstick. The oil level should be checked with the dipstick resting on top of the gearbox casing and with the machine standing on ground level. A drain plug is provided at the base of the gearbox and the oil should be changed every 5000 miles. Do not over-fill or excess oil will be blown from the gearbox breather vents.

SPEEDOMETER DRIVE.

This is built into the gearbox, the drive gears being totally enclosed and lubricated by the gearbox oil. The flexible speedometer-drive cable, however, requires periodical lubrication as recommended in the machine handbook.

CHAINCASE.

The chaincase houses the primary-drive and the clutch. Mark 4T engines fitted into motor cycles should use Castrolite (S.A.E. 20) oil in the chaincase, but three-wheeler engines, which have Capasco-faced clutch plates, must use Castrol TQ or a similar S.A.E. 5 oil. The location of the filler and level plugs is shown in Fig. 1. When filling the chaincase both plugs should be removed and oil poured in until it commences to run out of the level-plug hole. Allow the surplus oil to drain off before replacing the plugs. Change the oil every 5000 miles.

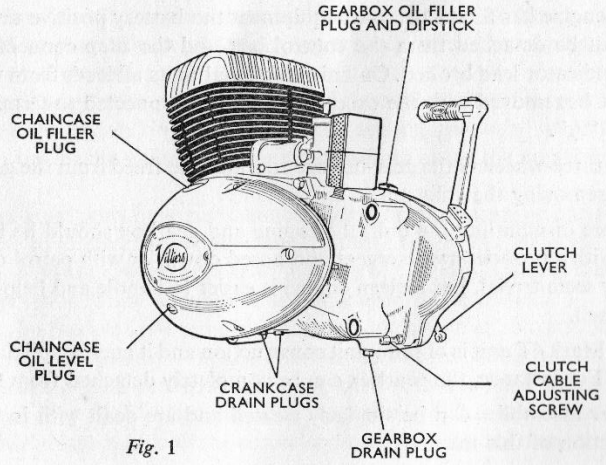


Fig. 1

Removal of Engine

The manner in which engine overhauls are tackled depends upon the individual and the facilities he has at his command. It is preferable to overhaul an engine in a workshop, in dust-free surroundings, with adequate lighting and a selection of hand tools. One factor cannot be ignored—time! If an overhaul is to be done "against the clock" it is better postponed until more time is available.

This manual covers a complete overhaul and in the main, therefore, it is assumed that the engine is removed from the frame. Obviously, when certain sub-assemblies only need attention removal of the engine is not necessary.

To remove the engine from the frame take off the final-drive chain, disconnect the clutch cable and remove those parts of the vehicle necessary to give access to the engine. Most probably this will include the petrol tank and the fuel pipe leading to the carburettor.

Detach the battery negative lead before disconnecting any wiring and remove the multi-pin plug from its socket in the engine. Unscrew the top ring of the carburettor and gently pull the throttle slide, with the taper needle attached, from the throttle body. To avoid damage, tape the throttle slide to the frame top tube. Detach the exhaust pipes and silencers from the engine and frame and, using a "C" spanner, undo the exhaust flange nuts which screw into the cylinder and retain the exhausts in place. Finally, take out the four studs securing the engine to the frame and lift the engine clear.

If the engine has Siba Dynastart equipment the battery positive and negative leads must be detached from the control box and the snap connection of the neutral-indicator lead broken. On uni-directional units all leads from the control box must be removed with the exception of those connected to terminals "D", "F" and "A".

On all three-wheelers the gear-linkage rod must be freed from the gear-change lever by removing the split pin.

Before dismantling the unit, the engine and gearbox should be thoroughly washed with a proprietary detergent and hosed down, or with petrol or paraffin. This may seem trivial, but a clean engine is easier to handle and helps to keep a clean bench.

The Mark 4T unit is of semi-unit construction and it may be split into various sections. For instance, the gearbox can be completely detached from the engine.

Other assemblies can be similarly treated and are dealt with in the appropriate section of this manual.

Decarbonising

The time to take the "lid" off and decarbonise the engine will be indicated by such symptoms as a general falling off in power, detonation or pre-ignition, increased fuel consumption and difficulty in starting. A machine used predominantly for town work will need "decoking" more often than one which mainly motors briskly on the open road.

The engine need not be removed from the frame for a "top" overhaul.

The cylinder heads are separate castings, but they are best considered as one as the cylinder-head nuts tighten down the cylinders and therefore affect the position of the manifold studs. The manifolds are secured by four nuts, each having a plain washer and an insulating washer under their heads, and these must be tightened before finally tightening down the cylinder-head nuts.

Take off the insulating gasket to prevent damage. Slacken the four head nuts on each cylinder head and remove the heads. Examine each in turn. The colour of the deposits will give a fair indication of the mixture strength. Also observe whether any "blow by" of gas is evidenced. Where there are signs of an extremely weak mixture in one cylinder, examine the cylinder head for a possible crack in the casting.

The best method of removing carbon from the cylinder head is with a flat piece of solder or copper with a rounded end. Rotating wire brushes, while useful for cleaning ports, must on no account be used.

When the heads have been decarbonised the threads of the sparking-plug holes should be cleaned with a 14 mm. plug tap to prevent them being fouled by minute pieces of carbon.

Examine the cylinder walls for wear and signs of scuffing. Discoloration will indicate that the piston rings have not been seating properly, while the wear ridge at the top of the cylinder will give an indication of the condition of the rings.

If the exhaust ports have sufficient carbon in them to warrant decarbonising it is advisable to remove the cylinders and pistons to carry out the work. If, however, only the piston crowns appear to have carbon in any quantity they can be cleaned in position, using a length of solder shaped like a chisel.

If the cylinders are to be removed, position one piston at bottom dead centre and gently pull the cylinder over the cylinder studs. The piston will tend to rise while this is being done and it must be supported with one hand as the cylinder is drawn clear (Fig. 2). If this is not done the piston will fall against the cylinder studs and be damaged. Lift off the second cylinder in a similar manner. Remove

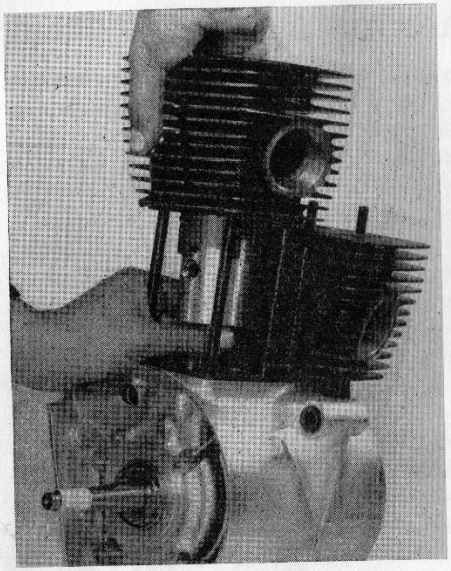


Fig. 2
Support the piston with one hand as the cylinder is drawn clear

with a straight, firm pull. Do not twist the cylinder or the rings will foul one of the ports and break.

Before removing the pistons, pack clean rag into the mouth of each crankcase and around the connecting rods to prevent carbon deposits or small components dropping into the crankcase.

The piston is attached to the connecting rod by a gudgeon pin, which in turn is located by "Seegar" circlips sprung into grooves machined in the piston bushes. To remove the circlips squeeze the eyelets with a pair of snipe-nosed pliers. The gudgeon pins are a push fit in the piston bosses, but to prevent damage the pistons should be heated before removing them. A hot soldering iron or a can of boiling water applied to the crown of the pistons will heat them sufficiently to enable this to be done.

A steel bar slightly smaller than the gudgeon-pin diameter will facilitate removal of the pins. Do not remove the pins completely, but push them through the bushes far enough to allow the piston to be lifted clear (Fig. 3). Once clear of the connecting rod the gudgeon pin can be pushed back into the piston. This will eliminate any danger of the gudgeon pins being interchanged. Note which

piston goes with which cylinder and ensure that it is returned to the one from which it was removed.

Keep the pistons apart and deal with each one separately. The compression rings must be returned to the grooves from which they are taken. The ends of the rings butt against a peg, the purpose of which is to prevent the rings turning in the cylinder bore and becoming trapped in the cylinder port. Remove the rings by inserting the thumbnails under the ends of the ring (Fig. 4) and pulling them apart sufficiently to lift the ring clear of the piston. Care must be taken or the rings will snap. Under no circumstances clamp the piston in a vice or it will distort.

Carefully scrape off the carbon deposits from the piston crown with a stick of soft solder shaped like a chisel. The best way of cleaning the ring grooves in the piston is with a brass-wire brush dipped in metal polish. Finally, wash the piston in clean petrol and allow to dry. Refit the rings to their respective grooves and proceed with the second piston.

The carbon deposits in the cylinder ports can be removed with a rotary wire brush or a variety of scrapers, but great care must be taken not to alter the shape or size of the ports. When the cylinders have been decarbonised, wash away all traces of carbon from the cylinders with clean petrol.

Never use abrasive material to clean the piston as emery or carborundum

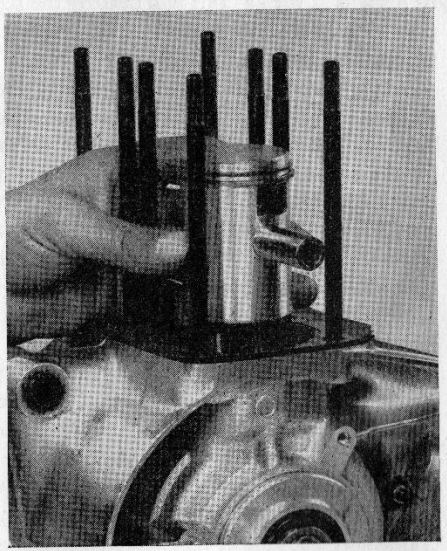


Fig. 3
Removing the piston from the connecting rod, the gudgeon pin having been pushed far enough through the bush to free the piston

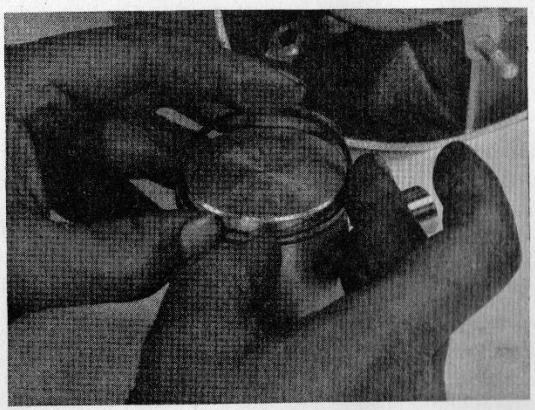


Fig. 4
Expanding the piston rings to remove them from the piston

dust will bed itself in the piston and cause a rapid deterioration of bearing surfaces.

Before replacing the components, examine the cylinder-base joint washers. These are located on each side of the cylinder-base plate, which fits across both crankcase halves. Damaged washers must be renewed. The base plate must not be dispensed with as this will destroy the sealing of the two halves, will alter the port timing and may cause irreparable damage. No jointing compound is necessary, although Villiers use a fixative which washes off with hot water.

Warm the pistons and fit them to the connecting rods by means of the gudgeon pins, making certain that each is connected to the correct rod and that the word "Front" stamped on the crown of the piston faces the front of the engine. Fit the piston circlips by compressing and inserting them into the groove in the piston bush. Rotate each circlip in its groove to make sure it is correctly fitted.

When the circlips are fitted securely, remove the rag from the crankcase and pour a little oil over the pistons to lubricate the rings and smear some on the cylinder walls. Support each piston with service tool ST.2535D (Fig. 6) by bringing them to top dead centre and lowering onto the support. Compress the rings with the fingers, making sure that the gaps mate with the piston pegs, and lower the cylinder gently over the cylinder studs and slide it down over the piston. Do not fit with a twisting action. The piston must enter the cylinder easily. If resistance is met, do not under any circumstances use force as this can only result in broken rings and a damaged piston. See that the cylinder is spigotted down into the crankcase and repeat the operation with the other cylinder.

Hold the cylinders down with the palm of one hand and slowly rotate the crankshaft a couple of times to ensure correct assembly and to distribute the oil.

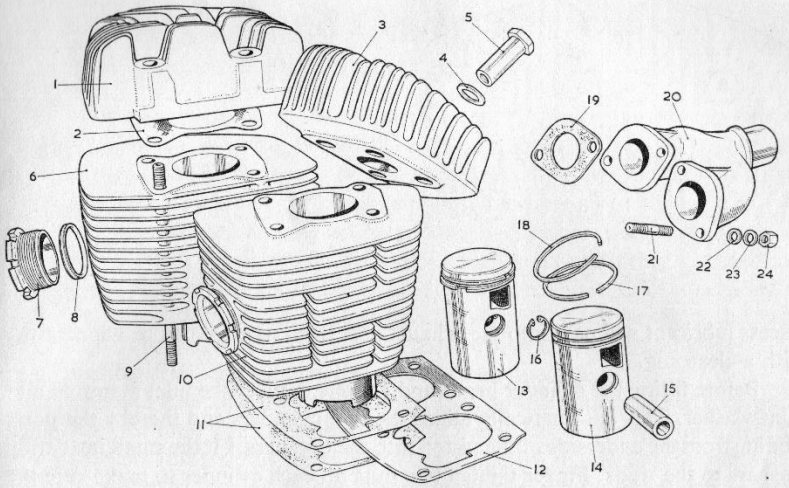


Fig. 5
CYLINDERS and PISTONS

1. Cylinder head, right-hand
2. Cylinder-head gasket (2)
3. Cylinder head, left-hand
4. Cylinder fixing-nut washer (8)
5. Cylinder-fixing nuts (8).
6. Cylinder, right-hand.
7. Exhaust-pipe ring (2)
8. Exhaust-pipe washer (2)
9. Cylinder-fixing stud (8)
10. Cylinder, left-hand
11. Cylinder-base gasket (2)
12. Cylinder-base joint plate
13. Piston complete (2)
14. Piston
15. Gudgeon pin
16. Circlip (4)
17. Piston ring, lower (2)
18. Piston ring, upper (2)
19. Inlet-pipe joint washer (2)
20. Inlet pipe
21. Inlet-pipe stud (4)
22. Inlet-pipe stud insulation washer (4)
23. Inlet-pipe fixing washer (4)
24. Inlet-pipe fixing nut (4).

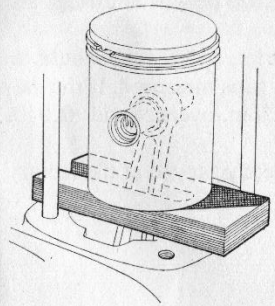


Fig. 6
Service tool ST.2535D supporting the piston during reassembly

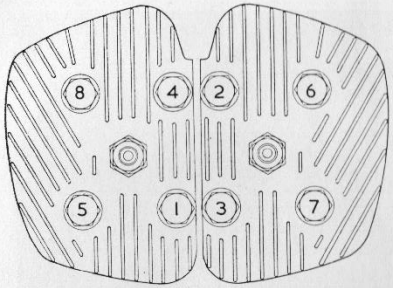


Fig. 7
Order of tightening the cylinder-head fixing nuts

Excess lubricant will pass into the exhaust port from where it can be wiped away with a clean rag.

Before fitting the cylinder heads and gaskets, replace the inlet manifold and joint washer. This automatically aligns the two cylinders and thereby the ports feeding from the underside of the piston into the transfers. Fit the small insulating washers to the studs. Finger tighten two nuts on each cylinder to make sure the cylinders are properly located and tighten the inlet-manifold retaining nuts. Take care that the cylinder-head gaskets do not overlap the bores and fit the cylinder heads.

Tighten each cylinder-head nut a little in turn as shown in Fig. 7. Start at number 1 and go in the order shown to number 8, then finally tighten down in the same order to a torque figure of 220 in./lb.

SERVICE-EXCHANGE CYLINDERS AND PISTONS.

After considerable usage, the cylinders and pistons will have worn sufficiently to necessitate the former being rebored and the latter replaced with oversize pistons with the correct cylinder clearances. Oversize pistons and rings are available in two oversizes of +·020 in. and +·040 in.

To determine the necessity of reboring the cylinder, a new ring should be fitted in the bottom of the cylinder bore and the end gaps measured. If the gap exceeds ·121 in. the cylinder should be rebored to ·020 in. oversize and ·020 in. oversize piston assembly fitted.

New rings when supplied with the piston are correctly gapped at the factory and only require fitting to the piston.

Right-hand Cover, Rotor and Armature Plate

If the engine is still in the frame, the clutch cable, the five-pin wiring connection and battery negative lead must be released before the right-hand cover assembly can be removed. To free the gear-change lever, unscrew and take off the pinch bolt and pull the lever from its splines.

The kickstart lever is removed by undoing and withdrawing the pinch bolt, undoing the small cap screw to free the aluminium cap covering the kickstart spindle and pulling the kickstart lever from its splined shaft. Care is required at this stage as the kickstart return spring and cover will be released with the kickstart lever. It is not necessary to remove these from the boss but they may come away readily, in which case they can be placed on one side.

The cover is secured by three screws. Two dowels which help to locate the case have two long screws passing through them. The cover will be a tight fit on the dowels and a slot is provided in the crankcase to enable it to be levered off with a screwdriver (Fig. 8). The cover should be carefully withdrawn over the

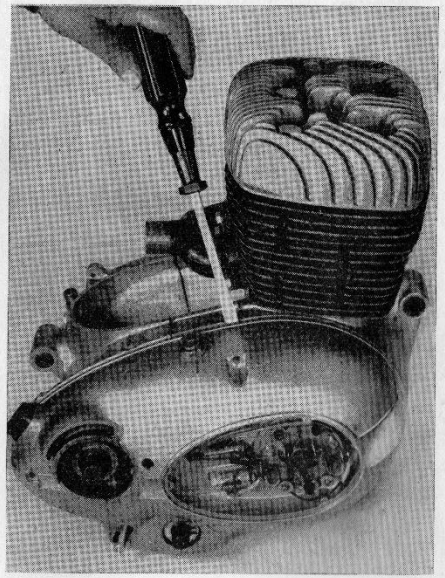


Fig. 8
Using a screwdriver to lever off the right-hand cover. A slot is provided for the purpose

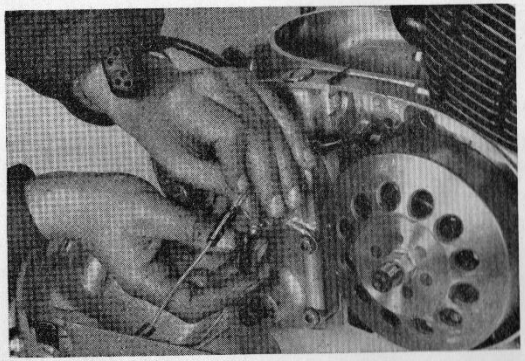


Fig. 9
Undoing the snap connectors to the wiring harness

cam to avoid damaging the contact-breaker rocker arms and the two leads freed by undoing the snap connectors to the wiring harness (Fig. 9).

The contact-breaker cam is retained on the protruding portion of the right-hand driveshaft by a Seegar circlip and is located by a small Woodruff key. To remove the cam, expand the circlip out of its groove (Fig. 10), place a screwdriver endwise into the slot in the lower portion of the cam and gently expand the cam (Fig. 11) to withdraw it from the shaft. The Woodruff key, which will be left on the shaft, must be gently tapped out before taking off the flywheel rotor. A torque wrench and strap wrench (Fig. 12) provide the best method of retaining the flywheel rotor whilst the extractor nut is undone, but in the absence of these tools

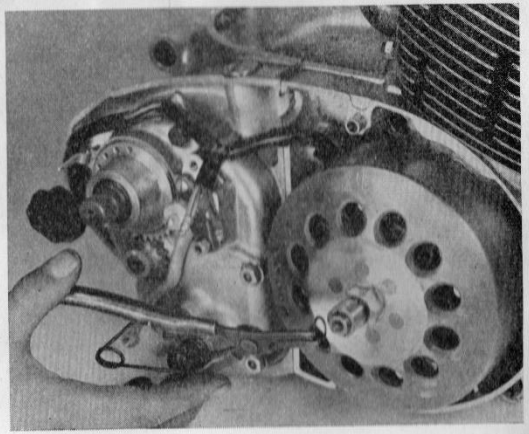


Fig. 10
Removing the Seegar circlip which retains the contact-breaker cam

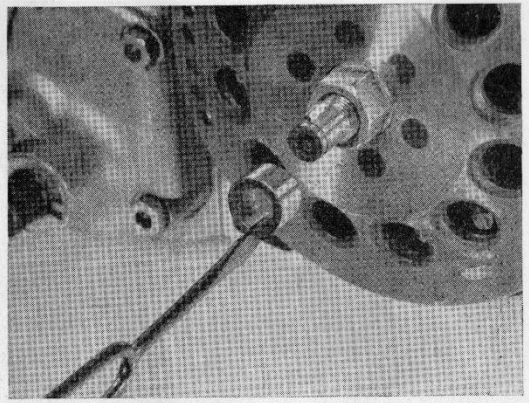


Fig. 11
Removing the contact-breaker cam with the aid of a screwdriver

a "Hammertight" spanner can be used, the nut being hammered undone while one hand restrains the rotor (Fig. 13).

The rotor must not be wedged or locked tight during this operation or

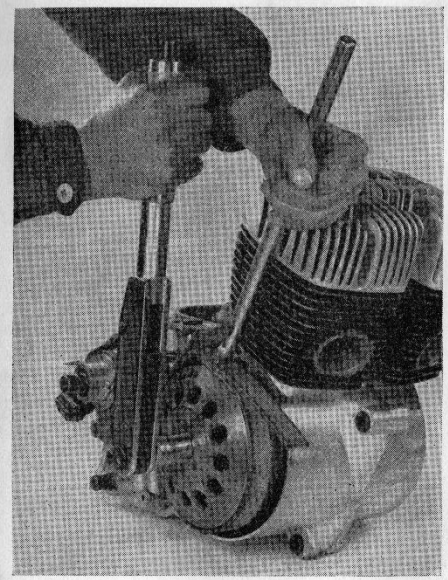


Fig. 12
Using a torque wrench and a strap wrench for undoing the extractor nut on the Villiers flywheel

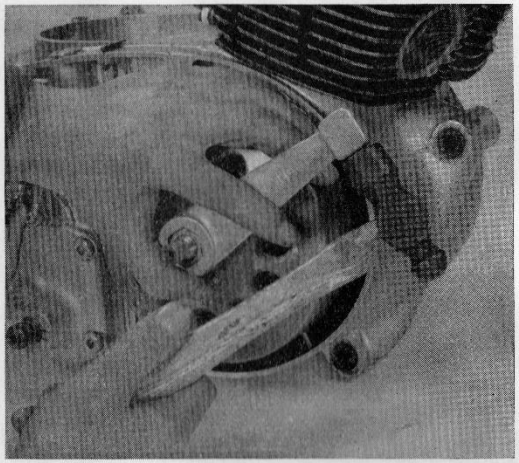


Fig. 13
Alternative method of undoing the flywheel exterior nut using a Villiers "Hammertight" spanner

shock loading may result in shaft misalignment. The nut will be done up extremely tightly and has a normal right-hand thread. After unscrewing a little the nut will go slack, but after another 1½ turns it will tighten up again as it begins its task of extracting the rotor from the taper on the driveshaft. Withdraw the rotor and place it face upwards on a clean surface. Remove the Woodruff key.

The armature plate is fixed to the crankcase by four screws, which will be

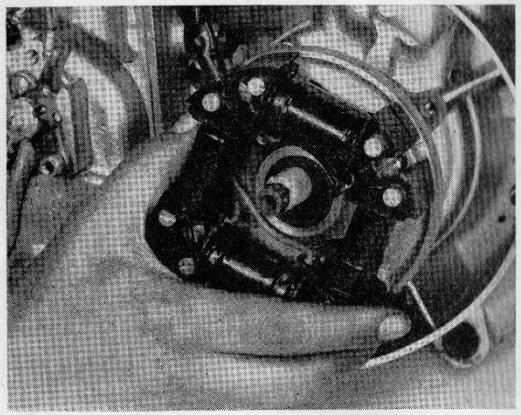


Fig. 14
Adhesive tape over the threads of the crankshaft will prevent damage to the oil seals when the armature plate is withdrawn

done up very tightly. If they resist unscrewing, place the screwdriver in the slot of each screw and give it a light tap with a hammer.

The wiring loom is retained by one clip on the gearbox-mounting stud which must be undone before the armature plate can be withdrawn. It is advisable to wind adhesive tape over the threaded portion of the shaft before withdrawing the armature plate to prevent damage to the oil seals (Fig. 14). If new oil seals are required, they may be gently tapped into position after the old ones have been removed. A paper joint washer will be found under the armature plate.

Contact-breaker Assembly

The right-hand outer cover serves as a supporting base for the contact-breaker assembly, condensers and ignition switch. It is not necessary to take off the right-hand cover from the engine to remove the condensers or the contact-breaker assembly, but it must be if the ignition switch is to be removed.

The condensers can be freed by slackening the small screws which hold their clips in position on the right-hand cover, disconnecting the leads from the fixed-point bracket. When ordering replacements it is important to state whether long or short leads are required. When refitting the condensers, make sure there is good contact between the clip and the condenser body or intermittent misfiring may result.

To clean and replace the points, it is advisable to remove all leads from the points for the sake of accessibility. If the right-hand cover is left in position the back plates should be removed complete, but if the cover has been taken off, work on the points can be carried out without any danger of a washer being drawn into the rotor by the magnetic field.

To remove the back plates complete, undo the three socket-headed screws

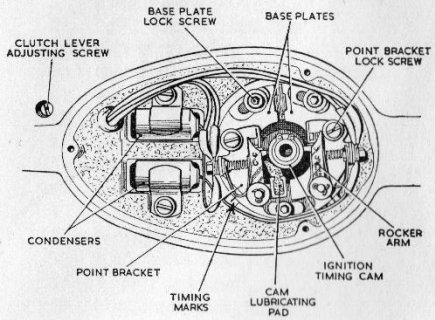


Fig. 15
Drawing showing the various component parts of the Villiers contact-breaker assembly

and withdraw the plates, each with its individual contact breaker, from the right-hand cover. Before proceeding further, loop a piece of cotton around the contact-breaker springs to avoid losing them. Take out the point adjusting screw and the split pin from each of the rocker spindles and the contact breakers can then be lifted clear of the spindle. If the points are burned, they can usually be rubbed flat on a smooth carborundum stick. Badly pitted or burned points will need renewing and may indicate the need for new condensers.

Fitting new points can be tricky and the best method is to place the fixed-point bracket over the rocker-pivot spindle and lock it lightly in position with the point-bracket adjuster screw. Pass the terminal-post screw through one hole in the bent copper strip, passing the screw from the inside of the "U" so the threaded portion faces outwards. Sandwich the copper strip by fitting the double-diameter insulating washer to the terminal-post screw with the larger diameter against the copper strip. The smaller diameter of the insulating washer is then fitted into the drilled hole in the point bracket and the large insulating washer fitted over the screw, so that in its turn the terminal post is sandwiched. Attach the terminals of the cut-out, coil and condenser and tighten the nut. Thread a piece of string through a coil in the spring. Place one end of the spring on the end of the terminal screw and locate the other end on the pimple on the rocker. Carefully compress the spring and fit the rocker to its pivot. Gently ease the rocker down the pivot and fit the retaining washer and split pin. Refit the cover and retime the engine.

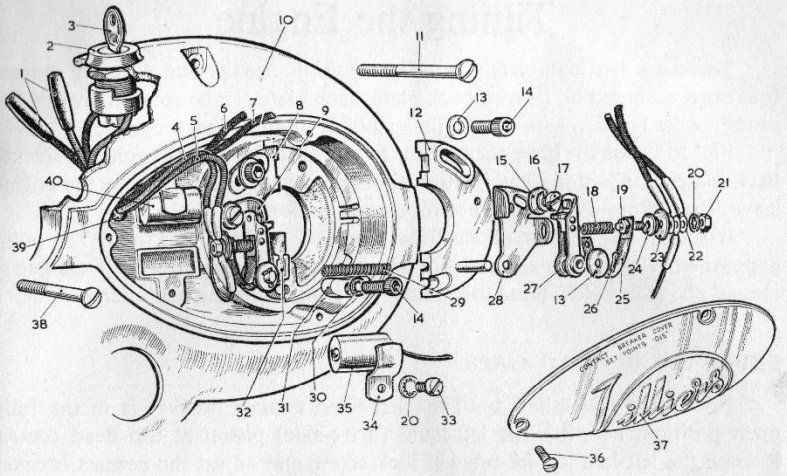


Fig. 16

CONTACT-BREAKER ASSEMBLY

1. Connector, L.T. lead (2)
2. Ignition switch
3. Ignition key (two per set)
4. Rocker lead, left-hand switch (green)
5. Rocker lead, left-hand connector (green)
6. Rocker lead, right-hand switch (blue)
7. Rocker lead, right-hand connector (blue)
8. Contact-breaker base plate, left-hand
9. Point bracket, left-hand
10. Right-hand cover
11. Right-hand-cover screw (2)
12. Contact-breaker base plate, right-hand
13. Washer (4)
14. Base-plate fixing screw (3)
15. Brass washer (2)
16. Point bracket-screw washer (2)
17. Point-bracket lock screw (2)
18. Rocker spring (2)
19. Point-bracket pin (2)
20. Shakeproof washer (4)
21. 4.B.A. nut (2)
22. Shoe, L.T. and condenser leads (6)
23. Fibre washer (2)
24. Fibre bush (2)
25. Rocker connecting strip (2)
26. Rocker-pivot split pin (2)
27. Rocker arms (2)
28. Point bracket, right-hand
29. Base-plate spring
30. Base-plate shakeproof washer
31. Base-plate clamp
32. Oil pad
33. Condenser-clip screw (2)
34. Condenser clip (2)
35. Condenser, long lead
36. Nameplate screw, right-hand cover (3)
37. Nameplate, right-hand cover
38. Right-hand-cover screw
39. Rubber grommet
40. Condenser, short lead

Timing the Engine

There are two completely separate ignition circuits and as each contact breaker is mounted on its own back plate, each plate can be rotated around the centre of the ignition cam to give independent timing of each cylinder.

Fig. 16 shows the three socket-headed screws which lock the contact-breaker back plates in position. The ignition timing is accurately set before the engine leaves the factory and should not require alteration.

It is essential to keep all electrical connections clean and tight. The point gaps when fully open must measure between ·012 in. and ·015 in. If the gap is altered above or below these tolerances, the ignition timing will alter.

SETTING THE POINT GAPS.

Rotate the crankshaft until the left-hand contact breaker is in the fully open position, i.e. with the left-hand (drive-side) piston at top dead centre. Release the left-hand point-bracket lock screw and adjust the contact-breaker point gap to between ·012 in. and ·015 in. When this is done, lock the screw in position and recheck the gap. This is essential as the action of locking the screw may alter the gap. Repeat the operation with the other gap when the right-hand piston is at top dead centre. It is essential that each point is accurately set before attempting to time the engine.

IGNITION TIMING.

There are two methods of timing the ignition. Of the two the angular measurement is preferred, but if an engine is installed in a motor-cycle frame it is not always possible. Whichever method is adopted, however, accuracy is essential or the performance of the engine will suffer.

The pistons of the Mark 4T engine do not come to the top of the cylinder bores when they are in the top-dead-centre position. The primary requirement is, therefore, to establish top dead centre of the stroke. This is required whether the timing is by the angular method or by measurement from the cylinder.

To time the ignition by the angular method, rotate the crankshaft until the left-hand piston is as near top dead centre as possible. Fit a degree plate to the drive side of the crankshaft and lock in position with the zero mark roughly aligned with the cylinder. Fit a piece of stiff wire to a bulldog paper clip, clip it to a fin and align the pointer roughly with the zero mark (Fig. 17). Place a nut on the piston and a straight edge across the bore and rotate the engine on each side

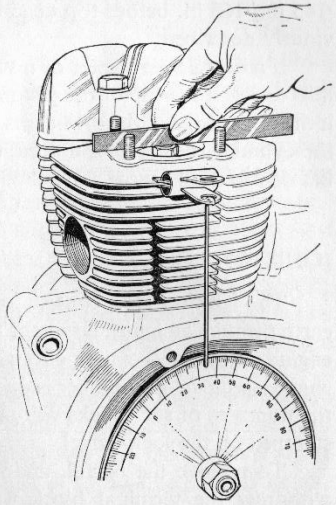


Fig. 17
Timing the ignition by the angular method, using a degree plate clipped to the finning and a nut on the piston crown

of the zero mark until the nut touches the straight edge. The mean of the two readings will indicate accurately top dead centre or zero degrees. **Note:** It is not necessary to move the disc, but simply to alter the position of the pointer.

Next rotate the crankshaft until the engine is 26 degrees below top dead centre. At this position the points should be commencing to break. This will not, however, be an obvious movement of the points and the break can be determined by two methods, undoubtedly the best of which is to pass current from a torch battery across the points to an electric bulb, the light of which will go out when the points have broken sufficiently to trigger the ignition. The other method is to place a cigarette paper between the points so that it is gripped, the point of ignition being reached when the points open sufficiently to enable the paper to be withdrawn without tearing.

In both cases, if the point of breaking does not coincide with the angular timing of 26 degrees, then the screws locating the back plate must be loosened and plate rotated around the cam until the correct opening is obtained.

If the linear method is used, rotate the crankshaft until the piston is approximately at its highest position in the cylinder bore and attach a dial gauge to the cylinder so that its stylus rests on the piston. Set the gauge so that at top dead centre it registers zero. Rotate the crankshaft so the points commence to break as described previously. The points should open at a clock reading of

·145 in./·165 in. before top dead centre. If not they should be adjusted as previously described.

If a depth micrometer or a vernier is used, the amount by which the piston fails to reach the top of the piston should be added to the dimensions given, i.e. if the upper edge of the cylinder is ·020 in. above the piston and the upper edge of the cylinder is used as a datum, then the points should open ·165 in./·185 in. before top dead centre.

IGNITION LOCK.

The ignition lock consists of a means of turning the primary current to earth through an ignition switch. Two keys are normally supplied with every new engine. Other keys can be obtained from the Villiers Service Department if the engine specification number is quoted. New locks can be obtained, but naturally the numbers of such locks will not be recorded. The lock number, however, is stamped on the lock barrel.

To remove the barrel, undo the screw retaining the ignition contact bar, withdraw the terminal block with terminals attached over the lock barrel. The barrel itself can then be withdrawn. The lock body is attached to the right-hand cover and retained by a single nut.

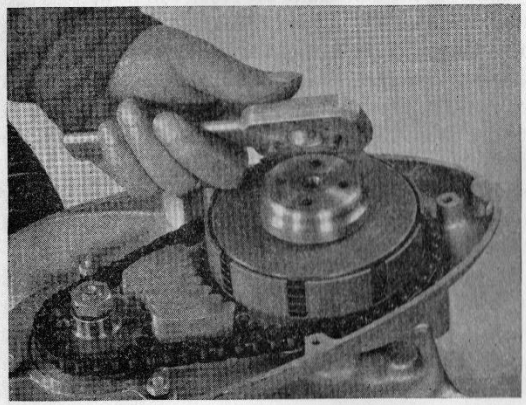


Fig. 18
Using a peg spanner, ST. 2552, on the clutch cap nut. Note the sprocket locking tool in position

Stripping the Clutch

Before dismantling the clutch take out the chaincase drain plug and drain off the oil. The outer chaincase is retained by five countersunk screws, which vary in length. A note made of their relative positions during stripping will save time and trouble during reassembly. Remove the joint washer which is normally secured in place with fixative. These washers usually distort when removed, but if laid flat under cardboard may be used again provided they are not damaged.

Turn the engine on its side with the clutch and engine sprockets uppermost and fit a sprocket locking tool, ST.2585B, between the teeth of the engine sprocket and the clutch sprocket. With a ring spanner unlock the central clutch-adjusting screw and unscrew the adjuster from the cap nut with a screwdriver. Locate two pegs of the peg spanner, ST.2552, in the holes in the clutch cap nut and tighten the centre bolt which threads into the adjuster-screw hole in the cap nut (Fig. 18). Fit a Villiers "Hammertight" spanner to the peg spanner and hammer the cap nut free. The cap nut threads onto the clutch sliding sleeve and unscrews anti-clockwise. It will be screwed up extremely tightly and has the pressure of the clutch operating spring against it. If the engine is to be overhauled use the "Hammertight" spanner to slacken the engine-sprocket retaining nut. It is not necessary to remove the sprocket before taking off the inner chaincase.

Once the cap nut is removed the clutch driving and friction plates can be withdrawn from the clutch cage (Fig. 19) and washed in petrol.

Retain the sprocket locking tool in position and fit a clutch-sleeve locking

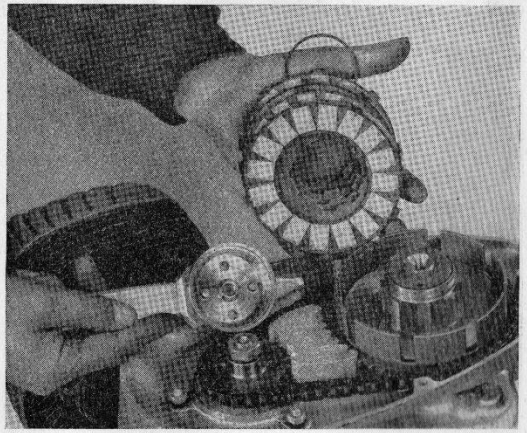


Fig. 19
Clutch cap released and the driving and friction plates removed from the clutch cage

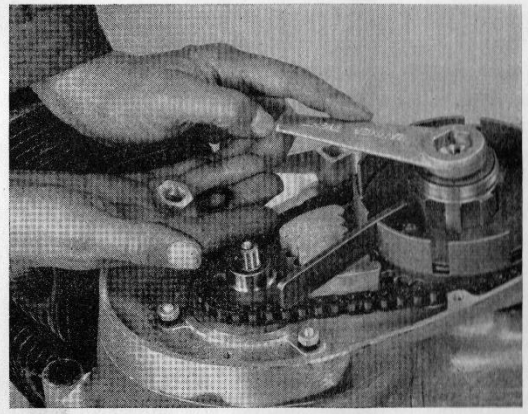


Fig. 20
Sprocket locking tool, clutch-sleeve locking plate and a "Hammertight" spanner being used to free the clutch centre retaining nut

plate, ST.2551G/1, over the splines of the sliding sleeve so that the extended handle fits into the slots in the clutch outer cage. This prevents the sleeve turning when the large centre retaining nut is undone with the "Hammertight" spanner (Fig. 20). The nut also unscrews anti-clockwise.

After removing the centre nut, the sliding sleeve, together with the inner springs, can be slid from the clutch hub. The hub is also splined to the mainshaft and can be lifted from the splines (Fig. 21). Ease the clutch backplate from the mainshaft and this will reveal a copper shim, which should be removed with great care as it covers 24 $\frac{3}{16}$ in. $\times$ $\frac{3}{16}$ in. rollers (Fig. 22). Lift off the chainwheel and

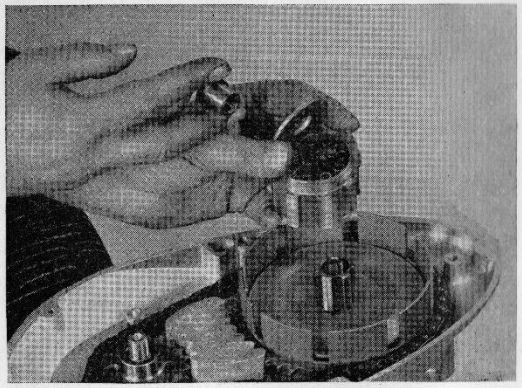
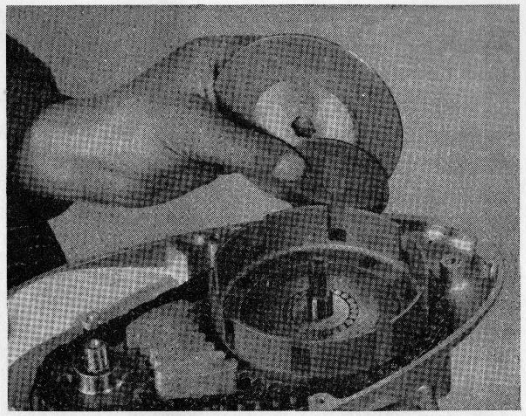


Fig. 21
Lifting the clutch sliding sleeve, with the inner springs, off the clutch hub

Fig. 22
Removal of the clutch backplate and the copper shim reveals the 24 rollers which comprise the clutch bearing

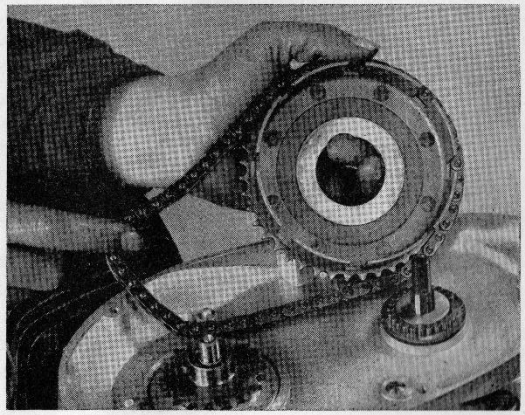


leave the rollers on their inner cage (Fig. 23). Remove the inner roller race with the rollers and place in a suitable container (Fig. 24).

The engine sprocket is located on the driveshaft by a key and can be pulled from the shaft after removing the hexagon nut. If tight, it may be necessary to use a sprocket extractor, ST.2587D.

On Siba-equipped engines the clutch is dismantled in the same manner, but there is a single adjusting shim under the clutch-cap nut which is *not* interchangeable and should never be dispensed with. A special cap tool removes the cap nut and the spring retaining sleeve nut.

Fig. 23
Careful removal of the chainwheel and chain leaves the rollers on their inner cage



The pressure plate, too, can only be fitted one way, with the machined inside face against the first friction plate. It is not flat when removed from the clutch assembly and is dished in the centre.

The friction plates are of solid material and the intermediate plates have radial slots machined in them. They operate in the same manner as the standard variety.

Two large coil springs, one within the other, complete the difference.

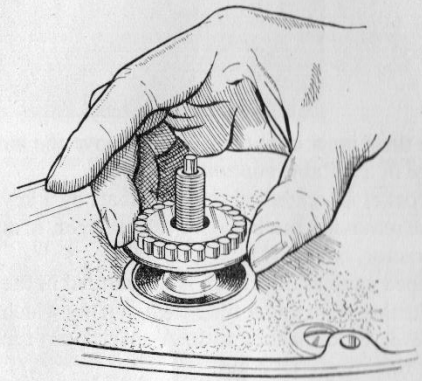


Fig. 24
Lifting the clutch inner roller race, with the 24 rollers, from the clutch shaft

Inner Chaincase

The inner chaincase is held in position at the rear by a $\frac{1}{4}$ in. dia. stud which passes through a hole in the lug on the top of the gearbox shell. At the forward end of the chaincase around the engine sprocket are three studs with nuts and washers. Two countersunk-headed screws are located behind the clutch sprocket. When all of these retaining devices are removed the chaincase can be lifted over the engine boss.

Complete Overhaul

If the engine is to be completely stripped down, the magneto, clutch and primary drive and gearbox should be removed before the cylinder heads and cylinders are taken off. This will protect the pistons from damage while the other assemblies are being removed.

When these assemblies have been removed take off the cylinder heads, cylinders and pistons, as described in the chapter on "Top Overhaul", and lift the sealing plate from the top of the crankcase. The object of this plate, which has a paper gasket above and below it, is to seal off each crankcase and prevent leakage between them. The gaskets can usually be peeled off, but if they are stuck together immerse the plate in boiling water and scrub them off. This method is far more effective than trying to scrape them off.

The crankcases are joined at the engine centre line and are held together by six studs with a washer and nut at either end. After removing the nuts and washers, four studs will pull out quite readily. The remaining two act as dowels and are a tight fit. Tap them out using a suitable pin punch, taking care not to damage the dowel holes. The magneto-side driveshaft is supported by a roller

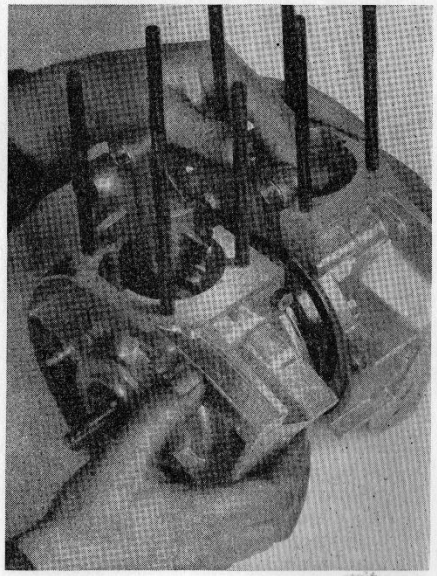


Fig. 25
Easing the connecting rod through the slot in the crankcase when splitting the two crankcase halves

bearing, the outer race of which is an interference fit in the crankcase. The inner race and roller cage is a press fit on the shaft. Tap the crankcase with a hide mallet to remove the magneto-side crankcase and lift away, easing the connecting rod through the slot in the case (Fig. 25).

Before the crankshaft assembly can be freed from the left-hand, or drive-side, crankcase, the hexagon-headed pinch bolt, which fits into a trunnion and clamps the centre plate in position, must be removed (Fig. 26). The socket-headed screws retaining the centre plate in position can then be released. Having removed the three socket-headed screws, fit two of them into the adjacent threaded extractor holes in the centre plate. By screwing up each a little at a time the centre plate will be eased from the crankcase (Fig. 27). Once removed, tap the crankshaft from the crankcase, remembering to hold the connecting rod in the bottom-dead-centre position and guide the rod through the slot in the case as the assembly comes free. One bearing will be left behind in the crankcase, secured by a circlip. With this circlip removed and the crankcase warmed to about 200° C. (392° F.), the bearing will drop out when the crankcase is tapped, open-face downwards, on a flat block of wood. If the oil seal requires renewing, tap it out gently with a suitable drift while the cases are warm.

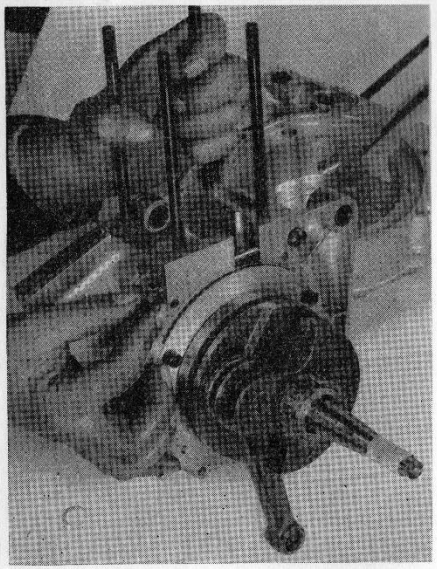
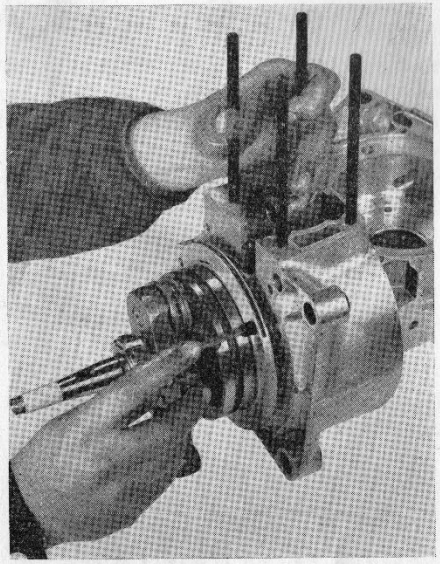


Fig. 26
To release the crankshaft assembly the pinch bolt in the left-hand crankcase must first be removed

Fig. 27
Using the centre-plate retaining screws in the extractor holes to assist in removing the centre plate



With Siba-equipped engines, the crankcases may be parted, once the gearbox is removed, in the same way as the motor-cycle units, except that the right-hand side has an extra R320 (20 mm. × 52 mm. × 15 mm.) bearing, retained in the crankcase by a circlip, supporting the right-hand crankcase. The inner race and rollers are press fits on the shaft. When dismantling the crankshaft, removal of the pinch bolts frees the Siba or right-hand side. To remove the outer races, extract the inner circlip, heat the case to 150° C. (302° F.) for ten minutes in an oven and the innermost race will drop out if the crankcase is tapped inner-face downwards on a wooden block. The outer of the races can then be tapped out of case working from the inside outwards. The bearings are extracted from the shaft with a bearing extractor. It is not necessary to remove the other two circlips in the Siba-side of the crankcase.

Crankshaft Assembly

The crankshaft assembly requires specialised equipment to undertake repairs. It is, therefore, recommended that apart from removing bearings from the outer ends of the shaft, the work should be entrusted to an authorised dealer of Villiers-engined vehicles.

Service-exchange crankshaft assemblies are available from any Villiers spares stockists.

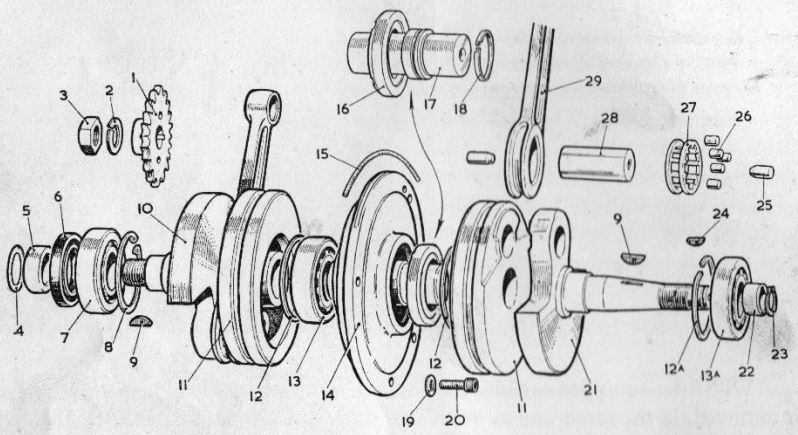


Fig. 28

CRANKSHAFT

1. Engine sprocket (20T)
2. Crankshaft spring washer
3. Crankshaft nut
4. Engine shim (as reqd.)
5. Engine distance piece
6. Crankcase oil seal
7. Crankshaft ball bearing
8. Crankshaft-bearing circlip (Seegar)
9. Engine key (2)
10. Crankshaft, left-hand
11. Crankshaft centre wheel (2)
12. Crankshaft-bearing circlip (3)
13. Crankshaft roller bearing (2)
14. Crankcase centre plate
15. Crankcase centre-plate sealing rubber
16. Crankcase centre-plate adaptor
17. Crankshaft centre
18. Crankcase centre-plate sealing ring
19. Crankcase centre-plate washer (3)
20. Crankcase centre-plate screw (3)
21. Crankshaft, right hand
22. Cam, ignition
23. Circlip
24. Key, ignition cam
25. Crankpin plug (4)
26. Crankpin rollers (18)
27. Big-end cage (2)
28. Crankpin (2)
29. Connecting rod (2)
— Crankshaft nut, right-hand (4T/SRK)

Crankcase Reassembly

Heat the drive-side crankcase to 130° C. (266° F.). Fit the oil seal from the inside of the crankcase and push it home until it presses against the inner lip of the crankcase. Fit the outer bearing into the crankcase and secure in position with a circlip.

In a similar manner insert the circlip into its groove and fit the outer race of the magneto-side roller bearing from the exterior of the crankcase, ensuring that it fits firmly against the circlip. Reheat the drive-side half of the crankcase and allow the magneto side to cool.

When the drive side is again hot enough, place the crankcase half, open side up, on a flat surface, preferably with a hole to accommodate the protruding end of the shaft. Smear a little fixative on the spigot and joint face of the centre plate and lower the shaft end into the ball bearing. At the same time position the left-hand connecting rod so that it will pass through the slot in the crankcase.

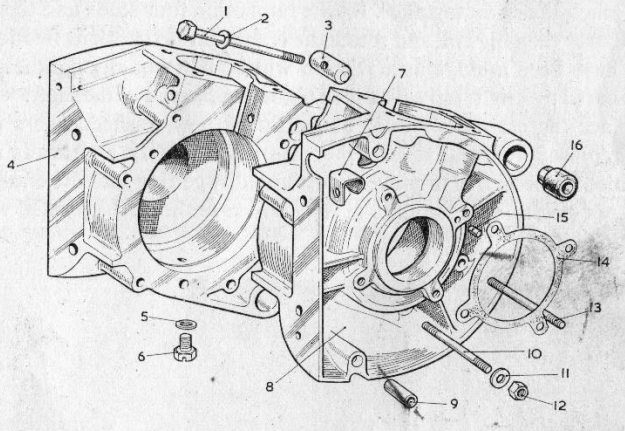


Fig. 29

CRANKCASE

1. Crankcase pinch bolt
2. Crankcase pinch-bolt washer
3. Crankcase pinch-bolt trunnion
4 & 8 Crankcase, left and right-hand (pair)
5. Crankcase-drain and level-screw washer (2)
6. Crankcase-drain and level screw (2)
7. Cable clip
9. Crankcase dowel, right-hand (2)
10. Crankcase fitting stud (2)
11. Crankcase washer (12)
12. Crankcase nut (12).
13. Crankcase fixing stud (4)
14. Armature-plate joint washer
15. Armature-plate dowel
16. Crankcase-mounting bush (4)

Turn the centre plate to bring the three screw holes in line with the holes in the crankcase and ensure that the rubber insert in the centre plate is uppermost and facing the open crankcase mouth. Start the three screws about three threads each and with a hide mallet tap the exposed shaft down into the crankcase. Lightly do up the three screws and tap the shaft home again. When the shaft is fully home, further tighten the screws.

Place the pinch-bolt trunnion in position, fit the pinch bolt and secure to a torque-wrench setting of 80 lb./in. Fully tighten the screws and check that the crankshaft revolves freely.

Smear a fixative on the joint face of the magneto-side crankcase and the outer diameter of the centre plate. Hold the crankshaft in a vertical position and lower the crankcase over the shaft onto the bearing. If an attempt is made to reverse the procedure, the bearings will tend to prevent the cases being fitted. Guide the connecting rod through the slot in the case and push the two halves together. Gently tap the two dowel pins through the cases and after fitting the nuts and washers pinch the cases together. Fit the remaining four studs and tighten. Pour a little oil over each big end and rotate the crankshaft to check its freedom. If new oil seals have been fitted, a little friction will be felt, but any tightness can generally be cured by a light tap with a hide mallet on the end of the shaft.

Replace the crankcase drain plugs, fitting new washers where necessary. Having replaced the crankshaft, the pistons, cylinders and heads should be reassembled immediately to prevent dust and dirt getting into the crankcase, but if this is not possible the mouths of the crankcase should be packed with clean, but not fluffy, rags.

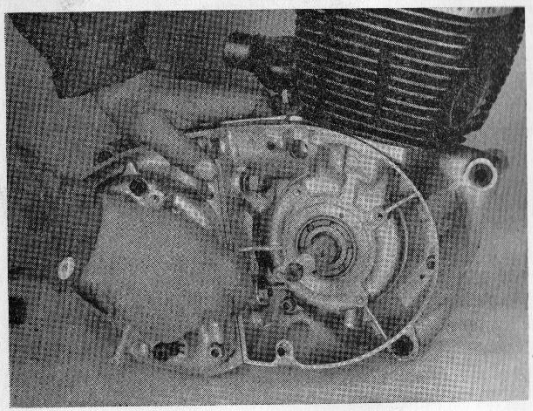


Fig. 30
The gearbox attached to the crankcase by four studs and nuts

Gearbox

There are two methods of dismantling the gearbox, one being to detach the complete gearbox from the engine and treat it as a separate sub-assembly, and the second to take the gearbox internals out with the gearbox still attached to the engine crankcase. Obviously the second method is the one to adopt when the engine is in the frame, but it entails "blind" assembly and should be used only when the circumstances dictate.

The gearbox is attached to the crankcase by four studs and nuts and is located by two dowels (Fig. 30). Take off the nuts and washers and lightly tap the gearbox away from its mating face on the crankcase. A number of paper washers will be found between the machined surface of each component (Fig. 31). These have the dual function of acting as a joint washer and as shimming to tension the primary chain. Remember how many washers are used and make sure the same number are replaced on assembly. The clutch push rods and the dipstick should be removed before dismantling the gearbox.

To extract the gearbox internals, remove the two bolts and undo the nuts from the three studs which secure the end cover in place. Lightly tap the protruding mainshaft to push the end cover off the locating dowels (Fig. 32). If light pressure is retained on the mainshaft, the end cover can be withdrawn complete with the gear cluster, leaving only the output-sleeve pinion, speedometer drive and the spring-loaded cam-barrel plunger in the gearbox.

The output sleeve pinion may be removed from the gearbox shell by undoing the small locking screw which retains the final-drive nut in position.

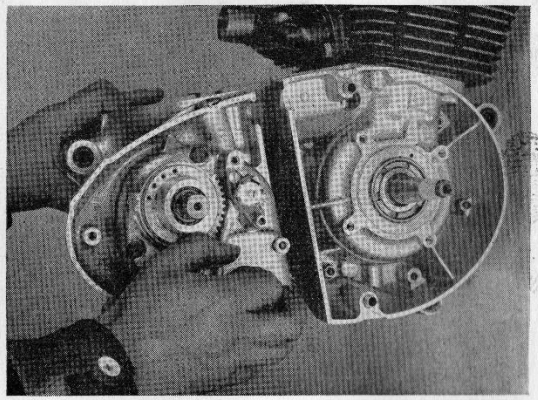


Fig. 31
Paper joint washers between the gearbox and crankcase also act as shimming to tension the primary chain

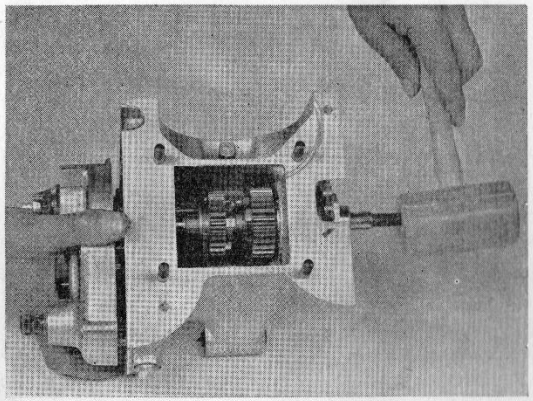


Fig. 32
Removal of the gear cluster is facilitated by tapping the end of the mainshaft with a hide mallet

Undo the final-drive nut and slide the final-drive sprocket from its splines. Push the sleeve gear inwards and it will slide from the double row of rollers which support it. The rollers and thrust washer should remain in position. It is not necessary to remove the output sleeve gear unless the dogs on its periphery are worn. To remove the bearing take out the thrust race and the rollers. The small thrust race fitted into the output sleeve gear is not replaceable.

The mainshaft, layshaft and cam barrel can be removed from the end cover after the split pin and gear-indicator pinion have been removed from the

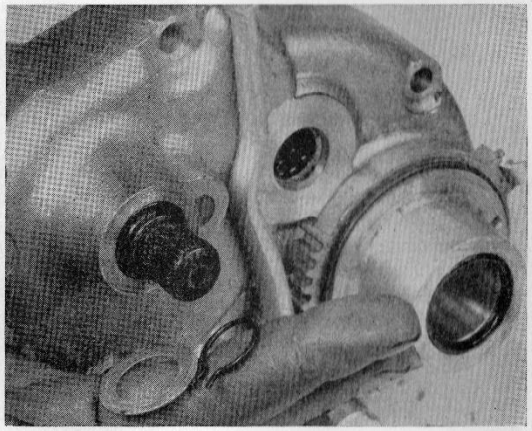


Fig. 33
Removal of the circlip and washer from the gear-change spindle. The rubber "O" ring is still in position

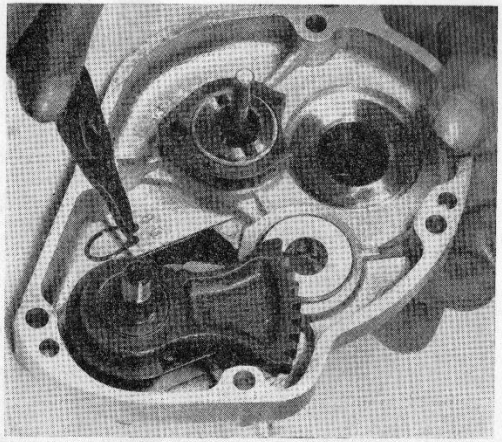


Fig. 34
Releasing the Seegar circlip which holds the gear-change quadrant in position

extension to the cam barrel. The layshaft and mainshaft clusters can then be lifted from their forks and examined.

END-COVER ASSEMBLY.

The end cover contains the gear-selector and kickstart mechanisms and the bearings for the mainshaft, layshaft and cam barrel. The kickstart shaft can be withdrawn from its bush if it has not already come away with the layshaft as the gear cluster was withdrawn. Take care not to lose the large rubber "O" ring.

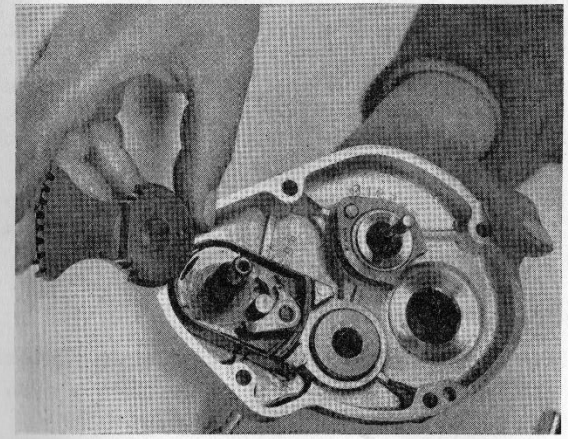


Fig. 35
Ratchet and quadrant assembly removed to show the gear-control pawls and pawl spring

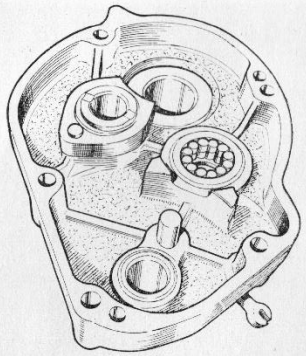


Fig. 36
Cam-barrel bearing assembly

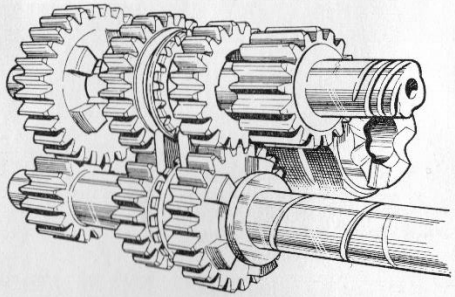


Fig. 37
Drawing showing the build up of the gear cluster

To remove the gear-change mechanism, expand the circlip from the spindle and take off the washer and rubber "O" ring (Fig. 33). Remove the Seegar circlip holding the quadrant in position (Fig. 34) and the ratchet and quadrant assembly may be lifted clear, revealing the gear-control pawls and pawl spring (Fig. 35). The pawls and spring can be lifted from the spindle assembly.

The cam-barrel bearing assembly is freed by taking off the thrust race and removing the 24 $\frac{3}{16}$ in. $\times$ $\frac{3}{16}$ in. rollers (Fig. 36).

GEARBOX EXAMINATION.

Examine the output sleeve gear for wear on the dogs and make sure that the ball thrust race is in good condition. Examine the bushes within the bore of the sleeve gear for wear and the teeth for wear or bruising. The pinions with dogs should be examined in a similar manner. The sliding pinions without dogs should have the teeth and splined bores examined and the mainshaft and lay-shaft should be checked for wear, bluing or roughness in the splines.

The cam-barrel forks should have clean, smooth bearing marks, with no scuffing or bluing. The forks should revolve freely in the cam tracks and unless roughness is experienced need not be stripped further.

REASSEMBLING GEARBOX.

These instructions have been written on the assumption that the gearbox has been stripped with the exception of the fixed bushes, cam-barrel bearing pin, thrust washer and the two end-cover locating dowels.

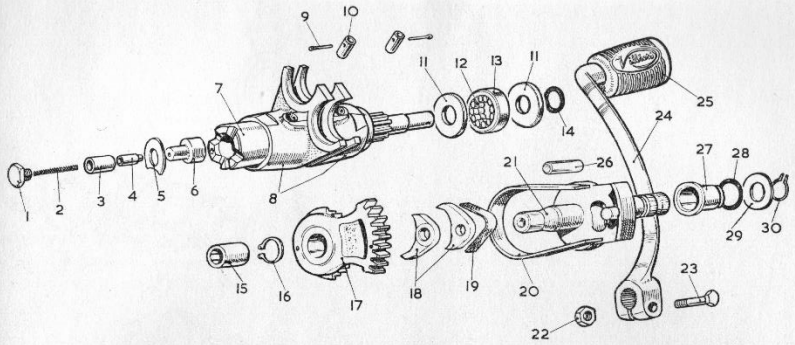


Fig. 38

GEAR-CHANGE MECHANISM

1. Cam-barrel-plunger end plug
2. Cam-barrel-plunger spring
3. Cam-barrel-plunger bush
4. Cam-barrel plunger
5. Cam-barrel thrust washer
6. Cam-barrel-bearing pin
7. Cam barrel
8. Sliding-gear forks (2)
9. Sliding-gear guide split pin (2)
10. Sliding-gear guide peg (2)
11. Cam-barrel thrust washer (2)
12. Cam-barrel roller (24)
13. Cam-barrel-bearing outer race
14. Cam-barrel "O" ring
15. Gearbox bush
16. Gear-change-spindle circlip
17. Ratchet assembly
18. Gear-control pawl (2)
19. Gear-control-pawl spring
20. Gear-control spring
21. Gear-change-spindle assembly
22. Gear-change-lever nut
23. Gear-change-lever bolt.
24. Gear-change lever
25. Gear-change rubber
26. Gear-control stop pin
27. Spindle bush
28. Gear-change "O" ring
29. Gear-change-spindle washer
30. Gear-change-spindle circlip

Warm the gearbox casing to 155° C. (311° F.) and insert the output sleeve-gear bearing outer race and push home. Allow the gearbox to cool and fit the 38 rollers which support the output sleeve gear, holding them in position with grease. Grease the cam-barrel plunger bush and offer the spring and plunger into the orifice (Fig. 40). It will not go fully home, but will go far enough for it to be left. Slide the thrust race over the output sleeve gear and insert the sleeve gear into the rollers and push firmly home (Fig. 41).

Press the sleeve-gear oil seal into the gearbox, wrapping a layer of transparent sealing tape on the splined extension of the sleeve gear to prevent damage to the seal. Ensure that the seal fits squarely with the open side facing the sleeve-gear bearing.

Fit the final-drive sprocket with the boss towards the seal, followed by the

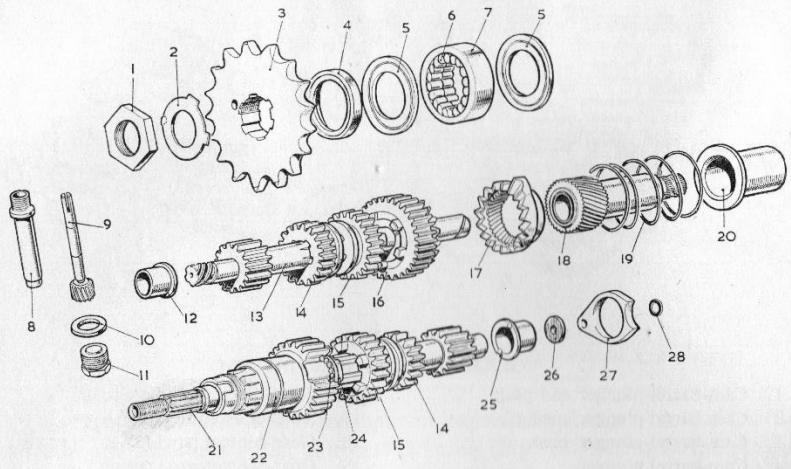


Fig. 39

GEAR CLUSTER

1. Final-drive-sprocket nut
2. Final-drive-sprocket lockwasher
3. Final-drive sprocket (18T)
4. Mainshaft oil seal
5. Mainshaft-bearing thrust washer (2)
6. Mainshaft roller (38)
7. Mainshaft-bearing outer race
8. Speedometer-drive worm-wheel bush
9. Speedometer-drive worm wheel
10. Speedometer-drive housing-plug washer
11. Speedometer-drive housing plug
12. Layshaft bush
13. Layshaft
14. Sliding gear without dogs (2)
15. Sliding gear with dogs (2)
16. Kickstart-ratchet pinion
17. Kickstart ratchet
18. Kickstart shaft
19. Kickstart-ratchet spring.
20. Kickstart shaft-housing bush
21. Mainshaft
22. High-gear pinion
23. High-gear ball thrust race (16)
24. Mainshaft pressure washer
25. Mainshaft bush
26. Mainshaft rubber washer
27. Kickstart-ratchet stop
28. Sealing washer

lockwasher with the tang turned into the locating hole in the sprocket. Fit the locknut to the threaded end of the sleeve gear and tighten to a torque figure of 1000 lb./in. Turn over the edge of the lockwasher against the flats on the locknut and fit a joint washer to the end-cover joint face.

The remainder of the gearbox internals are built into the gearbox end cover. Grease the cam-barrel outer race and fit the 24 $\frac{3}{16}$ in. $\times$ $\frac{3}{16}$ in. rollers, followed by the cam-barrel thrust washer.

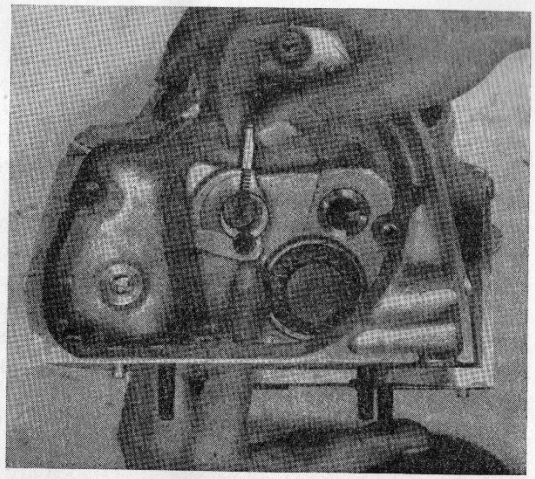


Fig. 40
Inserting the spring and plunger during gearbox reassembly

Lubricate the spindle of the gear change quadrant and locate the spindle in the bush. Place the rubber "O" ring over the splined portion of the spindle and push it into the recess in the cover until it lies flush. Fit the retaining washer and circlip and force the circlip down into its groove. There are two grooves and the circlip fits into the one furthest from the splines. Place the larger gear-control

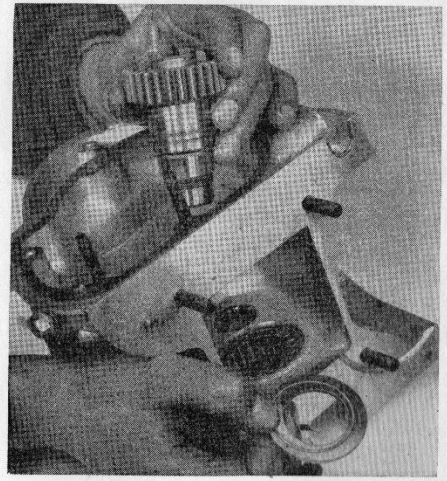


Fig. 41
Sliding the thrust race in position before inserting the the sleeve gear into the roller bearing

spring over the spindle assembly and push it down until it lies flush with the bosses around the cam-barrel bearing.

Push the two gear-operating pawls on the small pivot on the spindle assembly. The longer legs of each pawl should face outwards and the left-hand pawl should be fitted first, so that it lays under the right-hand pawl and nearest to the quadrant (Fig. 35). Once the pawls are in their correct position, ease the pawl spring over the pawls. The object of the spring is to force the outer legs of the pawls towards each other. Fit the quadrant over the spindle, ensuring that the pawls engage with the ratchet, and secure the quadrant with the "Seegar" circlip. Finally, in preparation to receive the gear cluster, operate the mechanism until the marked tooth on the quadrant aligns approximately with the centre of the cam-barrel bearing, place the end cover, open-face uppermost, between soft jaws of a vice and pinch gently to secure in this position. This will leave both hands free to assemble the gear cluster.

First assemble the mainshaft with sliding gears to the cam barrel and insert the kickstart spindle into its bush. Lower the cam barrel and the mainshaft into their respective bearings, ensuring that the marking on the cam barrel coincides with the marked tooth on the quadrant (Fig. 42). If the two are lined up, the

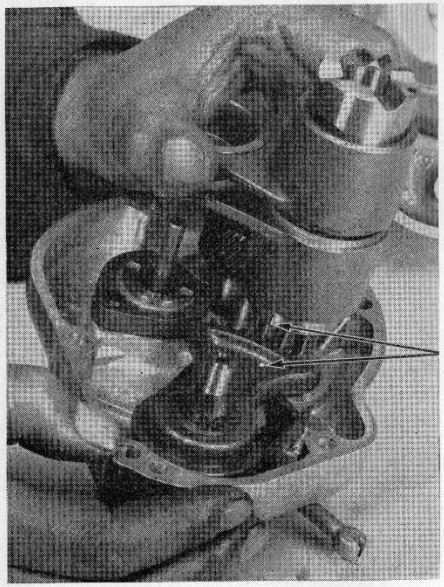


Fig. 42
Location marks on the cam barrel and quadrant must coincide to ensure correct gearbox timing

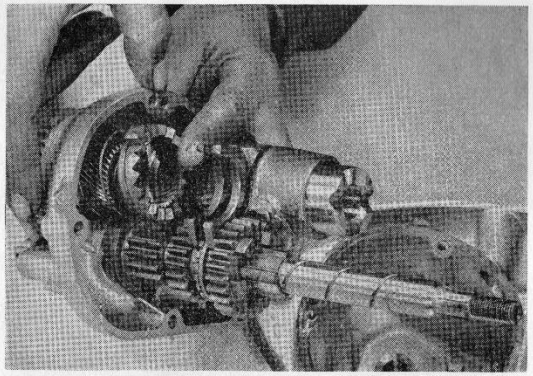


Fig. 43
Engaging the kickstart ratchet with the helical gear

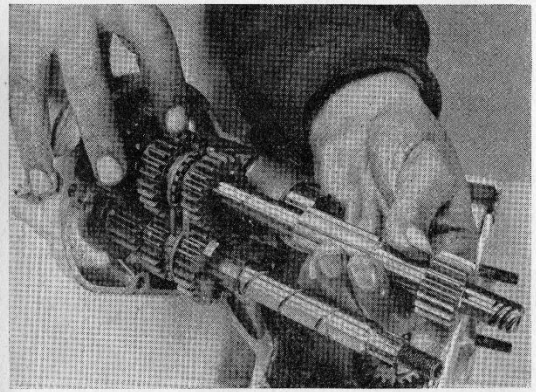


Fig. 44
Fitting the layshaft into the gear cluster before locating it in the end-cover bush

gearbox will be correctly timed. Fit the kickstart-ratchet spring over the helical gear on the kickstart spindle and engage the kickstart ratchet with the helical gear (Fig. 43). Hold the ratchet against the pressure of the spring and place the kickstart pinion in position. Fit the layshaft sliding gears to their respective forks and wriggle the layshaft down through the cluster until the layshaft is fully home in the end-cover bush (Fig. 44). Fit the thrust washer to the end of the mainshaft .

Take the end cover with the gear cluster (Fig. 46), and feed the mainshaft into the high-gear pinion already located in the gearbox shell and carefully push the assembly fully home. The "window" of the gearbox will facilitate correct alignment (Fig. 47). If the end cover fails to press home, turn the final-

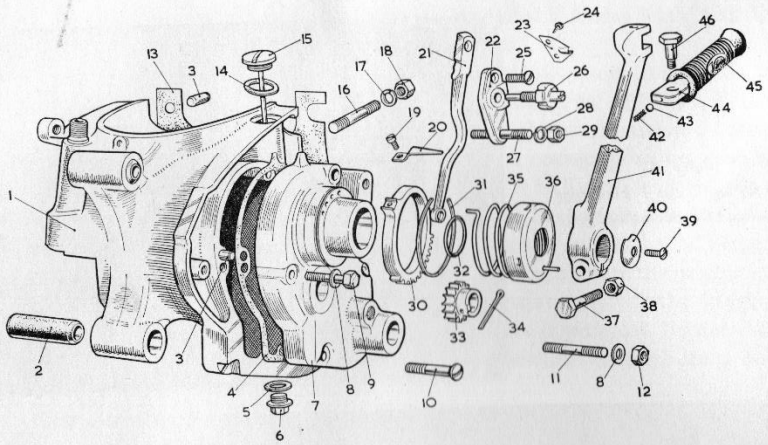


Fig. 45

GEARBOX SHELL and KICKSTART UNIT

1. Gearbox
2. Mounting-lug bush (2)
3. Gearbox end-cover dowel (4)
4. Gearbox end-cover gasket
5. Gearbox end-cover drain-plug washer
6. Gearbox end-cover drain plug
7. Gearbox end cover
8. Gearbox end-cover washer (4)
9. Gearbox end-cover bolt (2)
10. Gearbox end-cover screw
11. Gearbox end-cover stud (2)
12. Gearbox end-cover nut (2)
13. Gasket (as required)
14. Gearbox end-cover washer
15. Dipstick and knob
16. Gearbox/crankcase stud (4)
17. Gearbox end-cover washer
18. Gearbox end-cover nut (4)
19. Gear indicator-pointer screw
20. Gear-indicator pointer
21. Clutch lever
22. Clutch bridge
23. Clutch-adjuster lockplate
24. Clutch-adjuster lockplate screw (2)
25. Clutch-bridge screw
26. Adjuster screw
27. Kickstart-stop stud
28. Clutch-bridge washer
29. Clutch-bridge nut
30. Gear-indicator ring
31. Gear-indicator circlip
32. Kickstart-shaft "O" ring
33. Gear-indicator pinion
34. Gear-indicator split pin
35. Kickstart-lever return spring
36. Kickstart-lever return-spring cover
37. Kickstart-lever gear-change bolt
38. Kickstart-lever gear-change nut
39. Kickstart end-cover screw
40. Kickstart-shaft washer (4T/SRK)
41. Kickstart lever
42. Kickstart-pedal spring
43. Kickstart-pedal ball
44. Kickstart pedal
45. Kickstart-lever rubber
46. Kickstart-pedal pivot pin

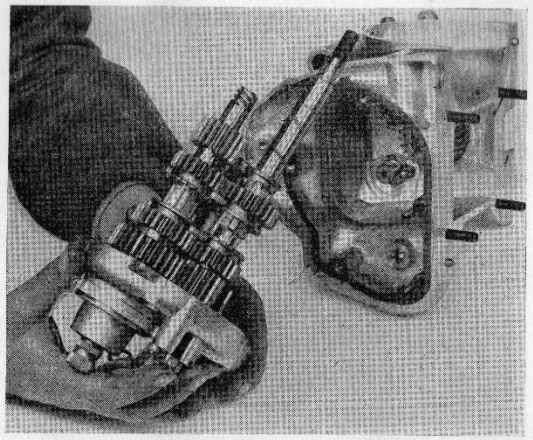


Fig. 46
End cover with gear cluster ready for inserting in the gearbox shell

drive sprocket and the protruding end of the mainshaft until it does so. Lightly tighten the three nuts and check the operation of the gearbox. Until this is assured, it is pointless to continue with the building.

When everything is correct, place the oil seal over the protruding portion of the cam barrel and fit the gear-indicator pinion, the boss of which has a punch mark on one tooth and should face outwards. The punch mark must be in line with and on the same side as the groove on the end of the shaft (Fig. 48). When

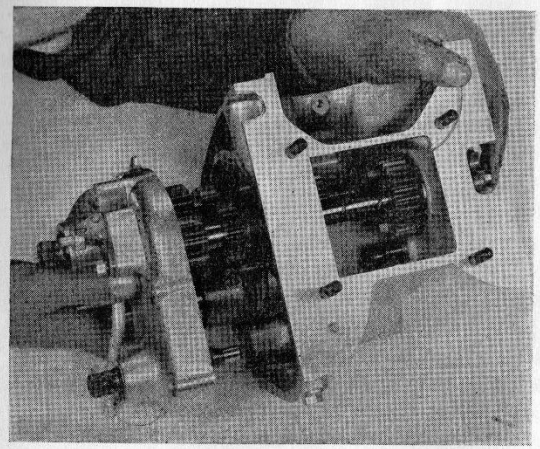


Fig. 47
The "window" in the gearbox enables the operator to align the mainshaft with the high-gear pinion

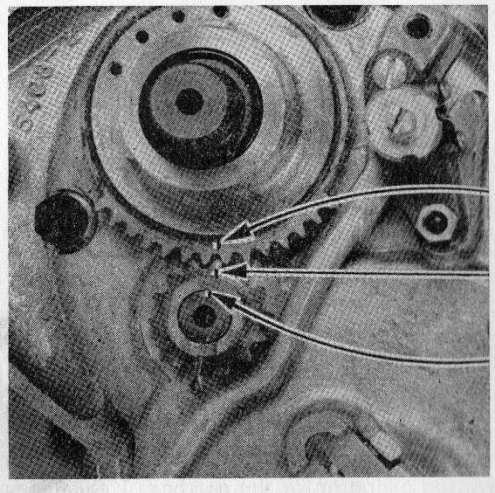


Fig. 48
Correctly aligned timing marks

in this position secure it with a split pin which should have its ends splayed open. If the gear-ring indicator has been disturbed, it must be refitted with the punch marks on the ring and gear-indicator pinion aligned. Finally replace the oil drain plug and oil filler-plug dipstick.

CLUTCH BRIDGE—SIBA-EQUIPPED ENGINES

This component on Siba-equipped engines is slightly different from that on the standard motor-cycle units owing to its different usage.

The means of adjustment, however, is the same, but instead of a spring and the dimpled adjuster nut, a centre screw with locknut is fitted, enabling the spring to be dispensed with.

Additionally, a small thrust race is fitted to the larger ($\frac{1}{4}$ in. dia.) push rod. The push rod has a collar integral with the rod, the rod protruding beyond the collar by approximately $\frac{1}{8}$ in. Over the protruding portion is fitted to a hardened thrust race, followed by a small roller race and another steel thrust race. This assembly is placed in a cap having a slot for the clutch lever to operate on. The cap has a circlip groove placed around its inner periphery and the circlip when fitted retains both races and roller bearing in position. A small hole is drilled through the side of the thrust cap and breaks into the groove, enabling a piece of wire to be pushed through the hole to release the circlip.

NEUTRAL-INDICATOR SWITCH—SIBA-EQUIPPED ENGINES

This fitting is also special to engines fitted to three-wheeler and light cars. The cam barrel has an extension in the form of a shaft integral with the cam barrel which extends through the gearbox and cover. To this is fitted a cam, the apex of which is coincidental with the neutral position. As the cam barrel selects gears by rotating, it must move into one of five positions, counting the neutral. A live wire is taken to a terminal tag and is kept insulated from the gearbox. The tag has a protruding "pip" which matches the peak of the cam in neutral and allows the current to earth through the engine unit, illuminating the neutral indicator.

On the gearbox end-cover casting, adjacent and to the rear of the protruding end of the cam barrel, is a boss drilled with two holes. To this are attached the neutral-indicator wire and the earthing strip. The order of assembly is shown in Fig. 49, the upper fixing being by a screw passing through the spring and engaging in the upper hole from the back of the lug. The insulating bush is placed over this protruding screw. For the lower fixing, the screw is passed through the double-diameter insulating bush and the bush and screw are fitted into the earthing strip. Fit the lead behind the strip, followed by the plain insulating washer and screw it into the lower hole of the lug from the front. The hole in the upper end of the earth strip should then be looped over the upper insulating bush and the lower screw clamped tight.

1. Clutch bridge
2. Washer
3. Bolt
4. Adjuster screw
5. Locknut
6. Stud
7. Circlip
8. Collar
9. Thrust race (2)
10. Thrust bearing
11. Housing
12. Screw (3)
13. Spring
14. Insulator
15. Contact
16. Cam
17. Washer
18. Bush
19. Cable (8″) assembly
20. Gearbox end cover

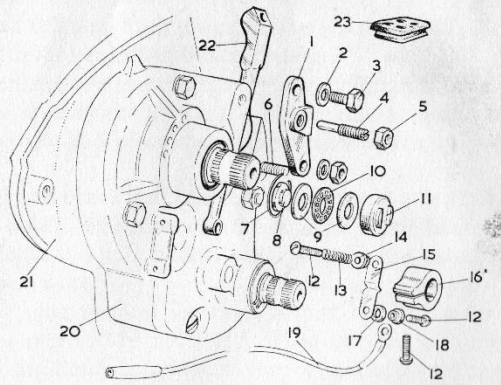


Fig. 49
GEARBOX END COVER (SIBA EQUIPMENT)
21. Gearbox 22. Lever 23. Grommet

Select neutral gear and check by turning the final-drive sprocket manually. This will bring a marking on the protruding end of the cam barrel roughly horizontal. Fit the cam with the indent on one lug so that it locates with the "pip" on the earthing strip and tighten the clamp screw. The contact to control the switching of the light is adjustable by the upper screw and spring.

To check the adjustment, which must be done before fitting the right-hand cover, join a piece of wire from a torch battery to the "live" lead fitted to the contact strip and take an earth return from the battery to a torch-bulb body and earth the bulb on the engine. If the contact strip and cam are in the neutral position the bulb will light. If it does not, adjust the cam or strip until the bulb lights up.

SPEEDOMETER DRIVE.

On three-wheelers the speedometer usually operates independently of the engine, but on the motor-cycle version it is built into the gearbox. The drive is taken from the layshaft fixed pinion to the speedometer-drive pinion and by a short spindle to a worm gear. The worm gear drives a worm wheel and shaft, into which is tongued the drive to the speedometer cable.

If it is necessary to dismantle the speedometer drive it should be noted that the housing plug has a left-hand thread.

Rebuilding the Engine

Once the crankcase and cylinders have been reassembled, provided no other work is required on the gearbox or clutch, the remainder of the rebuilding can be completed.

The same number of joint washers as were originally fitted should be used between the gearbox and crankcase joint faces, but if the washers have been destroyed and the number forgotten a trial assembly of the gearbox and clutch will be necessary as the washers act as shims to determine the tension of the primary chain. The method of determining the number of washers required is only effective in the case of unworn primary chains and it is always advisable to use a new chain to be certain of the correct tension. Worn or hooked sprockets, which also affect chain tension as well as cause rapid chain wear, should be renewed.

Most engines require two joint washers between the gearbox and crankcase and it is important to fit at least one. Commence with two washers and fit the gearbox to the crankcase and tighten the four securing nuts. Turn the engine on its side with the gearbox mainshaft facing as near vertical as possible. Fit the paper joint washer behind the inner chaincase half over the crankcase boss and locate the chaincase inner half over the boss and gearbox mainshaft.

Secure the chaincase in position with the three nuts and spring washers, two screws and single bolt. Fit the distance piece on the driveshaft and push fully home. Before fitting, make sure the distance piece is clean and undamaged otherwise damage to the oil seal is likely. Push the engine-sprocket key into the keyway and fit the sprocket with the projecting boss outwards.

Slide the clutch inner-roller race complete with rollers on the gearbox mainshaft and fit the clutch cage and primary chain by locking the chain on the clutch cage and over the engine sprocket and place the chainwheel over the rollers (Fig. 23).

Hold the chainwheel firmly and check the chain tension by moving the chain up and down between the sprockets. The movement should be approximately $\frac{1}{4}$ in. If the movement is less remove a joint washer from between the gearbox and crankcase; if greater add a washer.

The maximum number of paper washers permitted is four, but with a new chain it is unlikely that this number will be necessary. When satisfied with the chain tension the remainder of the clutch components can be refitted, but if the shim behind the engine sprocket and distance piece has been lost or damaged, or if the engine sprocket has been replaced, it will be necessary to check the alignment of the chain. To do this fit the sprocket and the chainwheel without

the chain and with the engine sprocket held firmly against its boss and the chainwheel against the inner roller race place a straight edge across the flats of both sprockets and check the alignment. Any necessary adjustments can be made by placing the appropriate thickness of shimming under the engine sprocket.

Before reassembling the clutch components should be cleaned in white spirit or petrol and when dry examined for burrs on the clutch-plate tangs or signs of hammering within the cage. These can be removed with a small file and will improve the action of the clutch. Clutch drag caused by scuffing on the clutch hub can be eliminated by smoothing on a carborundum stone. The associate inner tangs on the plain intermediate plates should be cleaned up where necessary.

Examine the friction plates for wear and if the overall width of each plate, including the friction material, is less than ·105 in. they should be changed.

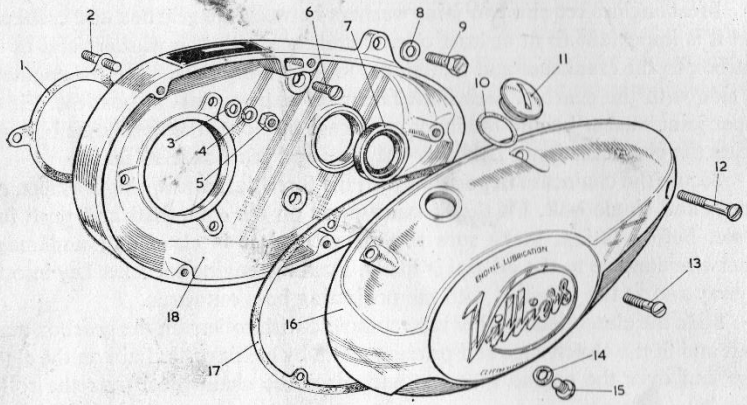


Fig. 50
CHAINCASE

1. Chaincase/crankcase gasket
2. Chaincase fixing stud (3)
3. Chaincase fixing-stud washer (3)
4. Chaincase fixing-stud spring washer (3)
5. Chaincase fixing nut (3)
6. Chaincase fixing screw (2)
7. Chaincase oil seal
8. Chaincase fixing-bolt washer
9. Chaincase fixing bolt
10. Chaincase filler washer
11. Chaincase filler plug
12. Chaincase-cover screw (2)
13. Chaincase screw, short (4)
14. Chaincase level-screw washer
15. Chaincase level screw
16. Chaincase, outer half
17. Chaincase gasket
18. Chaincase inner half

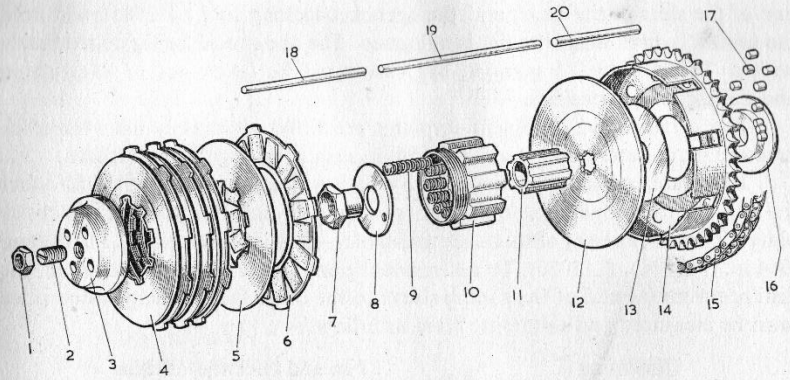


Fig. 51
CLUTCH and PRIMARY-DRIVE

1. Clutch-adjuster locknut, internal
2. Clutch-adjuster screw, internal
3. Clutch-cap nut
4. Clutch pressure plate
5. Clutch plate, intermediate (3)
6. Clutch plate, driving (4)
7. Clutch chainwheel centre nut
8. Clutch washer
9. Clutch springs (9)
10. Clutch sliding sleeve
11. Clutch hub
12. Clutch backplate
13. Clutch-backplate shim
14. Clutch-chainwheel assembly
15. Clutch chain (60 pitches)
16. Clutch-chainwheel centre
17. Clutch rollers (25)
18. Clutch push rod
19. Clutch push rod
20. Clutch push rod

Packing piece, sliding sleeve (as reqd.)

Distorted clutch springs must also be renewed but if assembled properly their life will equal that of the engine.

When the primary chain and clutch cage is fitted to the clutch-roller race, apply a small quantity of graphite grease between the rollers and inner and outer tracks.

Place the copper shim over the mainshaft and fit the clutch backplate, dished face outwards, to the splines on the mainshaft. Place the clutch hub on the splines and fit the sliding sleeves with its springs. Thoroughly grease the springs and interior of the sleeve before fitting the spring retaining washer and hexagon-headed centre nut. The small hole in the spring retaining washer enables a short length of $\frac{3}{16}$ in. diameter rod to be inserted through the washer into the centre of one of the clutch springs. This will prevent the washer rotating and damaging the clutch springs as the centre nut is tightened. Service tool ST.2551C/1, fitted over the sleeve with the extended portion passing through

one of the slots in the cage, and the sprocket-locking tool ST.2585B will hold the assembly firm while the nut is tightened. The nut should be tightened firmly with a "Hammertight" spanner, but care must be taken not to overtighten and damage the mainshaft.

The driving and intermediate plates are fitted alternately with the thick pressure plate outermost. Insert the clutch push rods into the mainshaft.

To ensure correct operation of the clutch it is necessary to fit shims under the cap nut to compensate for variations in the overall thickness of the clutch plates. Two thicknesses of shims are available—·048 in. (Part No. E.11019) and ·064 in. (Part No. E.11020). To determine the amount of shimming required, the distance from the end of the sliding sleeve to the outer face of the pressure plate must be measured and shimming fitted as follows:

Dimension	No. and thickness of shim
$\frac{9}{32}$ in. or less	2–·048 in.
$\frac{5}{16}$ in.	1–·064 in.
$\frac{11}{32}$ in.	1–·048 in.
$\frac{3}{8}$ in. or over.	None.

Fit and tighten the cap nut using a clutch spanner and a "Hammertight" spanner. Refit the sprocket nut and tighten with the "Hammertight" spanner. Remove the sprocket-locking tool and rotate the crankshaft a few times to check for freedom of movement. Make sure there is the right amount of end float on the gearbox mainshaft.

CLUTCH ADJUSTMENT—MOTOR-CYCLE ENGINE.

After rebuilding the clutch or replacing new clutch plates, it is necessary to readjust the clutch. Slacken the locknut fitted to the screwed adjuster which is sited in the centre of the clutch cap nut. The adjuster determines the amount of push-rod protrusion from the gearbox end cover necessary to control the lift of the pressure plate.

If new fraction linings are fitted, screw the adjuster in or out until the push rod protrudes $\frac{9}{32}$ in. from the end cover (Fig. 52). If the existing friction plates are used the protrusion should be $\frac{5}{16}$ in. The difference between the two dimensions is to allow for "bedding down" of the friction material. Make sure that the push rods are touching each other and are against the cap-nut adjuster by applying finger pressure to them before the dimension is taken.

When satisfied, tighten the locknut, ensuring that the adjuster screw does not move, fit the clutch lever and clutch bridge and complete the rest of the assembly.

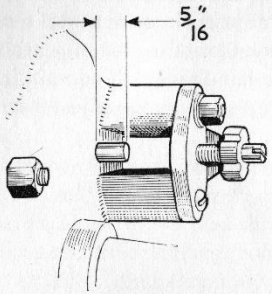


Fig. 52 (above)
Clutch adjustment for the motor-cycle engine

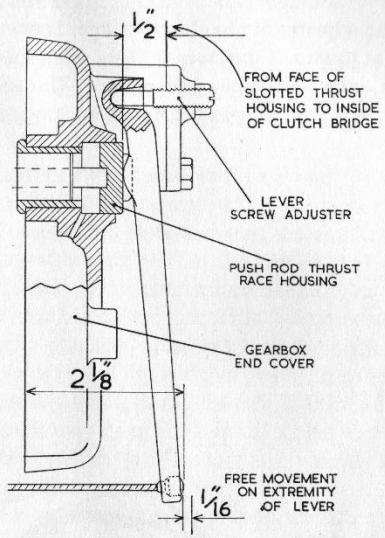


Fig. 53 (right)
Clutch adjustment for the three-wheeler engine

If the engine has been removed from the machine, the remainder of the clutch adjustment must wait until the engine is replaced in the frame.

Refit the clutch cable to the clutch lever and insert a screwdriver into the hole in the right-hand cover and turn the adjuster clockwise until the lever touches the end of the slot in the cover. Turn the adjuster anti-clockwise to give approximately $\frac{1}{8}$ in. free movement at the end of the lever before it presses on the push rod. This movement will have to be felt, but it will also give an $\frac{1}{8}$ in. free movement at the handlebar lever provided the cable run is smooth and free from tight bends.

CLUTCH ADJUSTMENT—THREE-WHEELER VERSION.

Owing to the clutch push-rod thrust race and different clutch bridge, the adjustment on Siba-equipped engines varies from that for the standard motor-cycle unit. Slacken the cap-adjuster locknut and screw the adjuster in or out until the lower face at the bottom of the slot recessed into the push-rod thrust-race cap is exactly $\frac{1}{2}$ in. away from the inner face of the clutch bridge (Fig. 53). Tighten the locknut, making sure the cap-nut adjuster does not rotate.

Fit the clutch cable and clutch operating lever and slacken the locknut retaining the adjuster in the clutch bridge. Screw the adjuster in or out until the outer edge at the tip of the lever is $2\frac{1}{8}$ in. from the inside face of the lug of gearbox and cover, into which the cable is sited. The vehicle handbook will contain instructions on the clutch-pedal adjustment. Lock the nut securing the adjuster screw.

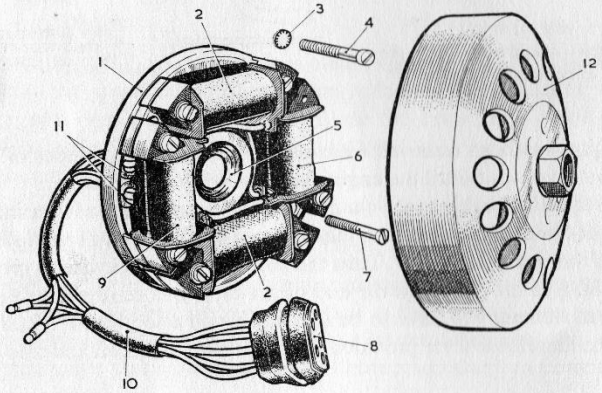


Fig. 54

FLYWHEEL and ARMATURE PLATE

1. Armature-plate assembly
2. Lighting coil (1 pr.)
3. Shakeproof washer
4. Coil fixing screw (8)
5. Armature-plate oil seal
6. Energising coil
7. Armature-plate screw (4)
8. 5-way connector with pins
9. Energising coil
10. Harness complete (less connector)
11. Armature-plate grommet (2)
12. Flywheel rotor complete

Refitting Magneto

Examine the coil seal fitted to the stator plate and renew if necessary. This oil seal prevents air leaking into the crankcase. While the stator plate is separated from the crankcase, examine the wiring attached and ensure that all joints are secure.

A paper washer is fitted between the right-hand crankcase and the stator plate. A small dowel determines the correct position in which the stator plate is secured. Four screws pass through the stator plate and into the crankcase.

Tuck the wires leading from the stator plate behind the clip secured to the upper gearbox mounting stud and lead the wiring loom behind the small projecting boss immediately above the clutch bridge. This will prevent the wiring fouling the flywheel and being pinched when refitting the right-hand cover. Fit the key to the crankshaft keyway and tap it down gently. It should be positioned with the upper side as near as possible parallel to the crankshaft axis, not to the taper of the shaft, otherwise it may be pushed out of its keyway when the rotor is screwed on. Offer up the flywheel to the shaft and visually check that the keyway passes over the key as the rotor is slid on.

Tighten the centre of the flywheel, preferably using a strap wrench to hold the rotor whilst the nut is being tightened to a torque figure of 750 lb./in. If a torque wrench is not available, the nut may be tightened with a "Hammertight" spanner, but excessive force should be avoided.

When fitting the small key in the shaft in readiness for the ignition cam take care that it is a tight fit in the keyway, or it may disappear inside the rotor as soon as it is released. The ignition cam is split longitudinally and a small screwdriver fitted into the slot will enable the cam to be pushed on easily. The cam has a direction arrow stamped on the outside and should be fitted so that the recessed position faces the rotor, i.e. innermost. It is secured by a circlip. When fitted rotate the circlip to make certain it is correctly located in its groove.

Take the right-hand cover and remake the "snap" connections between the contact breaker and stator cables, taking care to match the colours. Slide the loose P.V.C. sleeve over the connectors. Fit the multi-pin plug to the right-hand cover and carefully push the wiring into position, ensuring that it is not pinched as the cover is fitted, particularly between the rear fixing-screw bosses. Push the right-hand cover gently into retaining dowels and fit the retaining screws. Care must be taken when fitting the cover to avoid fouling the rocker-arm heel on the cam. The secret is to part the points against the pressure of their respective springs as the cover is offered up. Ensure that the felt lubricating pad is to the left of the cam so that in effect it is trailing.

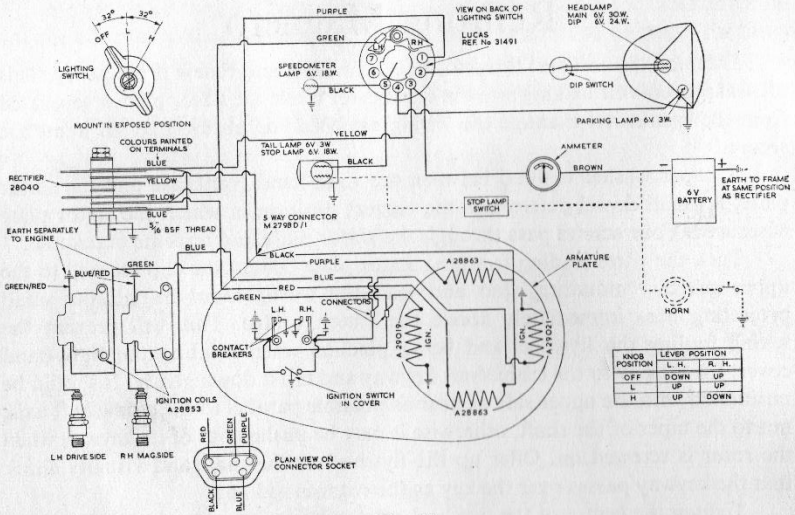


Fig. 55
Wiring diagram 40605

Wiring Circuits

The importance of good connections between rectifier, battery and coils cannot be over-emphasised and where a rectifier is suspect the connections should be carefully examined before it is scrapped and replaced with a new one.

If the earth on a charging coil is suspect, check with a small bulb and lead to one wire of the coil using the engine as the earth. If the bulb lights the coil is earthing out. The continuity may also be tested with an ohmmeter.

The reversal of battery leads is dangerous and can cause damage to the units as can running the engine without a battery. If it is ever necessary to run the engine without a battery, the headlights must be turned on before starting the engine and the engine speed kept very low or the bulbs may burn out. An alternative is to remove the two A.C. connections to the rectifier.

The diagram of the electrical system fitted will be given in the vehicle manufacturer's handbook. If this is not available reference can be made to the appropriate diagram in this manual, bearing in mind that while the basic circuit will be applicable there may be differences in the colour coding of cables and details of switches.

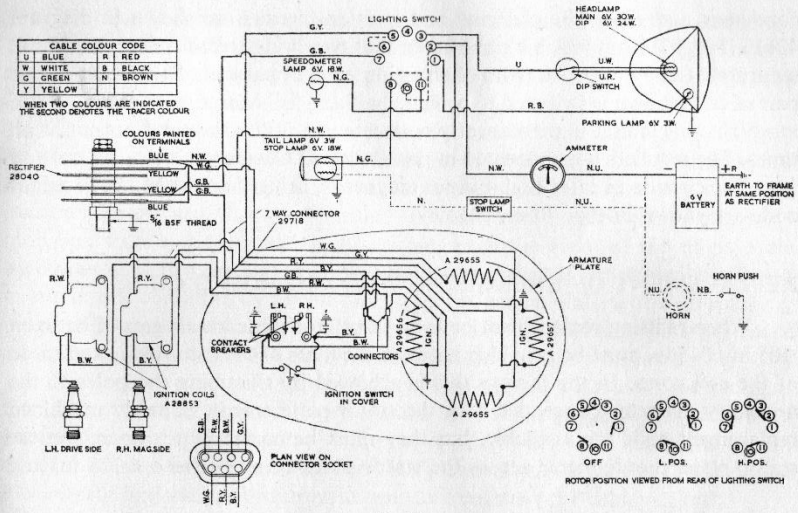


Fig. 56
Wiring diagram 40687

STANDARD MOTOR-CYCLE CIRCUIT.

The charging system uses a full-wave, bridge, solenium rectifier with four terminals and a centre bolt forming the positive earth connection in common with that of the battery. The two outer connections to the rectifier are negative and are linked together. The two inner connections are the A.C. input terminals to which one charging coil is directly connected to provide the "daylight" charge. The second charging coil is connected in parallel with the first to provide the full charge by means of additional contacts on the main lighting switch which are closed when the switch is in the "head" position. Separate external ignition coils are provided, each being controlled and fed by its own contact breaker and energising coil respectively. Diagrams 40605 (Fig. 55) and 40687 (Fig. 56) are both applicable to standard motor-cycle units and are functionally identical, the latter being introduced to conform to the S.M.M. & T. colour code.

HIGH-OUTPUT UNIT.

This unit has a stator designed exclusively for charging output. Ignition is by battery-type H.T. coils used in conjunction with the standard contact breakers,

condenser and cam. The charging and ignition circuits are shown in diagram 40616 (Fig. 57) from which it can be seen that two bridge rectifiers are employed, separately fed by opposite pairs of charging coils in parallel. The circuit of one pair of coils shown is switched to provide half and full charge, though on certain machines this circuit is permanently connected to utilise the total output at all times. The rectifiers are connected in parallel on D.C. side.

The circuits of later high-output magnetos, using the S.M.M. & T. colour code are shown in Fig. 70 on page 87.

REPLACEMENT OF ENERGISING AND CHARGING COILS.

When refitting replacement coils to the stator plate an air gap of between ·101 in./·015 in. must be provided between the faces of the rotor poles and those of the coil cores. In the factory this is achieved by skimming the poles to the necessary diameter concentric with the stator-plate spigot. Suitably machined replacement coils are available, but they must be correctly positioned on the stator plate, the diameter across the stator poles being between 4·715 in. and

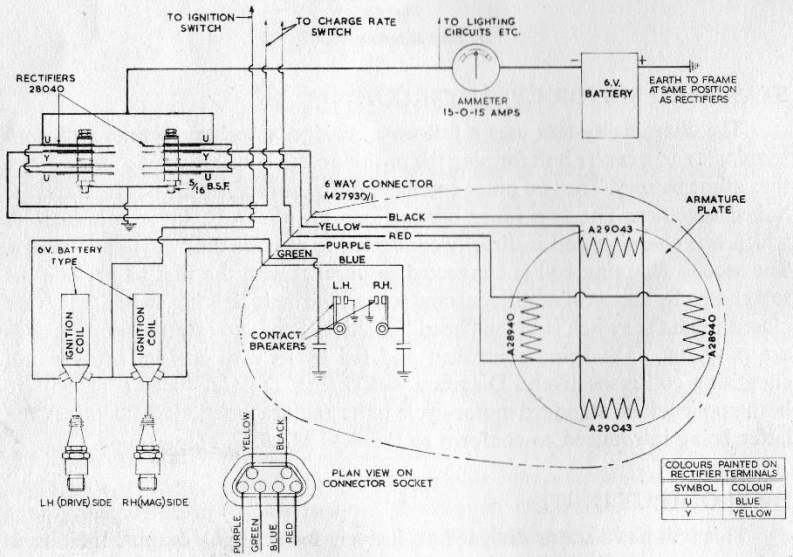


Fig. 57. Wiring diagram 40616 *for the high-output magneto*

4·710 in. If only one coil is replaced at a time it can be set accurately against the remaining coils diameter or concentricity, depending on the available instruments. Service-exchange armature plates, complete with coil assemblies, are available from any Villiers spares stockists.

The ignition energising coils are earthed at one end by a copper strip clamped between the core and plate. The separate ignition coils are also earthed to the engine and it is preferable to take two separate leads, one from each coil, to a point on the engine. It is not advisable to have the two "earths" joined by a common link with a single cable to the engine, as in the event of the single cable becoming detached the two coils will be left in series. If the engine is allowed to run in this condition there will be two sparks per revolution at each sparking plug. Although this usually gives rise to pre-ignition it does not necessary cause misfiring and may, therefore, only be detected through loss of power.

The encapsulated coils should be kept free of road dust and if located near the battery their external surfaces should be washed regularly to prevent an accumulation of acid deposits. Maintenance of this kind will lessen the risk of the H.T. spark tracking to earth. New H.T. leads should be sealed in place with a waterproofing material to prevent moisture entering the cable socket.

Rectifier Tests

A series rectifier fault will show up as a full-scale discharge reading in the ammeter, indicating that a heavy current is being returned from the battery to the charging coils. This could partially demagnetize the rotor and damage the charging coils by overheating the insulation.

For this condition to arise two cells of the rectifier have to fail and, in addition to a replacement rectifier, it may be necessary to remagnetise the rotor and renew the charging coils.

To check the cells separately with an ohmmeter, attach the meter leads to the positive stud and to one of the A.C. connections. Note the reading and reverse the cables again noting the meter reading. It can be expected that one reading will be about 100 times the value of the other. Move one meter cable to the other A.C. terminal and repeat the test.

Test the remaining cells by connecting between an A.C. terminal and a negative terminal, carrying out a reversal as before and repeat with the other A.C. and negative terminal.

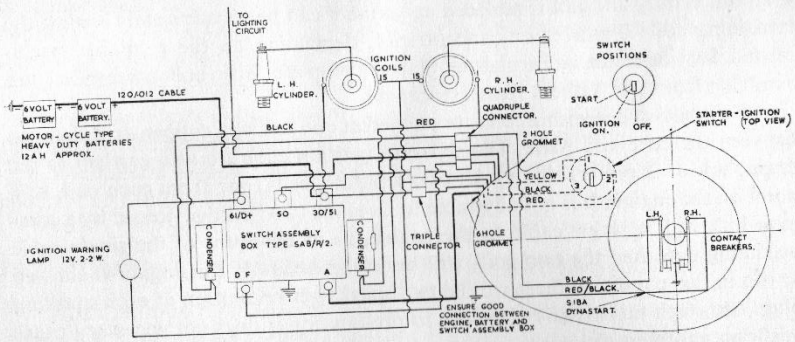


Fig. 58
Wiring diagram for Siba uni-directional equipment

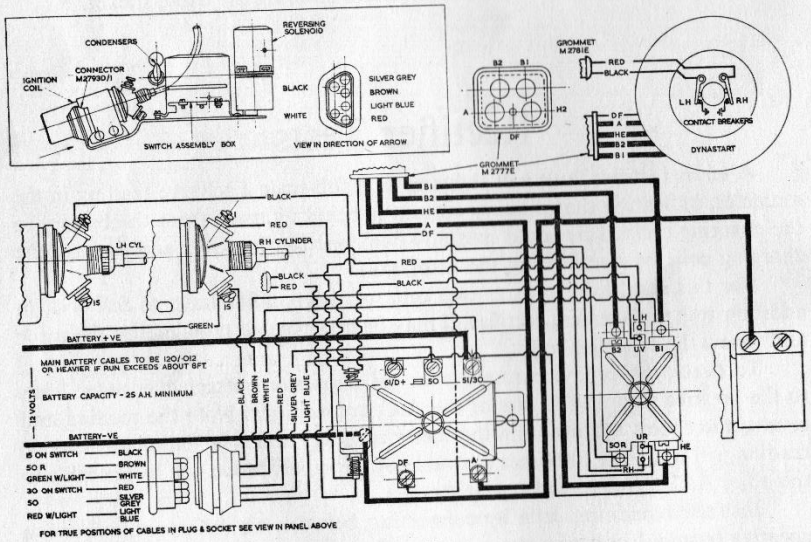


Fig. 59
Wiring diagram for Siba-reversing unit

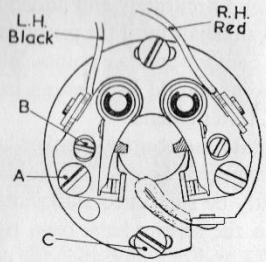


Fig. 60
Point setting for Siba units

Siba Dynastart Equipment

There are two types of Siba Dynastart, one uni-directional, the other reversible. Both have similar characteristics and apart from different switching and wiring layouts are substantially the same.

Both have ninety-watt output, with a 50 per cent overload for short periods, but it is important that the system is not persistently overloaded.

Where the reversing Dynastart is fitted, the engine must be allowed to come to rest before starting the unit in the opposite direction. If the engine fails to start and it is known the battery is not discharged, do not continue turning the starting key or serious damage may result. It is better to trace the fault. Check with the fault-finding guide and the wiring diagram.

TIMING AND POINT SETTING (UNI-DIRECTIONAL UNITS).

The contact breakers are located behind the small round cover which is secured to the Siba casing on the right-hand side of the engine. As both contact breakers are mounted on the common back-plate it is usual to check the timing using the right-hand piston as a datum. The contact-breaker point gap must first be correctly set.

To check the point gap rotate the crankshaft until the points are fully open and adjust the gap to between ·020 in. and ·022 in. by slackening screw "A" and turning screw "B" (Fig. 60) until the dimension is correct. Re-check the gap after tightening screw "A".

To set the ignition timing remove the cylinder heads and gaskets and bring the right-hand piston to top dead centre. This is a little below the top of the cylinder and if this is to be used as a datum point for measuring the piston

movement the dimension must be measured accurately and added to the timing dimension of ·172 in./·202 in. Turn the crankshaft until the piston is ·172 in./·202 in. before top dead centre and check the contact-breaker points. With the piston in this position the right-hand rocker point should be opening just sufficiently to release a cigarette paper or a ·0015 in. feeler gauge.

If the dimension does not agree, rotate the contact-breaker assembly right or left to open or close the points as required. Screw "C" holds the contact-breaker plate in position and should only be slackened sufficiently to turn the plate. Always re-check the timing when the screws have been tightened. It is advisable to check the timing of the left-hand cylinder and if it does not come within the tolerances given, the necessary adjustment must be made.

As an example, if the right-hand rocker commences to break at ·200 in. before top dead centre and the left at ·210 in., there is a difference of ·010 in. between the openings. As the mean of ·172 in. and ·202 in. is ·187 in., by setting the points to open respectively ·005 in. either side of ·187 in. an acceptable compromise ·192 in. and ·182 in. is arrived at. It is unlikely that such a degree of accuracy will be achieved but it serves to illustrate the requirements.

TIMING AND POINT SETTING (REVERSIBLE UNITS).

This is carried out in a similar manner to the uni-directional units, except that the crankshaft is rotated backwards until the right-hand piston is ·090 in./·218 in. before top dead centre, at which stage the points of the left-hand rocker should commence to open. The tolerances for forward rotation must not, however, be exceeded.

REMOVING ROCKER ARMS.

Remove the point-bracket clamp screws and extract the small circlips retaining the rockers in position. Lift off the thin steel washer from the spindle and with the aid of a small thin screwdriver lift the white plastic insulating pad out of the point bracket, an operation requiring care and patience. The complete rocker, spring and cable will then lift from its spindle, revealing another thin steel washer.

It is inadvisable to unsolder the cable from the rocker tag and if complete removal is necessary the cable should be withdrawn from the right-hand cover. If the adjustable point requires replacing, it can be lifted away as soon as the rocker is removed.

If the points are pitted or burnt, they can be rubbed flat with a carborundum stone or on a piece of emery cloth laid on a flat surface. Do not use a file.

When the points are removed, examine the cam lubricating pad and if dry apply a few drops of oil to its lower end. Ensure that the pad is in contact with the cam.

When reassembling, which is in reversed order to the dismantling, lubricate the rocker-pivot pin and push with a light lithium-base grease.

REMOVAL OF RIGHT-HAND COVER.

The right-hand cover housing the contact-breaker points and the remainder of the Siba starter unit is secured in the same way as on the motor-cycle engine. Before removing the cover or any of the other electrical components take off the battery positive lead. Failure to do this may lead to short circuiting and a possible fire, especially if a spark occurs near the carburettor.

Take off the kickstart and gear-change levers and disconnect the H.T. leads to the sparking plugs and leads to the switch-assembly box. The cover can now be removed complete with the contact-breaker assembly, switch assembly box and ignition coil.

RENEWING H.T. LEADS.

To renew the high-tension lead, unscrew the cap on the ignition coil and the sleeve and grommet will be free to slide off ready for fitting to a new cable. Push the cable end into the coil moulding, ensuring that the spark enters the cable. The cap can then be firmly screwed down over the sleeve and grommet, making a waterproof joint.

INSPECTING BRUSH GEAR (EVERY 5000 MILES).

Once the right-hand cover is removed, the ignition cam, which has an integral base, recessing into the face of the rotor, can be removed by taking out the two screws retaining the cam to the flywheel. A slot in the flange or base of the cam engages with a dowel in the rotor to ensure correct location of the cam.

The rotor is located on the shaft by a key and is retained by two mating tapers, one on the shaft and the other in the hub of the rotor. A $\frac{9}{16}$ in. box spanner will be required to loosen the nut, which unscrews leaving the rotor in position. The rotor can then be withdrawn with a special extractor, ST.1565D (Fig. 61).

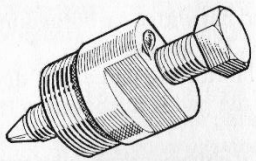


Fig. 61
Rotor extractor, ST. 1565*D.*

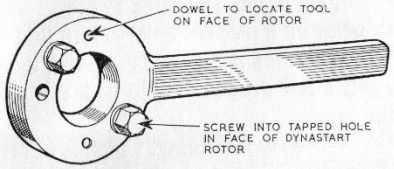


Fig. 62
*Extractor tool, ST.*1687*A.*

This screws into the body of the rotor and, by tightening the centre bolt, withdraws it from the taper on the shaft. Difficulty may be encountered in preventing rotation of the rotor whilst the extractor is tightened and service tool ST.1687A (Fig. 62) secured to the face of the rotor by two screws will simplify the task.

Replacement of the rotor is in the reverse order and the securing nut should be tightened to a torque figure of 650 lb./in. There is no washer under the retaining nut.

Take care not to damage the windings as the armature is removed. A certain amount of carbon dust from the brushes will have collected in the rotor and this should be blown off with a high-pressure air line or carefully brushed away. When cleaned, place the rotor, open face upwards, on a clean surface free from swarf or metallic particles and examine the copper commutator for wear. After a long period of use this may require skimming, but this is a skilled operation and should be entrusted to a specialist.

The brush gear and stator windings should be cleaned of all excess carbon and if the carbon brushes are worn as far as the shoulder, they must be renewed. If oil is present on the windings, clean both stator and rotor with carbon tetrachloride. Oil will cause damage and the oil leak must be traced and rectified.

Each brush is complete with spring and cable, but they are not interchangeable. The two bottom brushes have their cables coming from the left and right respectively and the cables are earthed in *uni-directional* starters to the stator by means of the screws provided. The upper pair, painted red, are *not* earthed. They have larger holes in the cable tags which fit over insulating washers above and below. These brushes also have right- and left-hand leads attached. Later types do not have "handed" brushes but the remarks concerning the difference in the tags is applicable.

When removing the cable-securing screws from the top brushes, be careful not to lose the spring washer, plain washer, fibre washer and fibre brush. These must be in good condition and be carefully replaced or there will be danger or serious damage to the unit. The screws holding the upper pair of brush leads

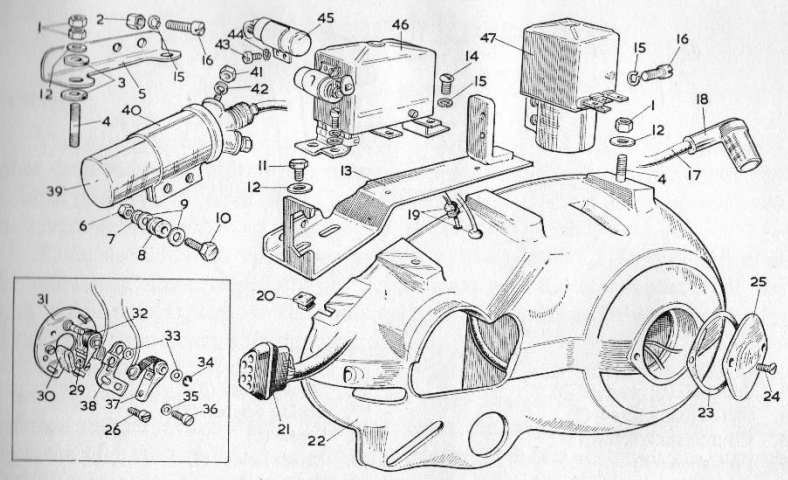


Fig. 63

RIGHT-HAND COVER FOR SIBA-EQUIPPED ENGINE

1. Nut (5)
2. Nut (2)
3. Rubber washer (4)
4. Stud (3)
5. Coil bracket
6. Locknut (2)
7. Washer, small (2)
8. Grommet (2)
9. Washer, large (4)
10. Bolt (2)
11. Bracket bolt
12. Washer (4)
13. Bracket
14. Regulator-box screw (2)
15. Spring washer (6)
16. Screw (4)
17. H.T. lead (2)
18. Waterproof cover and suppressor (2)
19. Grommet (2)
20. Indicator-cable grommet
21. Connector (6-way)
22. Cover, right-hand
23. Cover-joint washer
24. Cover screw (2)
25. Contact-breaker cover
26. Contact-breaker fixing screw (2)
29. Point bracket, right-hand
30. Oiling pad
31. Base plate with pins
32. Rocker arm with cable, right-hand
33. Washer (4)
34. Circlip (2)
35. Washer (2)
36. Point-bracket screw (2)
37. Rocker arm with cable, left-hand
38. Point bracket, left-hand
39. Ignition coil (2)
40. Support bracket (3)
41. Terminal nut (4)
42. Spring washer (4)
43. Condenser fixing screw (2)
44. Spring washer (2)
45. Condenser (2)
46. Switch, assembly-box
47. Reversing solenoid

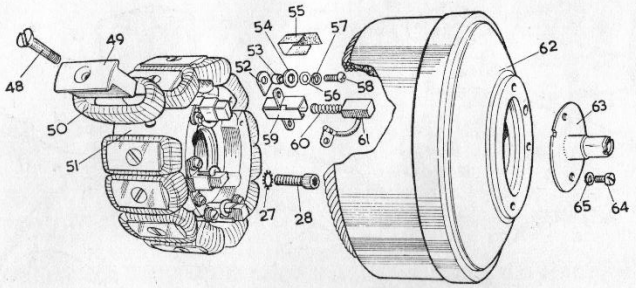


Fig. 64

SIBA DYNASTART PARTS

27. Stator-fixing washer (3)
28. Stator fixing screw (3)
48. Countersunk screw (21)
49. Pole-shoe (12)
50. Shunt or series winding (1 set)
51. Stator
52. Fibre sheath (8)
53. Fibre insert (8)
54. Fibre washer (8)
55. Insulating sheath (4)
56. Steel washer (8)
57. Spring washer (8)
58. Screw (8)
59. Brush holder (4)
60. Spring (4)
61. Carbon brush (4)
62. Armature
63. Cam
64. Screw (2)
65. Spring washer (2)

must only act as securing screws and must not be in electrical contact with the brush connection. The position of the brush-holder assemblies is carefully set during manufacture and it is vitally important that the brushes should be dealt with one at a time so that the holder assemblies are never completely removed and the original setting lost.

In the case of reversing units, the whole of the last paragraph also applies to the lower pair of brushes. The screws will be painted red, which means they are not earthed.

The brushes should slide freely in their holders with the leads close to the stator to prevent contact with the rotor.

The stator-plate oil seal is visible and can be renewed if necessary by removing the stator as a unit. The stator is attached to the right-hand crankcase by three socket-headed screws which can be removed with an Allan key. Take care not to lose the shake-proof washer fitted to the screws. Always remove crankshaft keys before removing the stator.

Reassembly is in the reverse order to dismantling, but all joints should be smeared with jointing paste, as should the heads of the socket-headed screws.

Test Data and Procedure

ROTOR.

The windings on the rotor should not show any continuity to metal parts other than the commutator. On reversible units this may be checked with the rotor in position, provided the stator cable (marked B1) is first disconnected from the reversing solenoid.

There should be no continuity between B1 and earth and if any is indicated the remaining stator cables should be removed and the test repeated. If the fault is still present, remove the rotor and test the stator and rotor separately. If the fault then clears, test the control gear.

In the case of uni-directional units, where one pair of carbon brushes is internally connected to "earth", the rotor must always be removed and tested between copper commutator bars and any clean steel portion of the rotor. Presence of a fault in the rotor windings is usually indicated by undue burning and discoloration of certain commutator bars. Rotor-winding faults are best checked by means of a suitable "growler" test.

If after long use the commutator requires skimming, the cut should not exceed ·080 in. below the adjacent unworn surface. After machining, the commutator insulation between bars should be undercut about ·020 in. to ·030 in. This operation requires special equipment and extreme care and is best left to an expert.

STATOR.

Alternate poles carry shunt and series coils, each six being connected in series to form the shunt-field and series-field windings.

The shunt-field winding has a resistance of 3·6 ± 0·1 ohms, which may be checked by measuring between cables DF and D+ in uni-directional units, and between cables DF and HE on reversible units.

Cable DF must always be disconnected from the control gear before making this measurement.

The resistance of the series-field winding is too low to be measured by ordinary ohmmeters, but should give continuity between cables A and D+ on uni-directional and between A and HE on reversible units.

If an "earth fault" is suspected in either of these windings it is necessary to disconnect all stator cables and, in the case of uni-directional types, to remove the rotor before testing between cable A and "earth".

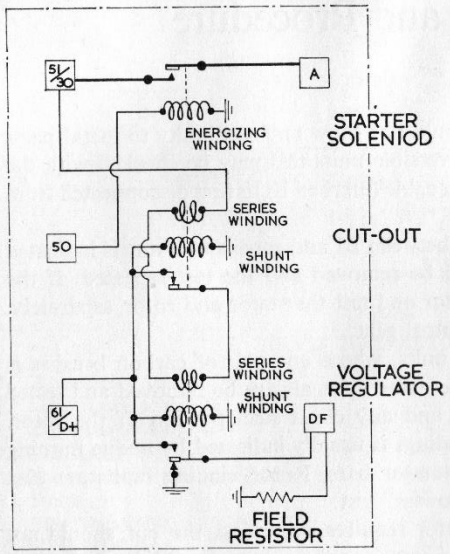


Fig. 65
Siba uni-directional internal connections

To ensure there is no internal short circuit, test to see there is no circuit between B1 or B2 and HE, A or DF, with the stator cables disconnected from the control gear.

CONTROL GEAR.

Do not remove the switch assembly-box cover or the guarantee becomes invalid. If a fault is suspected in the cut-out, regulator or starter solenoid the complete box should be returned to the makers for examination.

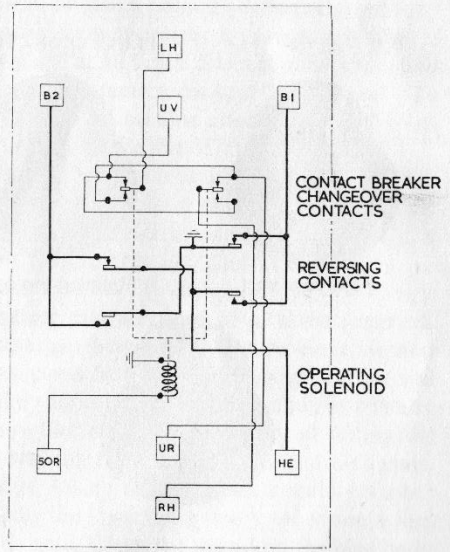
The uni-directional unit is equipped with a switch-assembly box, type SAB/f/1. This has two ignition condensers and the box contains the starter solenoid, cut-out and voltage regulator, the internal connections being shown on Drawing No. M.3104D (Fig. 65). With the aid of this diagram and with the battery and all cables from the box disconnected, the functioning of the various circuits may be checked.

The starter-soleniod circuit, terminal 51/30 to terminal A, should be made

only when the solenoid is energised. Satisfactory operation should occur with 7 volts applied between terminal 50 and the case (D—).

The cut-out contacts should close, giving continuity between 51/30 and 61/D+ with the application of 11·5–12·5 volts across 61/D+ and the case. Measuring between 61/D+ and the case gives the combined resistance of the cut-out and regulator shunt coils, since they are in parallel. This should be 27·9± 3 ohms for the cut-out and the regulator respectively and the measurement of one of these values indicates that the other coil is open circuit.

The opening of the cut-out may be tested on the vehicle by inserting an ammeter (about 0–10 amp minimum) between the 61/D terminal and the cables removed from it. If the engine speed is gradually reduced to a slow tick-over the satisfactory operation of the cut-out will be indicated by the contacts opening with a reverse current of between 2 and 6 amp. By suitably reconnecting this ammeter, or using a centre-zero type, the gross charge from the generator can be measured. No specific figures can be quoted for this output, as it may vary from 1 to 10 amp depending on the state of the battery, how recently it was used for starting, and the lighting load, etc., applied.



CONTACTS SHOWN IN FORWARD OPERATING POSITION

Fig. 66
Internal circuit for Siba reversing unit

When checking the voltage regulator, the open-circuit voltage at terminal 51/30, at comparatively low engine speeds, should be between 15·2 and 16·2 volts.

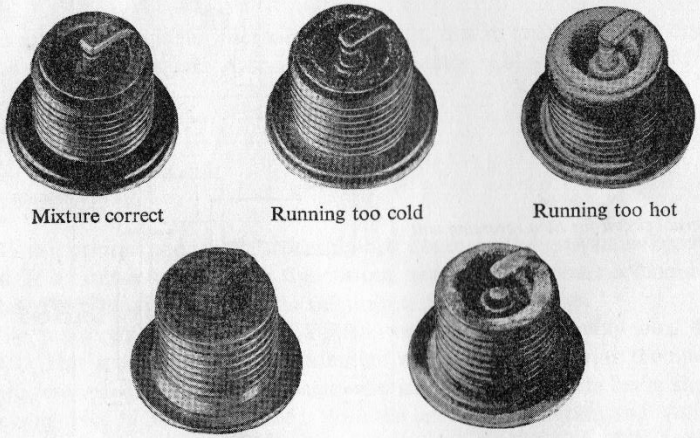
The field resistor has a value of about 6·5 ohms, but as this is normally short-circuited by the regulator contacts, the simplest check is to measure between the case and the centre of the resistor. A reading of approximately 1·6 ohms should be obtained.

The control gear for reversible units includes a functionally similar switch-assembly box, but designated SAB/r when housed in a control-gear box to signify the different arrangement of terminals and feet.

The internal circuit for the reversing solenoid, Type SSW3, is shown on Drawing No. M.3102D (Fig. 66).

The functioning of the reversing solenoid may be verified by checking continuity between appropriate terminals and freedom from earth faults with, of course, the solenoid energised when necessary, having first removed all other connections.

PLUG CONDITIONS



Mixture correct | Running too cold | Running too hot

Mixture too rich | Worn-out plug

Fig. 67

Sparking Plugs

To most road users the sparking plug is an accessory tucked away out of sight and mind and not until it fails is any thought given to this hard working component. It is worth remembering that the plug has to provide a spark for every engine revolution—and at 6000 r.p.m. this means 100 sparks **per second.** Having provided the spark whilst subjected to high pressure, it has then to withstand extreme temperatures and get rid of the heat absorbed, all within 100th of a second. And all the time it is surrounded by a mixture of oil and petrol that may foul the electrodes!

Sparking plugs should be cleaned and checked at intervals dictated by conditions under which the machine has been operating. Mileage, whether in town or open country, will effect the issue, as will the state of carburation, engine temperature, etc. It is advisable to have a look at the plug when carrying out routine maintenance tasks such as washing the machine or examining the chains or brake adjustment.

If difficult starting, poor performance, misfiring, or excessive fuel consumption is experienced, the sparking plugs should be removed. Cleaning and adjusting the plug gaps may cure the problem, or give a pointer to the real trouble.

As a sparking plug can fail miles from the nearest garage it is always advisable to carry a spare set of new plugs at all times. Suspect plugs should be ruthlessly disposed of and never under any circumstances kept "just in case". To do so is pure folly for inevitably the faulty will become mixed with good plugs and their use will probably set up a completely false line of fault diagnosis.

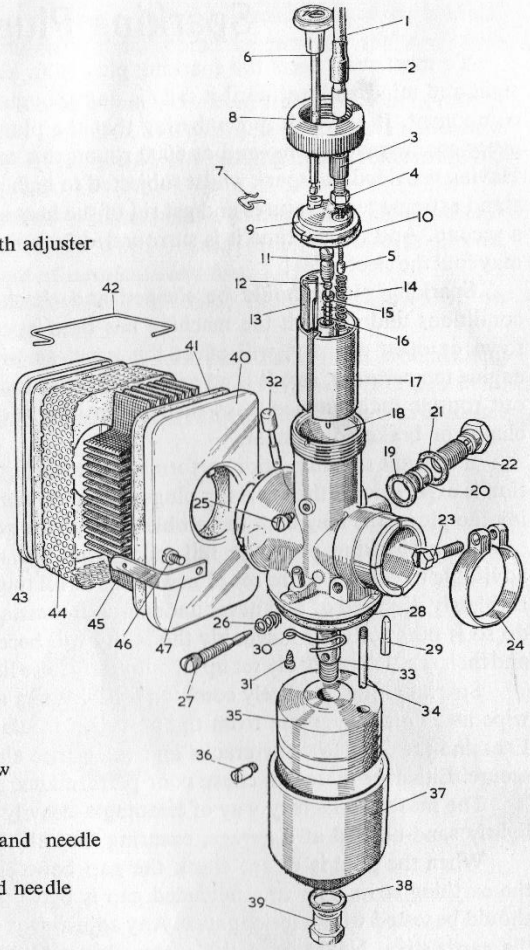
Sparking-plug is largely common sense. When a plug is removed, carefully wipe away oil and grease from the porcelain insulator with a clean dry cloth. Examine the insulator for cracks and the centre electrode to ensure that it is secure. Either of these can cause poor performance and chronic misfiring.

The most satisfactory way of cleaning a heavily carboned plug is to have it lightly sand-blasted at a garage, ensuring that all traces of sand are removed.

When the plug is clean, check the gap between the centre electrode and the earthing strip. The recommended gap is between ·018 in. and ·025 in. and should be tested with a feeler gauge. Any adjustment should be made by bending the earth strip. Never bend the centre electrode. The best way of setting the earth strip is with a small setting tool available from the most motor-cycle agents.

When replacing the sparking plugs, ensure that the copper sealing washer supplied with the plug is threaded onto the lower plug body, otherwise a loss of compression and weak mixture will result. Clean the thread on the plug body as grit or foreign matter will damage the threaded hole in the cylinder head.

Fig. 68
CARBURETTOR



1. Throttle cable complete with adjuster
2. Cable-adjuster cover
3. Cable adjuster
4. Cable-adjuster nut
5. Cable nipple
6. Control knob and spindle
7. Spring clip
8. Top ring
9. Top disc
10. Top-disc washer
11. Needle adjusting screw
12. Needle No. 3½
13. Strangler slide
14. Throttle spring
15. Needle collar
16. Needle spring
17. Throttle No. 3 cutaway
18. Carburettor body
19. Banjo washer
20. Banjo gauze
21. Banjo washer
22. Banjo bolt
23. Carburettor-body clip screw
24. Carburettor-body clip
25. Throttle-guide screw
26. Pilot-jet adjuster screw and needle spring
27. Pilot-jet adjuster screw and needle
28. Float-cup washer
29. Fuel needle
30. Tickler spring
31. Tickler-spring screw
32. Tickler rod.
33. Centrepiece
34. Pilot jet, 35 c.c.
35. Float
36. Main jet
37. Float-chamber
38. Washer
39. Nut
40. Inner filter case
41. Felt pad
42. Spring clip
43. Outer case
44. Gauze
45. Filter element
46. Fixing screw
47. Fixing bracket

Carburettor

A carburettor is a device for metering petrol and mixing it with air so that the engine can burn it at varying engine speeds. On a two-stroke engine it also rations oil for the engine's requirements.

An internal combustion engine requires air to burn as well as to cool it, but as pure air will not burn another chemical, petroleum, is mixed with it to make a combustible fuel. Experience has taught designers that to operate efficiently the internal-combustion engine requires petrol and air mixed in a ratio **by weight** of 14 parts of air to one of petrol. If the air content is increased the engine will overheat; if lowered, the mixture will not burn completely in the time available.

The engine also requires oil to cool and lubricate it, and in the two-stroke unit it has been found convenient to let the fuel carry the lubricant around the internals of the engine. This is done by setting or tuning the carburettor.

Movement of the piston alters, in turn, the capacity of the crankcase and cylinder, covering and uncovering the inlet port in the cylinder wall. The piston uncovers the inlet port on its up stroke and air enters the crankcase through the inlet pipe. As air has considerable weight, it continues to enter the crankcase despite the fact that the piston starts descending again. This flow of air through the carburettor has a siphoning action on a small tube running down into the float chamber and causes fuel to mix with the air stream. The amount of fuel is controlled by the main jet which is fitted into the bottom of this tube and which has a capacity or flow rate of so many cubic centimetres of fuel per minute when the throttle and needle are ¾-to-fully open.

By fitting a throttle slide the amount of air entering the crankcase can be controlled or it can be cut off completely. Although the maximum amount of petrol the engine can draw in by means of the main jet has already been established, the mixture at anything less than ¾ throttle will be "too rich" and the engine will require a lesser amount of fuel.

To meet this requirement, a taper needle is attached to the throttle slide which is raised or lowered as the throttle control is operated. This needle runs inside the tube connecting the main jet and air stream and its taper matches the engine's fuel requirement from ¼-to-¾ throttle openings. The amount of taper required is found by experiment during the development stage and although other tapers are available it is unlikely that the engine will require one. Adjustments may be made by raising or lowering the needle.

The throttle slide has a cut away at the bottom and this, by altering the effect of the depression over the the main-jet tube from ⅛-to-¼ throttle openings, supplies the correct amount of fuel required by the engine.

At less than $\frac{1}{8}$ openings, when the engine is running at very low speeds, a separate system, known as the pilot system, comes into action. When the throttle is nearly closed, the depression is very great and would cause neat fuel to be sucked into the choke tube. To overcome this a minute bleed hole connected to a pilot jet is drilled on the engine side of the throttle and meters the fuel required. The air supply is adjusted by means of a needle, known as the pilot air jet.

To keep the fuel system operating satisfactorily, a constant level of fuel is necessary or the mixture strength will vary. This is done by means of a float which rises and falls as the fuel is used. Movement of the float operates a small taper needle which cuts off the supply of fuel as the float rises and allows more fuel to enter the float chamber as the float sinks with the fuel as the engine uses it. Alteration of the throttle opening varies the rate of fuel consumed, but the float operates the needle and automatically allows for this.

TUNING THE CARBURETTOR.

If tuning the carburettor is necessary the first requirements are to have the engine at running temperature, a set of clean plugs and a quiet straight stretch of road.

Fit the new set of plugs and accelerate as hard as possible into top gear. Allow the engine to pull hard, preferably flat out, for a mile or more, then cut the throttle, free the clutch and coast to a standstill. Avoid letting the engine tick over.

Allow the engine to cool and take out the sparking plugs. By reading the deposits on the plugs it is possible to judge the mixture strength. The end of the body should be coated with a smooth dark brown or black coating of carbon. This should be free from loose fluffy deposits and there should be no excess of fuel or oil. Certain fuels will give lighter deposits than others, but the general picture of smooth firm darkish deposits will remain. The photographs (Fig. 67) give a good indication of what is expected.

If a weak mixture is indicated by a lighter deposit increase the size of the main jet by 10 c.c. The number of cubic centimetres flow is stamped on the bottom of the main jet, e.g. 140. If the mixture is too rich, the main jet should be lowered 10 c.c. If much alteration either side of the main jet size is required then look for another reason. Remember the carburation has already been set during manufacturing tests.

Having established the correctness or otherwise of the main jet, ride the machine a couple of miles to bring it back to normal temperature, then set the pilot jet with the pilot screw to adjust the mixture strength. Turn the screw

clockwise to richen the mixture and anti-clockwise to weaken it. When correctly set the engine will run steadily at idling speeds but respond immediately to quick throttle openings. A two-stroke engine will not idle as regularly as a four-stroke and needs to be under load before the engine note becomes regular.

The pilot mixture strength is set at the factory during initial testing and should not require more than half a turn either way to give the correct carburation.

Once satisfied with the pilot setting, road test the machine for even pulling over the cruising range, i.e. from $\frac{1}{4}$-to-$\frac{3}{4}$ throttle. If there are flat spots or richness try raising or lowering the taper needle attached to the throttle. To do this, take off the knurled retaining ring on the top of the carburettor and withdraw the throttle slide. In the top of the slide will be found a small brass screw. Turning this clockwise lowers the needle and weakens the mixture; turning it anti-clockwise raises the needle and richens the mixture. The initial setting of the needle is made by measuring the distance from the bottom of the throttle slide to the tip of the needle.

DISMANTLING THE CARBURETTOR.

The carburettor is secured to the inlet pipe by a clip fitting and is released by unscrewing the hexagon-head screw retaining the securing clip. Before dismantling the carburettor, wash the exterior with clean petrol and a small paint brush.

Unscrew the knurled ring on the top of the carburettor body and withdraw the throttle slide, needle, strangler, strangler plunger, return spring and cable complete. Close the twist grip fully to give the maximum possible cable length at the carburettor and compress the throttle return spring so that the inner cable can be pushed through the slide and disengaged. The strangler slide can now be removed from the spindle and, if necessary, the spindle itself withdrawn from the top cap removing the circlip. The control cable is removed by unscrewing the small adjuster on the top disc.

The taper needle is fitted loose in the throttle slide and held in position by an adjusting screw in the throttle slide. If the screw is removed in order to take out the needle, be careful not to lose the small spring and collar from beneath the head of the needle. The needle size is stamped on the side of the needle. As standard, the needle is adjusted so that it protrudes by 1·94 in.

The float chamber is located by the nut on the bottom of the cup, which when removed frees the cup from the main body of the carburettor. The main jet is fitted into the centrepiece and has the size stamped on its head. The number indicates its capacity or flow rate in cubic centimetres of air per minute. If the

jet is blocked it must be washed out in clean petrol and blown clear with a high-pressure air line. Never use a pin or piece of wire to unblock a jet or serious damage will result.

When the main jet is unscrewed the float can be removed from the centre-piece and the fuel needle taken from its bush. On the upper side of the float is a pad that bears on the fuel needle. The fuel needle is longer than that fitted as standard in most Villiers S.25 carburettors and it is important to quote the specification number of the engine when ordering a replacement.

To reseat the needle in the bush, give its protruding end a light tap with a spanner or similar instrument. Never attempt to relap the seat with grinding paste. A simple method of testing the efficiency of the seating is to invert the carburettor, fit the float and needle and blow through the threaded hole into which the banjo-union bolt fits. The needle should seat by the weight of the float pressing on it.

The pilot air-adjusting screw and spring may be removed for cleaning, but it is not advisable to remove the fuel-needle bush, centrepiece or compensating tube as these are liable to be damaged. If a fault occurs in these components or new ones are required the work should be entrusted to an authorized dealer.

REASSEMBLING THE CARBURETTOR.

Wash the various components in clean petrol, making certain that the tickler vent hole at the back of the tickler plunger is clear. Invert the carburettor and insert the fuel needle in the fuel-needle bush. Replace the float over the centre-piece, ensuring that the pad is towards the protruding end of the fuel needle and screw the main jet into the side of the centrepiece. Fit the float cup, making sure that the upper edge fits well up against the carburettor sealing ring and that the nut is not over-tightened.

Replace the throttle in the body at the same time guiding the taper needle into the centrepiece. A guide screw in the carburettor body prevents the slide being replaced wrongly. Locate the fibre washer into its seating at the top of the carburettor, fit the top disc onto it and screw down the knurled ring.

If the carburettor has been removed from the engine, make sure when re-fitting that the body is pushed as far as possible on the manifold and that it is set vertically. There are four slots in the body to allow the securing clip to function and the manifold stub must extend past the end of them or an air leak will develop and cause erratic carburation.

The carburettor has a banjo petrol-pipe fitting, inside of which is a fine-mesh filter gauge. This should be periodically washed in clean petrol. When

replacing the banjo be sure that the fibre washers make a petrol-tight joint, otherwise fuel consumption will suffer.

AIR FILTER.

Dust and oil make an excellent grinding paste, but provided it is cleaned periodically the air filter will exclude dust and safeguard the life of the engine. All that is necessary is to take out the filter element, wash it in clean petrol, dip it into petroil mixture and allow the surplus to drain off. Do not wash the felt pads which are placed either side of the filter element, but shake them free of dust.

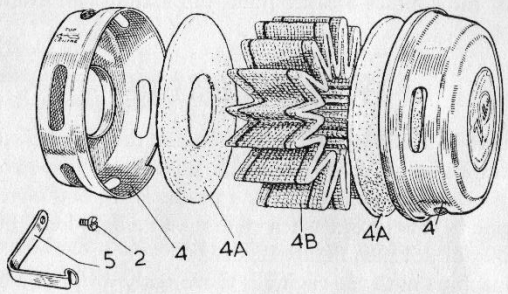


Fig. 69
Type V 1100 Air Filter

2 Screw
4 Covers
4A Felt pads
4B Filter element
5 Clip

Routine Maintenance

Most work required under this heading will be covered in the vehicle manufacturer's handbook and is largely dependent upon the type of normal running conditions. Where a vehicle is used daily the carburettor air filter should be washed and cleaned every 500 miles in accordance with the instructions given under this heading. Every week the oil level in the gearbox and chaincase should be checked and topped up as necessary with oil in accordance with the instructions given in the chapter on lubrication. The sparking plugs should be cleaned at approximately every 2000 miles and the points adjusted as necessary. At regular intervals the setting of the contact-breaker points should be checked and the condition of the contact-breaker point lubricating pad examined.

Road Testing

Many owners become worried if their engine four-strokes and particularly if it four-strokes excessively. On very rich mixtures a two-stroke engine will four-stroke and often eight-stroke. It is a perfectly normal characteristic for a two-stroke engine to four-stroke when running on a light load, but a simple test will show whether or not the mixture is correct.

Ride the machine until the engine is thoroughly warm and find a stretch of road with a slight uphill gradient. Pulling hard in top gear up this gradient the engine should two-stroke evenly, but on the over-run with the throttle closed, occasional four-stroking will be experienced. The same gradient climbed on full throttle in second gear should cause the engine to alternate between two-stroking and four-stroking until the limit of its speed is reached in that gear, when it will four-stroke continuously.

Exhaust System

Probably the greatest single influence on two-stroke engine performance is the exhaust system. Alter it and the result may be costly both in fuel consumption and repair bills and it is mentioned here only because it invariably comes under the consideration of the amateur tuners and the "special" builders. A Manx-type megaphone will not help and the two-stroke racing variety needs careful development before it is beneficial. But almost any alteration to the engine will affect the main jet requirements—be it an alteration in exhaust-pipe length or to

the internals of the silencer. Even a crack on the exhaust pipe will vary the mixture strength and cause trouble.

It pays, therefore, to be careful with exhaust systems and not to submit too readily to the claims of improvement of other "special" systems. Some of these can play havoc with the engine's characteristics.

Diagnosing Running Faults

Any unusual noise which suddenly develops should be investigated at once for it is evident that a mechanical fault has occurred. The questions are:

(a) Is the noise metallic?
(b) It is apparent at all speeds?
(c) It is rhythmical?
(d) Is it in the lower or upper part of the engine?
(e) It is accompanied by a loss of power?

A true analysis is never easy, but the application of common sense will help to narrow the field in which the trouble lies. Many a baffling fault can be easily resolved by a logical approach.

This manual includes a chapter on fault finding and this will help in tracing faults in the most logical sequence, thereby minimising time wastage. A few of the more obscure faults and remedies are:

(1) Light metallic tapping, particularly when the engine is cold, which appears to originate in the cylinders. This is known as piston "slap" and is caused by the difference in sizes of cylinder bore and the piston diameter. This is a necessary feature of all internal-combustion engines, but is more audible on the air-cooled engines than on the water-cooled variety.
(2) Tinkling or tapping noise from cylinder, particularly when pulling hard. This is pre-ignition or detonation caused by incandescent particles of carbon igniting the mixture before the correct timing interval. It may also be caused by the wrong grade of plug, by a cylinder-head gasket overlapping the bore, by weak mixture or too much ignition advance.
(3) Poor low-speed pulling may be caused by too rich a mixture and can be due to a partially blocked air filter, leaking fuel needle, punctured float or too much oil in the petroil mixture.
(4) Persistent "whiskering" of sparking plugs may be caused by overheating, weak mixture, pre-ignition or a cracked exhaust pipe.
(5) Rapid wear of clutch push rods is a good indication of faulty clutch adjustment.

Fault-finding Guide

ENGINE FAILS TO START.

Take out the sparking plugs. If the points are wet, dry them and make sure there is a good spark when the engine is kicked over. If there is no spark on either cylinder, check that

(a) the ignition key is in "ON" position;
(b) the contact points are dry and the gap correctly adjusted;
(c) the earth wires from the ignition coils are earthed positively to the engine;
(d) the ignition can revolve; and
(e) the multi-pin plug is making good contact within its socket.

If both plugs give a good spark, switch off the petroil, and open the strangler fully. Take out the crankcase drain plugs and open the throttle wide. Do not replace the sparking plugs at this stage, but rotate the crankshaft a dozen or so times with the kickstart lever to blow out the excess mixture. Replace the crankcase drain plugs and sparking plugs, reset the throttle and, with the petroil turned off, operate the starter. When the engine starts switch the fuel "ON".

If the plugs when taken out are dry, test the spark as already described. If the spark is good suspect fuel starvation, which can be caused by

(a) an empty fuel tank or the tap not "ON";
(b) a blocked fuel-tank cap vent;
(c) a blockage in the fuel pipe;
(d) a blocked main jet;
(e) a sticking needle valve; or
(f) failure of the strangler to operate when engine is cold.

DIFFICULTY STARTING WHEN ENGINE IS HOT:

The three main factors affect the engine whether hot or cold.

(a) The engine must be mechanically sound, with good compression and free from air leaks.
(b) The carburettor must be fed with an adequate supply of fuel and must meter the fuel to the engine in accordance with its requirements.
(c) The ignition system must provide an adequate spark at the correct firing intervals.

Most difficulties experienced when starting a hot engine stem from incorrect carburettor setting and this will be indicated by the plug condition.

RUNNING FAULTS.

If the engine runs evenly or shows a tendency to four-stroke or eight-stroke, the likely cause is too rich a mixture, but as already stated all two-stroke engines tend to four-stroke on light load, i.e. in the lower gear ratios, when going downhill, or on the over-run after the throttle is closed.

To decide whether the mixture is rich, test the engine by making it pull hard in 2nd, 3rd and top gear up a slight gradient. Under these conditions a tendency to four-stroking will indicate that

(a) the main jet is too large;
(b) the strangler is not fully open;
(c) the air cleaner is partially blocked;
(d) the taper needle is too high,
(e) the float is punctured;
(f) the fuel-needle valve is not seating; or
(g) the fuel-needle toggle is incorrectly set.

It is unlikely that (a) will be incorrect as the main-jet size is established at the factory. The strangler operation can be checked visually. Fault (c) indicates that routine maintenance has been neglected and emphasises that half an hour spent washing the filter is well worth the trouble.

The setting of the taper needle is initially carried out by the factory, but there is always the possibility that its setting has been altered during routine maintenance. The float may be punctured in a variety of ways, but by removing the float and shaking it one can generally detect a leakage. Alternatively, a punctured float, if immersed in a bowl of hot water, will give off a stream of bubbles. If the fuel-needle valve is not seating, the trouble may be caused by dirt under the needle or by a worn seat. In the latter case the needle should be replaced with a new one and the seating remade by giving the protruding end of the needle a light tap. If the fuel-needle is incorrectly set it must be adjusted to give the correct fuel level.

Another cause of apparent richness is an accumulation of oil in the crankcase. This may be drained by unscrewing the crankcase drain plugs and rotating the crankshaft to blow out the excess oil.

ENGINE LACKS POWER.

A falling off in power may be attributed to

(a) loss of compression
(b) excessive carbon in the exhaust system and ports;

(c) incorrect ignition timing,
(d) incorrect grade of sparking plug;
(e) incorrect petrol ratio; or
(f) stale fuel. This can happen when the machine has been out of use for two months or more.

ENGINE STOPS FIRING ON ONE CYLINDER OR WILL NOT RUN SLOWLY ON BOTH CYLINDERS.

Both faults may be caused by either ignition failure of weak mixture. To trace the fault, take out the sparking plugs and check the spark. If the spark is weak or non-existent, fit a new plug.

If there is still no spark, examine the appropriate lead and see that the plug cover is screwed firmly on the lead, that the lead is not ruptured and that the connection to the coil is good. Check all connections to the coil and to the engine and check the contact-breaker point gap for the appropriate cylinder.

If visual examination does not provide an answer and the spark remains elusive, exchange the right-hand plug lead for the left-hand and check the spark. If the spark changes side, then a lead is faulty. A similar check on the coil and condenser should pin-point the trouble.

If the spark is good on both cylinders, the fault is likely to be caused by an incorrect carburettor setting, a leaking joint or faulty oil seal. Loose or missing crankcase drain screws can cause similar trouble.

ENGINE SUDDENLY STOPS FIRING.

Check the fuel and see if there is a fuel blockage. Look to the spark-plug leads. Examine plug points for metallic fouling and make certain there is good compression. If the weather is wet, water may be short circuiting the H.T. leads.

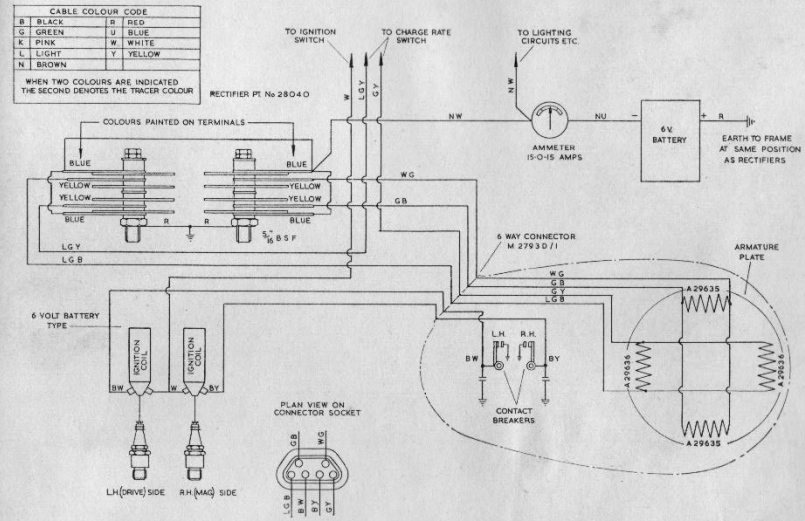


Fig. 70
Wiring diagram 40715 for later versions of the Villiers high-output magneto, using the S.M.M. & T. colour coding