Villiers

USER'S HANDBOOK

Marks

31A, 32A, 33A, 34A, 35A, 36A
246 c.c.

9E, 11E 197 c.c.

2L, 3L 173 c.c.

31C
148 c.c.

TWO-STROKE ENGINE-GEAR UNITS

INCLUDING

BLOWER-COOLED MODELS

THE VILLIERS ENGINEERING CO. LTD.
WOLVERHAMPTON ENGLAND.

TWO SHILLINGS

OCTOBER, 1962 V.E.C. 542

Introduction

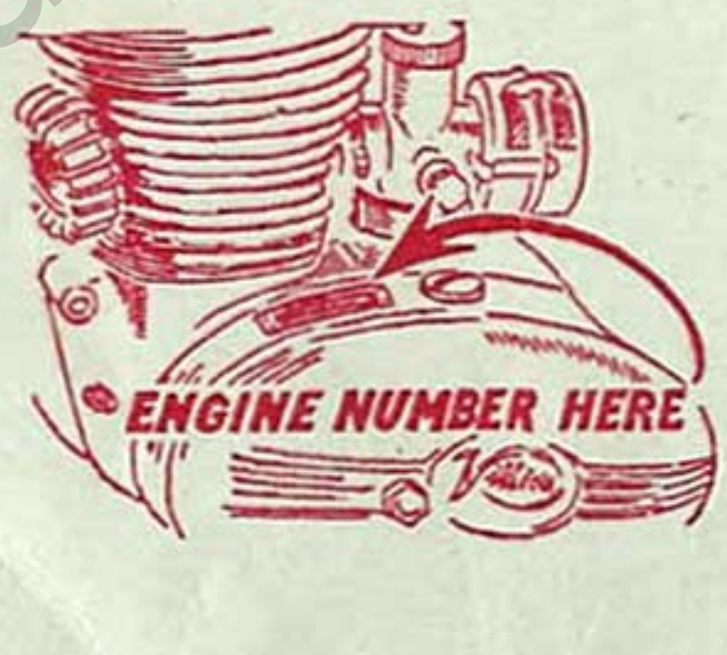
LIKE all Villiers products the engines covered by this book are precision built; every component part conforming rigidly to pre-set standards of the highest quality. Your engine, the heart of the machine in which it is installed, will give many years of efficient and trouble-free service provided it has proper care and attention.

The simple but important routine maintenance suggested in these pages is designed to assist you, and the book should be kept handy for consultation when required.

Because of the fine limits to which the engines are made and assembled we advise you to entrust major overhauling to your nearest dealer or to the manufacturer of your machine, both of whom have the full facilities of our service organization at their disposal.

Important

Your Dealer and our Service Department will find the answer very much easier to any queries concerning your engine if in all correspondence you will quote the full engine number which is to be found stamped on the plate fixed to the inner chaincase as illustrated below.



THE VILLIERS ENGINEERING COMPANY LTD.
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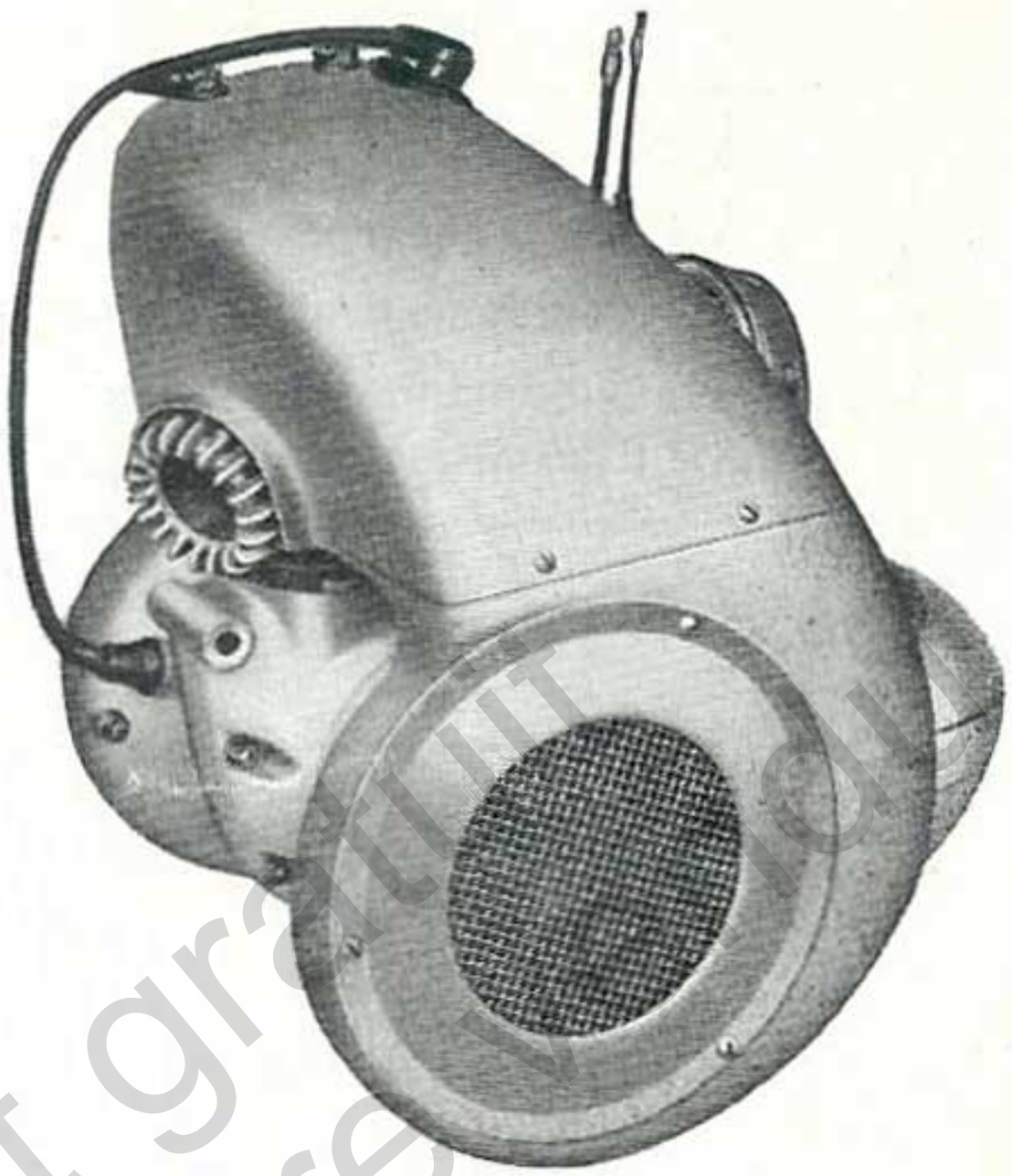
22399 (20 lines)
TELEGRAMS:—VILLIERS, WOLVERHAMPTON.

Villiers



Marks

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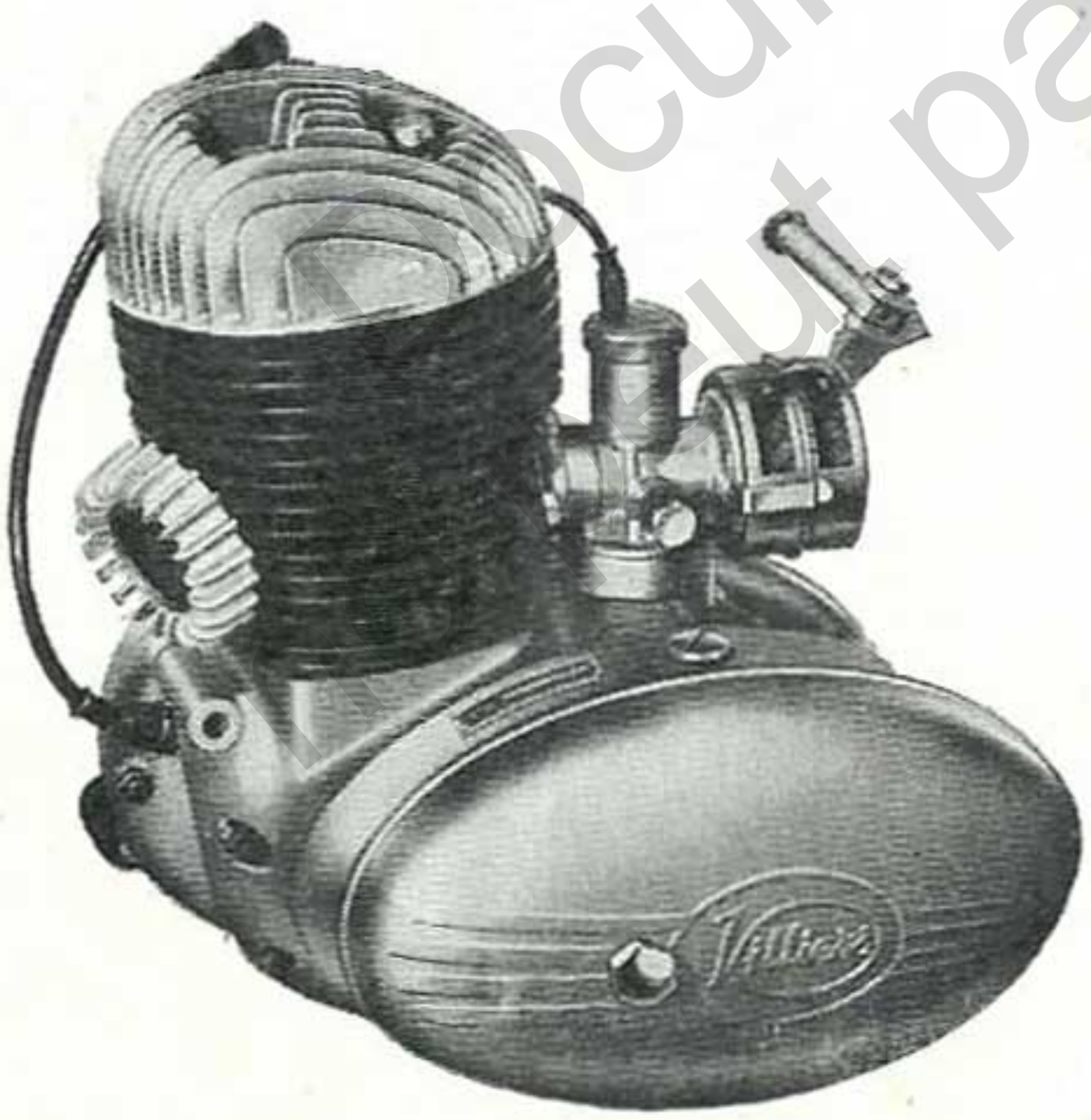


TWO-STROKE

ENGINE

GEAR-UNITS

Read pages 4 and 5 before putting Engine into Service.

SUMMARY OF ENGINE-GEAR

246 c.c.	197 c.c.
31A/4S or 4SR and 35A/4S or 4SR 32A/4 Sports and Trials 33A/4 (Scrambling and Racing) 34A/4 (Scrambling and Racing) 36A/4 (Scrambling and Racing)	9E/3 or 4 9E/3S or 4S 9E/3SR or 4SR 9E/4SF or 4SFR 9E/4 Trials or Sports 11E/4S or 4SR

3 or 4-speed gearbox. S—electric starter

TECHNICAL

	9E and 11E	2L
Bore (m.m.)	59	59
Stroke (m.m.)	72	63.5
Capacity (c.c.)	197	173
Compression ratio, (standard)	7.25: 1	7.4: 1
Compression ratio, (competition)	8.25: 1	—
Engine sprocket $\frac{3}{8}''$ Pitch	20T	As 9E
Clutch sprocket $\frac{3}{8}''$ Pitch	43T	
Primary drive ratio	2.15—1	
Gear ratio	See page 22	
Final drive sprocket $\frac{1}{2}''$ P×.295″ W... ...	18T	17T
Carburetter	S.25	S.22
Needle	No. $3\frac{1}{2}$ 1.95″ out	No. $3\frac{1}{2}$ No. 4 groove
Throttle	No. 3	No. $2\frac{1}{2}$
Sparking plug	Lodge HH14	As 9E
Sparking plug gap	.018″/.025″	
Spark timing *Before Top Dead Centre* ...	$\frac{11}{64}'' \pm \frac{1}{64}''$	
Contact breaker point gap	*.012″/.015″	
Lubrication: Engine	Petroil mixture.	For first 500
,, Gearbox	Castrol XL (SAE.30) oil	As 9E
,, Chaincase	Castrolite (SAE.20) oil	

*When electric starter-generator is fitted Point Gap is ·020″

UNITS COVERED IN THIS LIST

173 c.c.	148 c.c.
2L/3 or 4	31C/3 or 4
2L/3KF or 4KF	31C/3KF or 4KF
2L/3SF or 4SF	31C/3SF or 4SF

R—reverse. F—blower and cowling. K—kickstarter.

DATA

31C	31A and 35A	32A	33A, 34A and 36A
57	66	As Mk.31A	As Mk.31A
58	72		
148	246		
7.75: 1	7.4	—	—
—	—	7.9: 1	12: 1
As 9E	As 9E	25T	20T
		43T	43T
		1.72: 1	2.15: 1
1, 1.56, 2.18, 3.6	1, 1.56, 2.18, 3.6	1, 1.27, 1.78, 2.94	1, 1.27, 1.78, 2.55
16T	19T	15T	15T
S.19	S.25	S.25	AMAL 389
No. $3\frac{1}{2}$. $1\frac{31}{32}$″ out	No. $3\frac{1}{2}$. 1.95″ out	No. $3\frac{1}{2}$. 1.85″ out	D in No. 3 groove
No. $2\frac{1}{2}$	No. 4	No. 4	No. $3\frac{1}{2}$ (AMAL)
As 9E	As 9E	As 9E	RL47 or RL49
			.018″—.022″
	.020″		$\frac{1}{8}$″—$\frac{5}{32}$″
			As 9E
miles 1 part Castrol XL (SAE.30) oil to 16 parts petrol.			1 part Castrol R to
Subsequently 1 part oil to 20 parts petrol.			24 parts petrol
As 9E	As 9E	As 9E	As 9E

OPERATING INSTRUCTIONS

LUBRICATION

ENGINE

The engine is lubricated by the petroil system and no lubricant other than that introduced with the petrol is necessary. We recommend Castrol Two-stroke Self-Mixing Oil at a ratio of ½-pint to one gallon of petrol (1—16) **or** Castrol XL (SAE.30) ratio 1—20.

Due to the Self-Mixing properties of Castrol Two-Stroke Self-Mixing Oil, ½-pint to one gallon of petrol represents a ratio of 1—20 actual lubricant to petrol, and **no pre-mixing is necessary, but it is essential to turn off the Petrol Tap and put the Oil into the Tank before the petrol.**

MK.34A and 36A only—24 parts of 80 octane petrol to 1 part Castrol "R" oil.

GEARBOX

Castrol XL (SAE.30) is also recommended for the Gearbox, and this can be inserted after removal of the dipstick or filler plug. (See sketch below). The positions of the 3-speed gearbox plugs are slightly different, the diagrams below refer to the 4-speed gearbox. The oil level should be maintained to the notch cut into the dipstick and should be checked with the dipstick resting on **top** of the gearbox casing and not when screwed down. A drain plug is provided at the base of the gearbox so that after every 5,000 miles the oil can be drained away and replaced by fresh oil.

CHAINCASE

Castrolite (S.A.E.20) oil is recommended for the chaincase and reference to the diagrams below will show the location of both the filler and oil level plugs (in the case of the cowled engines the filler plug is situated more to the rear). When filling the chaincase, both plugs should be removed and oil fed in until it just commences to run out of the level plug hole. Allow any surplus oil to drain off before replacing level plug.

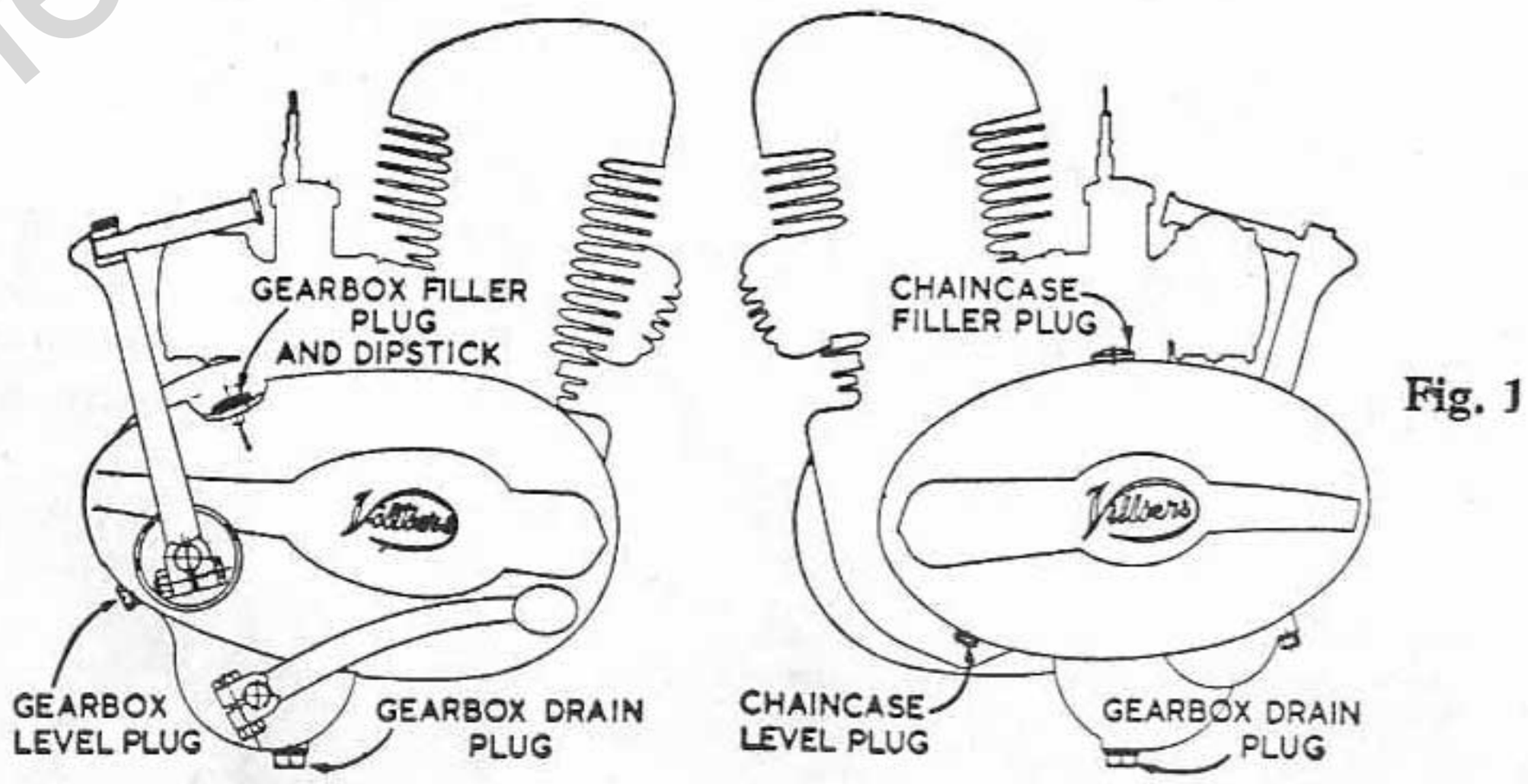


Fig. 1

STARTING—WHEN COLD

Place the petrol tap in the " ON " position and flood the carburetter by depressing the tickler on the right-hand side of the carburetter body. Close the strangler by the means provided in order to obtain a rich mixture. Having done this, make sure that the gearbox is in the neutral position, open the twist grip about 1/3rd and turn the engine over sharply by means of the kick-starter or self-starter. When the engine fires, the throttle should be adjusted accordingly and the strangler can be opened gradually as the engine warms up. With Self-Starter equipped engines the ignition must also be switched ' ON.'

Some engines with self-starter have a reversing arrangement. In these cases a key is provided which is turned to the right for switching ignition on and then turned hard over against a spring resistance to operate the starter for *forward* running. Switch off and allow engine to stop before changing from forward to reverse running and vice versa.

To start in *reverse* the key must first be depressed before turning to right as before.

Immediately engine fires release the key—this is most important.

WHEN HOT

It is not necessary to close the strangler or flood the carburetter.

FAILURE TO START

If repeated kicks fail to start after flooding (when cold), turn off fuel supply, open throttle wide, and clear cylinder of excessive mixture by giving a number of kicks to starter lever. Now turn on fuel supply, and, after closing throttle to 1/3rd, try again. If not successful, the sparking plug will probably be found to be wet. If so dry out and rotate engine quickly, after having removed the drain plug situated at bottom of crankcase, so that accumulated mixture can be blown out. If still not successful after having replaced drain plug the trouble must be found elsewhere, and reference should be made to the "Fault Finding Chart" on page 18, and, for Self-Starter equipped engines, to the chart in the separate booklet.

STOPPING THE ENGINE

If the engine is stopped by turning off the fuel supply instead of closing throttle or switching OFF the ignition an easier start will be made if the machine has to stand a long time before again being required. Where this method of stopping is employed, the ignition must be switched OFF when the engine has stopped.

RUNNING IN

The useful life of your engine will depend a great deal upon the way in which it is treated during the first 500 miles. As a general rule it is not advisable to exceed 30 m.p.h. in top gear, 20 m.p.h. in third, 15 m.p.h. in second and 10 m.p.h. in bottom gear. After the running-in period is completed, do not throw caution to the winds and open up the engine to its full extent. The machine should be gradually brought up to its peak performance. See further details on inside back cover.

GEARBOX

The gears are selected by a lever which returns to its original position after each gear change, or alternatively, by a remote control having a different position for each gear. To obtain first (bottom) gear, the gear lever should

be moved upwards in the case of the foot-change, or in the direction indicated in the case of the remote control. The higher gears are obtained by pressing the foot-change lever downwards, or the remote control to the gear position indicated. The neutral position is between first and second gear, and is selected by moving the gear lever over half the distance required for a normal gear change.

Remember that when in motion and changing to a higher gear the engine speed must be reduced by partially closing throttle, but when selecting a lower gear the engine speed should be increased to obtain a smooth and silent change. When selecting any gear with the machine at rest or in motion, always fully de-clutch before operating the gear lever.

Do not allow the engine to race, or labour. Full use should be made of the gearbox thus enabling the engine revolutions to be maintained under varying load conditions.

During the initial stages the operation of the gearbox may be slightly stiff, but this condition will disappear as the engine is run-in.

Engines with reversing arrangement can be started in either direction, and it is essential that the first gear position only be used when the engine is running in the "REVERSE" direction.

CLUTCH AND PRIMARY DRIVE

The drive from the engine to the four plate clutch is by a pre-stretched endless chain running in the oil bath chain-case. No attention is necessary beyond that of lubrication, and occasional adjustment of push rod clearance to prevent clutch slip. Whilst the clutch is engaged, i.e. driving, there must be clearance between end of the push rod, located in the hollow gearbox mainshaft, and the clutch lever fitted to the gearbox end cover. An adjuster having a slotted end is provided and this can be reached with a screwdriver through a hole in the right-hand outer casing, or fan casing.

To adjust the clutch proceed as follows:—

1. Engines with covered clutch lever (See Fig. 2)

First slacken off the adjuster in the clutch control cable, then turn adjusting screw with screwdriver until there is about $\frac{1}{8}$" of free movement between the end of the clutch lever and the right hand cover. Now take up any slack in the control cable, still leaving $\frac{1}{16}$" free movement of the clutch lever before commencing to depress the clutch spring. Finally, tighten the cable adjuster locknut after making sure that there is no end pressure on the push rod whilst the clutch is engaged. Although the clutch runs in oil the corks may in time become worn on the driving faces, and it will be necessary from time to time to make use of the push rod adjuster to maintain the free movement referred to above.

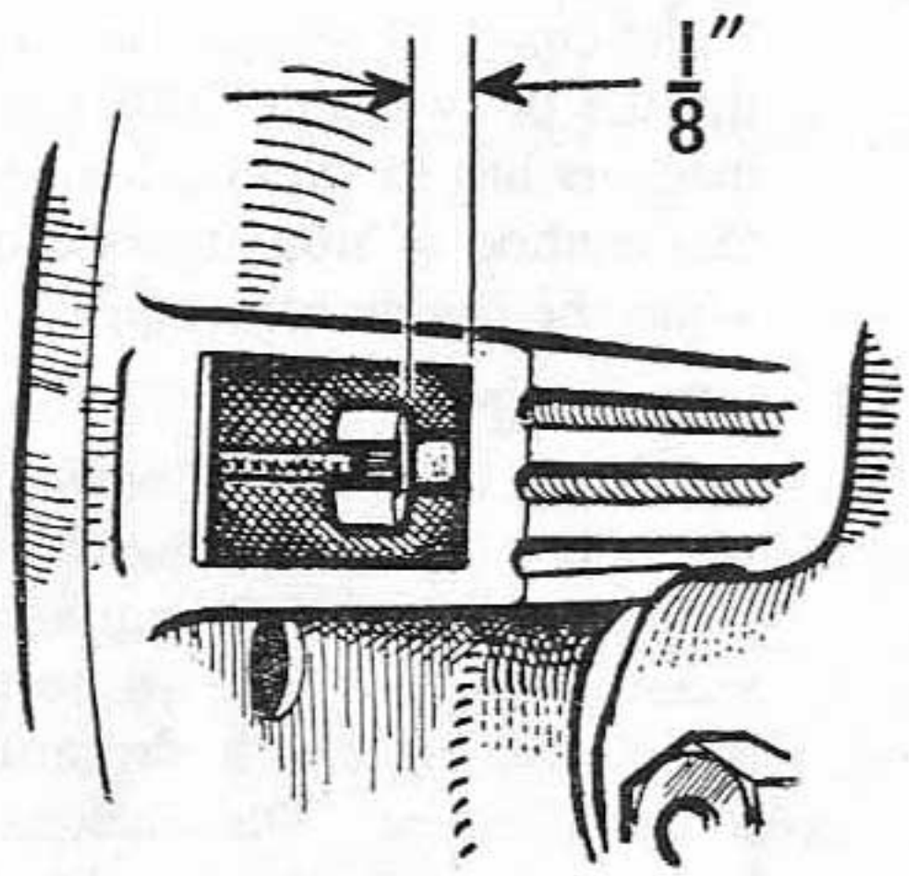


Fig. 2

2. Engines with exposed clutch lever (See Fig. 3)

Slacken off the clutch cable adjuster in the control cable. Locate a screwdriver in the slot of the clutch lever adjusting screw and position the screw so that the clutch lever is in approximately the position indicated. Now take up any slack in the control cable until there is $\frac{1}{16}$" free movement of the clutch lever before it commences to depress the clutch spring. Finally, tighten the cable adjuster lock nut after again checking that there is no end pressure on the push rod whilst the clutch is engaged.

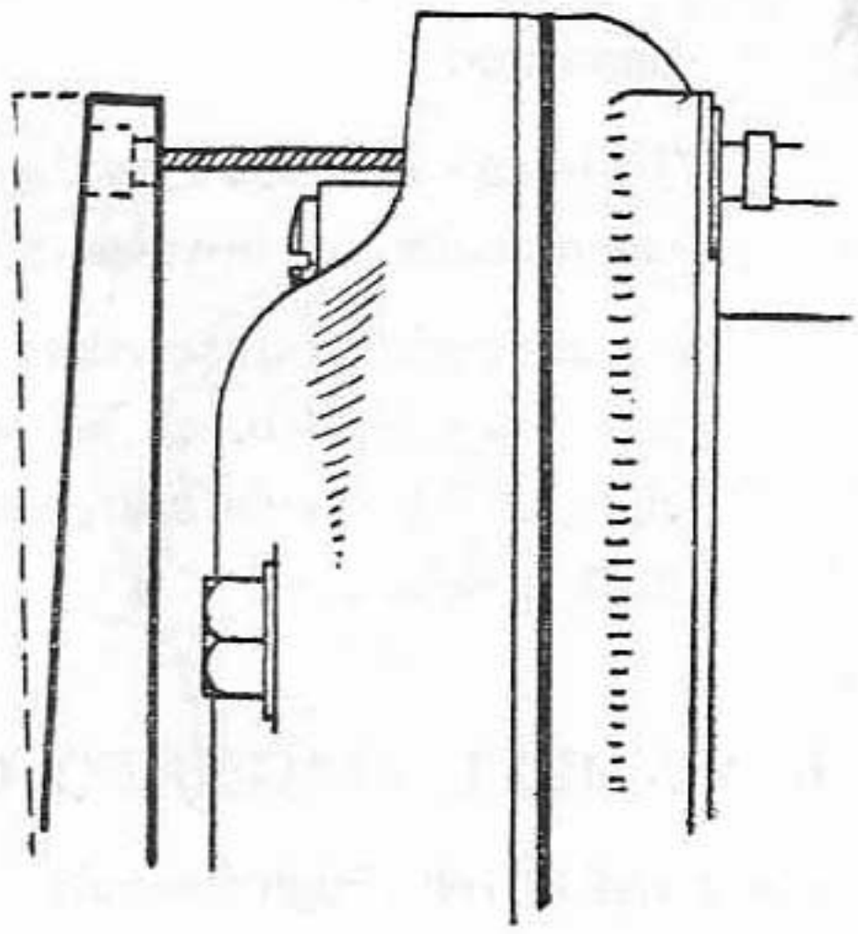


Fig. 3

3. Adjustment of push rod (See Fig. 4)

In order to maintain satisfactory operation of the clutch, it is necessary for the effective length of the push rods to remain within certain limits. This adjustment is carried out by means of the adjuster situated in the centre of the clutch cap nut. When carrying out this adjustment, it is preferable to remove the clutch lever so that the extent to which the push rod protrudes through the gearbox end cover can be measured. The correct setting is for the push rod to protrude $\frac{5}{16}$" and the adjusting screw in the clutch cap nut should be turned until this setting is obtained. It is most important that the adjuster screw lock nut is securely tightened after carrying out any adjustments. Under normal conditions of running adjustment of the push rods should not be necessary unless new push rods and/or clutch components have been fitted, but it is recommended that the push rod setting be checked at the time of changing the oil in the chaincase as the push rod adjusting screw is then readily accessible.

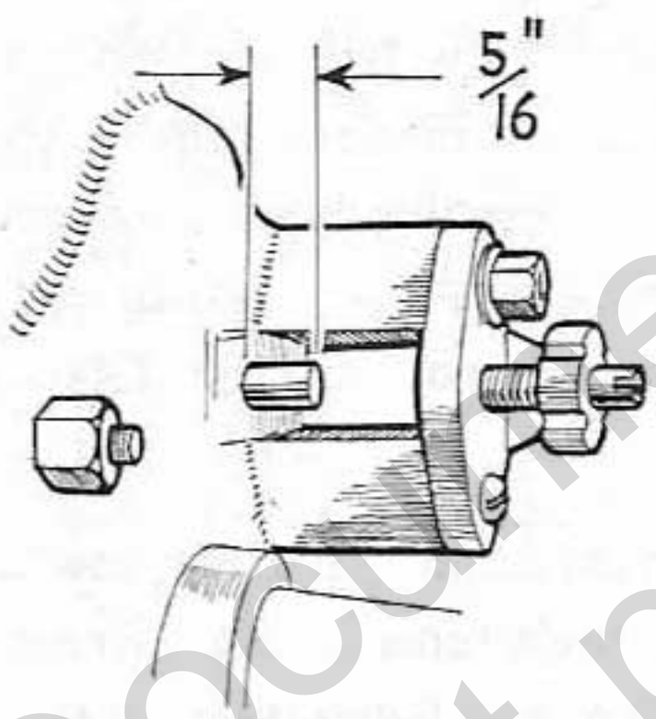


Fig. 4

Do not slip the clutch when in motion except when getting away from a standing start, otherwise rapid wear will take place. If stopping for any length of time at traffic lights, etc., move gear lever to " NEUTRAL " position. Do not stand in gear with clutch lever pulled up.

ENGINES WITH SELF-STARTER

The letter " S " in the engine mark indicates that self-starting equipment is fitted. A separate booklet is supplied with each engine giving operating instructions and spare parts list.

Special care should be taken when fitting a new rocker arm to ensure that the " heel " is well " bedded in," i.e. is in contact with the cam over the whole width of the heel. The method of re-timing is explained in the separate booklet, which includes wiring diagrams.

Important

To ensure maximum service from the self-starter, it is essential to keep the commutator and brushes clean.

At intervals not exceeding 5,000 miles running, it is recommended that the armature (rotor) be removed, and the commutator and brushes cleaned. See separate booklet and Villiers Service Bulletin M/C.24 for further details.

FLYWHEEL MAGNETO GENERATOR (Villiers)

6 volt and 12 volt (High Output)

This assembly comprises three main components, i.e. the flywheel, the armature plate and the contact breaker assembly.

The Flywheel is totally enclosed by the armature plate and right-hand cover, and is located on the drive shaft by means of a key, and locked on a taper by a single centre nut, which also serves as an extractor. The magnets and pole shoes are secured in the flywheel by means of screws and retaining plates, and the complete flywheel assembly is balanced and magnetised after final machining. No attempt should be made to remove the magnets or pole pieces. Under normal circumstances the flywheel magnets should not require attention, but if for any reason there is a drop in magnetism the complete flywheel should be returned to our Service Department for attention.

The Armature Plate is secured to the right-hand crankcase, and consists of the ignition and lighting coils. The high tension lead screws into the armature plate, connection to the ignition coil being by means of a spring-loaded brass pad. The lighting coils are connected to cables which are in turn connected to the sockets on top of the armature plate in the case of the 6-volt system, and to leads, which are fed through grommets in the armature plate, in the case of the 12-volt system. The pole pieces of the coils are machined after they have been assembled to the armature plate and should not be disturbed unless replacements are to be fitted. Al lighting coils bought as spares are supplied with the appropriate length of connecting lead and have the pole pieces machined, but it is essential to check that there is clearance of .012″/.015″ between the pole pieces of the coils and those of the flywheel before any attempt is made to run the engine. The right-hand crankcase oil seal is also housed in the armature plate and care should be taken not to damage the knife edge of the seal, should it be found necessary to remove the armature plate from the crankcase. See separate booklet for description of the Self-Starter assembly.

The Contact Breaker Assembly is housed in the right-hand cover, and is accessible after removing the cover plate, which is secured by screws.

Fig. 5 shows the general lay-out of the contact breaker assembly fitted to engines having Villiers flywheel magnetos. The contact breaker cam B is located on the right-hand crankshaft by means of a key and circlip. It is not necessary to disturb either the cam or the flywheel when checking the contact point gap or altering the timing of the spark.

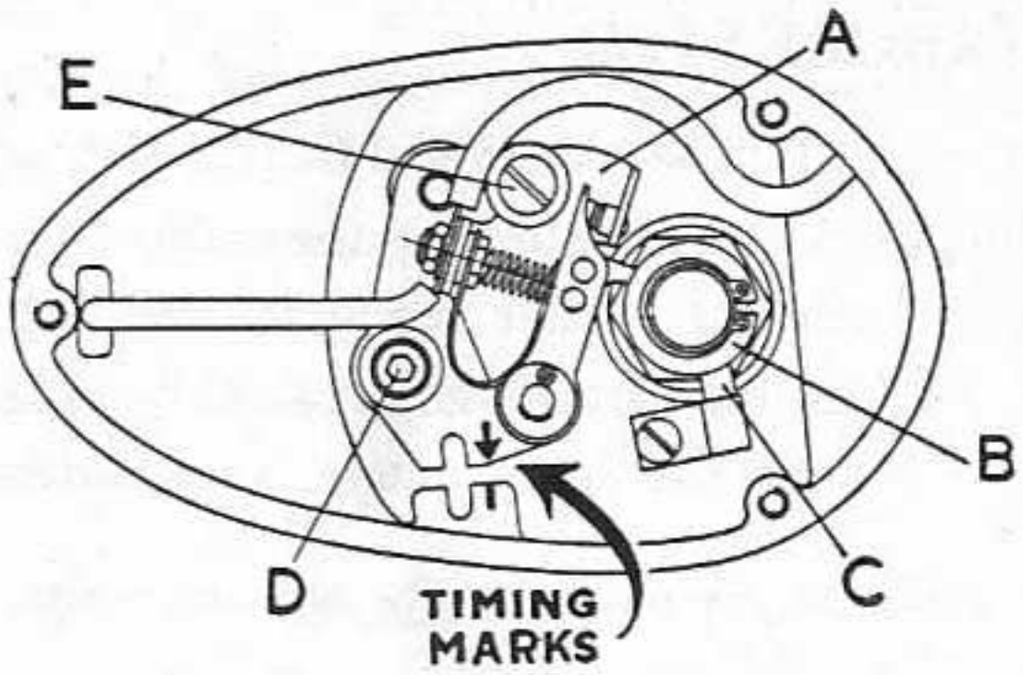


Fig. 5

The contact breaker point gap is adjusted as follows:—

Set gap to fully open position by rotating engine. Release screw E and alter position of bracket A until the point gap is .012″/.015″. Tighten screw E and re-check point gap. The screwdriver, and feeler gauge provided should be used for carrying out this adjustment.

It should not be necessary to re-time the ignition unless the engine has been dismantled or new components have been fitted involving the removal of screw D; this screw is filled with solder after timing is set when engine is built.

Re-timing ignition is carried out as follows:—

Remove solder from the socket-headed screw D and, after loosening, swing the contact breaker base plate to an average position. With piston set at top dead centre, release screw E and adjust point bracket A to give a gap between the contact points of .012″/.015″. Tighten screw E and rotate engine in the normal direction until the contact breaker points commence to open, check piston position which should now be 11/64″ before top dead centre. If piston position differs from this figure, the base plate should be swung to left or right to advance or retard the timing as required, and the contact breaker gap re-set. Repeat both adjustments, if necessary, until the piston position and point gap are within the required limits. Securely tighten screws D and E when correct adjustment has been obtained.

A felt oiling pad C is provided for the contact breaker cam. The pad should be removed periodically and soaked in molten high melting point grease, wipe off surplus grease before re-fitting.

Note:—In order to obtain trouble-free service from the electrical system it is essential that all component parts and connections are secure and clean. Regular inspection will ensure the minimum of trouble.

SPARKING PLUG

The plug should be screwed tightly into the cylinder and the copper washer make a gas tight joint. Keep the outside of the plug clean and dry. Periodically remove the plug, clean off all carbon deposits and adjust the spark gap to .018″/.025″. Obtain the correct gap by bending the point attached to the outer body—never bend the centre electrode.

The thread of the plug must be clean and free from particles of carbon or grit otherwise the cylinder head may be damaged. A smear of graphite grease on the plug threads will help to prevent seizure and damage.

CARBURETTER

(For Marks 33A, 34A and 36A see separate AMAL handbook).

All air passing through the carburetter is filtered, thus preventing particles of foreign matter reaching the engine. During bench-testing at our works, the carburetter is carefully set and normally it will not be necessary to alter the setting until a considerable mileage has been completed.

Means are provided for adjustment to suit individual requirements.

Except in the case of the Mark 9E/4 Trials Engine, the carburetter inlet manifold fixing screws must be removed before the carburetter can be lifted from the engine.

The carburetters fitted to the engines described in this booklet are as follows:—

Mark 31C Engines	...	...	Carburetter Type S.19
Mark 2L and 3 L Engines	...	...	Carburetter Type S.22
Mark 31A, 32A and Mark 9E and 11E Engines	...	...	Carburetter Type S.25

These carburetters are also available with a large air filter (Type V 1800 B) with rod operated strangler slide, or with the large air filter and handlebar control for the strangler slide. For identification purposes, each carburetter type has a suffix figure, i.e. S.25/2, to indicate the component parts fitted to the carburetter.

OPERATION OF CARBURETTER

The handlebar twistgrip (or lever) control operates the throttle slide and thereby regulates the amount of mixture entering the engine, whilst the carburetter itself automatically meters and atomises the correct amount of fuel to give the necessary mixture strength. To achieve this automatic control of the mixture strength, the carburetter incorporates main-jet and pilot-jet systems. At idling speeds the carburetter draws fuel from the pilot-jet and, as the throttle is gradually opened, fuel is then drawn in turn from the pilot " progression " hole and the main-jet system. Details of operation of the two systems are given in the following pages, and whilst the sectional drawings refer to the type S.19 and type S.25 carburetters, the information given also applies to the type S.22 carburetter fitted to the Mark 2L and 3 L Engines.

(a) **Pilot-Jet System.** (See Figs. 6 and 7).

At idling speeds, when the throttle is nearly closed, the pilot outlet hole A is subject to the very high engine suction, and petrol is, therefore,

drawn from the float chamber through the pilot tube B, and the pilot outlet hole. The calibrated pilot-jet is contained in the top of the pilot tube. At the same time, a filtered supply of air is drawn from the mouth of the carburetter through passage C, through variable air-jet D, and is then pre-mixed with fuel in the small chamber E. Pilot adjuster screw F varies the size of the pilot air jet, affecting the pilot mixture strength—to richen mixture, turn screw clockwise.

When the throttle slide is opened a small amount beyond that required for idling, suction on the pilot outlet hole is reduced, but at the same time, increased on the pilot " progression " hole G. A further supply of fuel is, therefore, drawn through the " progression " hole, preventing the weak spot which would otherwise occur due to the fall off in supply from the pilot hole before the main jet comes into full operation.

It follows from the preceding remarks that whenever the throttle is shut whilst the engine speed is high (such as on long downhill sections), the pilot system is subject to full engine suction, and petroil will flow into the engine from the pilot outlet hole. As the engine is not firing under these conditions, this fuel supply will tend to build up in the crankcase and cylinder and cause severe " four-stroking " or " eight-stroking " when the throttle is opened again.

To overcome this an automatic air bleed to the pilot has been incorporated, which relies upon the matching of two slots, one in the throttle slide and the other in the carburetter body. When the throttle slide is shut, these two line up and air can flow from the front of the carburetter through the throttle slide and down passages H and J into the pilot system. The high depression on the pilot system is then destroyed. In all other throttle positions, the two slots do not line up, and no air can pass to the pilot system through these passages.

S. 19 and S. 25 Carburetters

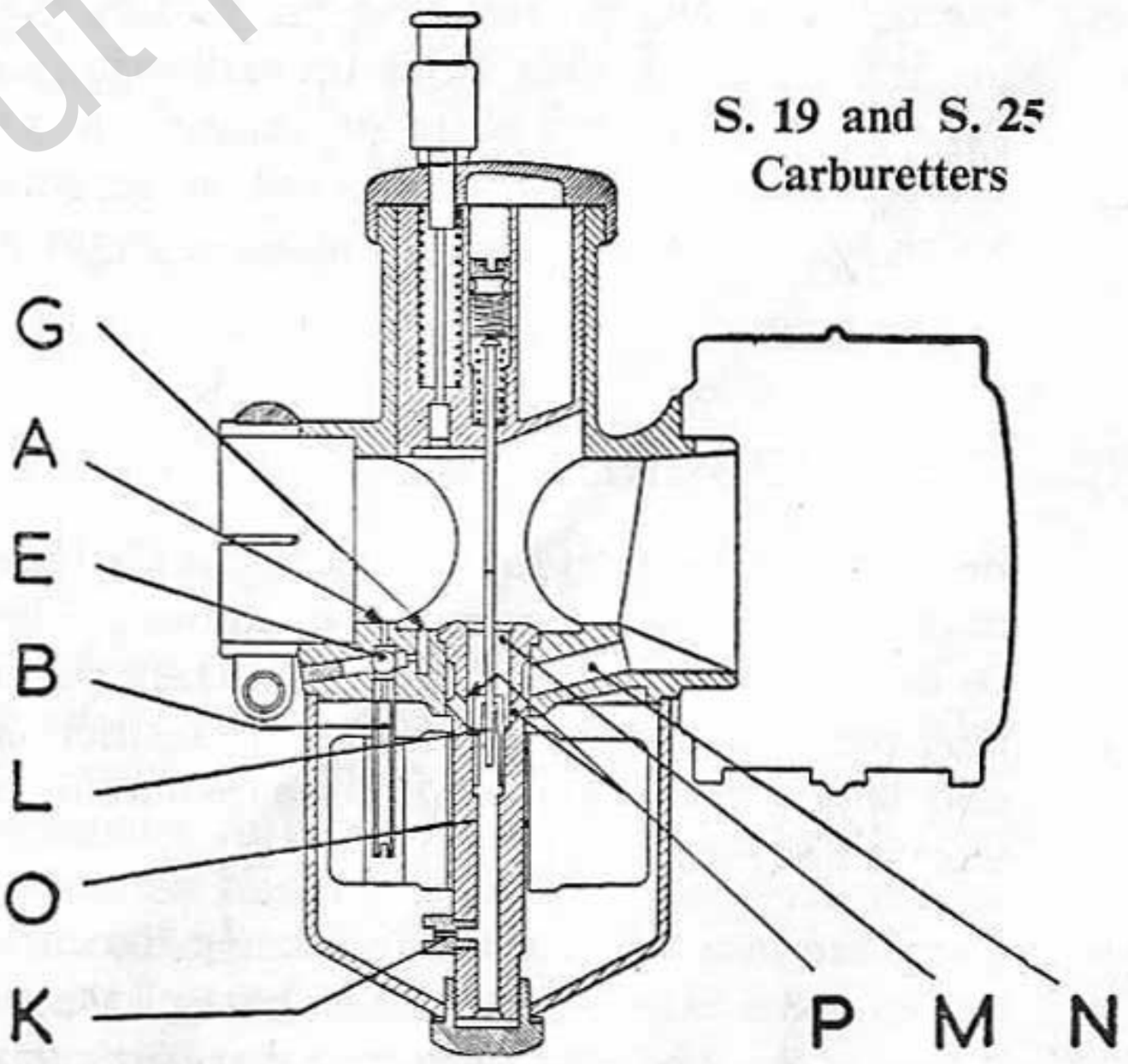


Fig. 6.

(b) Main Jet System

As the throttle slide is opened further beyond the idling and progression positions, engine suction has its effect upon the main-jet system, and fuel is drawn from the float chamber through the calibrated main jet K and the needle-jet L into the small pre-mixing chamber M. There the fuel is atomised by the filtered secondary air which is drawn from the mouth of the carburetter along passage N, and which enters the centre-piece O through four small holes P. The rich petroil-air mixture then flows from the pre-mixing into the main mixing chamber, where it meets the main air stream. The effective size of the needle-jet L depends upon the throttle slide position (as the taper needle is fixed to the slide), and the sizes of the jet and the needle are chosen to give correct carburation over the range.

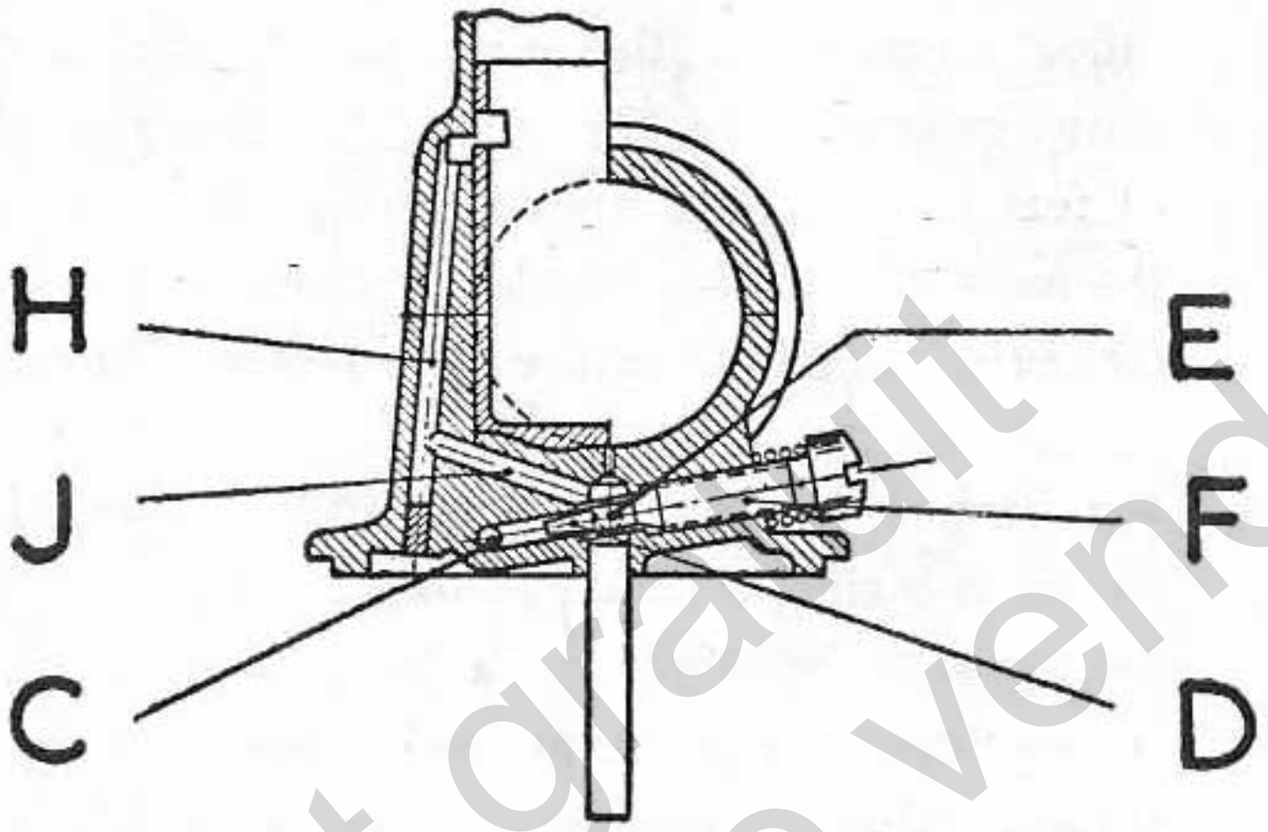


Fig. 7

AIR FILTER

The Air Filter provided with this engine is designed to prevent ingress of foreign matter to the engine thus extending its useful working life. Two sizes of air filter are available, the smaller one incorporating a strangler shutter. Where the larger air filter is fitted, it is necessary to provide alternative means of strangling for starting from cold. This is done by the fitting of an air slide within the carburetter throttle operated either by a knob on top of the carburetter or, remotely, by a control lever on the handle-bar. Filters should be maintained in accordance with the instructions which will be found on a plate attached to the filter.

TUNING CARBURETTER

Before any attempt is made to tune the Carburetter it is essential that the engine is in a good mechanical condition. This means that there should be no air leaks at any of the joints, there should be a good spark at the plug points and also that there is no restriction in the fuel supply. It is also important of course, that the carburetter is clean internally, and air filter is not obstructed.

There are four adjustments for tuning the carburetter, but each of these has its full effect at a particular part of the throttle range, and should, therefore, only be used for tuning that particular part of the range. There is also a definite sequence for the tuning, which must be adhered to

in order that the results achieved with one adjustment are not upset by the next.

Sequence of tuning with the necessary adjustments is given below:—

(1) Main Jet. Throttle Range—$\frac{3}{4}$ to Full

In order to obtain the correct main jet size, the engine must be tested at full throttle in top gear. If the engine lacks power, detonates badly or runs better with the strangler slightly closed, a larger main jet is required. Should the engine " four-stroke " or improve momentarily after the petrol has been switched off, a smaller jet is required. After de-clutching and stopping the engine quickly the sparking plug should have a shiny black appearance if the correct main-jet is fitted. As an additional guide the engine should tend to " four-stroke " at full throttle in bottom gear on level ground (or high engine speeds in neutral), but not in any higher gears.

(2) Pilot Jet. Throttle Range—Closed to $\frac{1}{8}$ open

The pilot jet must be set when the machine is stationary with the engine running at the required idling speed. To richen mixture, screw in the pilot adjuster screw, and to weaken, unscrew pilot adjuster. The mixture must be set as weak as possible consistent with a steady reliable idling speed and good engine acceleration from this throttle position. If the mixture strength is set too rich, trouble will be experienced with the fuel build-up in the crankcase when the throttle is shut with the engine still running fast. Should this latter fault be present after adjusting the pilot, unscrew pilot a further half a turn. Any weakness on acceleration can be cured by throttle cut away as given below:—

(3) Throttle Cut-Away. Throttle Range—$\frac{1}{8}$ to $\frac{1}{4}$ Open

The throttle slide is made with a cut-away on the carburetter inlet side which influences the depression on the main-jet system. Throttles are marked with a number which represents, in sixteenths of an inch, the amount of cut-away. A throttle with more cut-away will give weaker mixtures (over the particular throttle range) and vice-versa. If acceleration is weak, fit throttle with smaller cut-away, e.g. change from $3\frac{1}{2}$ to 3. Should engine tend to " four-stroke " when throttle is shut, fit larger cut-away.

(4) Needle Adjustment. Throttle Range—$\frac{1}{4}$ to $\frac{3}{4}$ Open

In the S.19 and S.25 carburetters the needle is adjusted by a screw in the top of the throttle—screw down to weaken mixture, and vice-versa. In the S.22 carburetter the needle is adjusted by means of a spring clip attached to the throttle engaging in one of five slots in the head of the needle. The needle controls mixture strength over most of the " cruising range " and must be correct for good fuel consumption and acceleration. After carrying out the above adjustments, it is wise to go back and re-check the pilot adjustment to see that this has not been affected by other adjustments.

TO CHANGE THE TAPER NEEDLE

S.19 and S.25 Carburetter

Remove throttle from body after unscrewing the top ring, and in the centre at top of throttle will be found a small slotted screw. This is the adjuster referred to in the previous paragraph, and when this is removed, by unscrewing, the needle with spring can be pushed up from underneath. When replacing the needle make sure that the collar and spring are in position.

S.22 Carburetter

The retaining spring should be moved to one side after which the taper needle can be lifted upwards and out of the throttle.

TO CHANGE THE FUEL NEEDLE

S.19 and S.25 Carburetters

After removing the float cup, main jet and float, the fuel needle lever can be removed by easing it off the pivot pin. The fuel needle can then be removed for inspection or replacement. Assembly is in the reverse order and care should be taken not to distort the fuel needle lever in any way.

S.22 Carburetter

Remove the float cup and float by unscrewing the cup from the carburetter body. The main jet is screwed into the bottom of the float cup. The fuel needle lever is retained by a pivot pin and removal of the pin will release the lever, which will then allow the fuel needle to be removed from the fuel needle bush. The latter item can be removed for replacement purposes.

THE CENTREPIECE

In the S.19 and S.25 carburetters the centrepiece is a press fit in the carburetter body and should not be removed unless absolutely essential. The S.22 carburetter centrepiece is an integral part of the carburetter body

TO REASSEMBLE CARBURETTER

S.19 and S.25 Carburetters

Clean the various components and make sure that the tickler vent hole is clear. Replace float in correct position, this is marked 'Bottom.' and replace main jet in side of centrepiece. Clean out float cup and replace, with large fibre joint washer at top. Replace bottom nut and fibre washer, but do not use too much force, otherwise there is danger of stripping the thread of centrepiece.

S.22 Carburetter

Clean the various components making sure that the tickler vent hole is clear, and that the main jet is screwed firmly into the float chamber. Replace float and check that float chamber seating ring is properly located in the recess in the carburetter body. Screw float cup into position, taking care not to overtighten.

All Carburetters

Replace throttle in body at the same time guiding taper needle into hole in top of centrepiece. A guide screw in carburetter body will prevent the throttle being replaced unless it is correctly positioned. Locate top disc in top of body and screw on top ring. If carburetter has been removed from the engine, make sure when refitting that the body is pushed on to the manifold as far as possible, and that it is set upright. There are four narrow slots in the body to allow the securing clip to function, and if the manifold stub does not extend past the end of the slots, air will be drawn in causing hard starting and erratic running.

The carburetter has a banjo petrol pipe fitting inside of which is a fine mesh filter gauze. This should be periodically cleaned by dipping in petrol. Be sure when replacing the fuel pipe that the fibre washers make a petrol tight joint, otherwise fuel will be wasted.

See separate handbook for AMAL carburetter

ELECTRICAL SYSTEM. Villiers Flywheel Magneto 6v.

Rectifier Lighting

A typical Wiring Diagram will be found on page 23.

The output of the magneto lighting coils is converted to direct current by means of a selenium rectifier. Switches may be provided to allow half-charge when lights are not in use.

Direct Lighting

This is used where it is not desirable to incorporate a battery in the vehicle. Two coils only of the magneto generator are used for lighting, the third being available for stop-light or A.C. horn operation.

A typical wiring diagram appears on page 24.

Villiers Flywheel Magneto 12v.

Rectifier Lighting

The basic circuit employed for this generator is given on page 22, and it will be noted that a switch is provided to give approximately half the normal charge.

RECTIFIER

The casing of the rectifier used for the 6-volt generator must not make contact with any portion of the cycle frame. Various methods of insulating the rectifier are adopted by the Motor Cycle Manufacturer, and any insulating material must be replaced in position if rectifier is removed. The 12-volt generator (high output) uses a rectifier with single bolt fixing. This bolt must be in good electrical contact with the frame of the machine.

BATTERY

The battery is supplied by the maker of the machine, and correct polarity must be maintained as shown in the relative wiring diagrams. About once a month the filler cap of each cell should be unscrewed so that distilled water can be added to bring the acid level above the top of the separator. **Do not add tap water as this contains impurities.** Acid should not be added unless this is accidentally spilled out of the battery, when it should be replaced by diluted sulphuric acid of the same specific gravity as in the cells. Keep the battery terminals clean. Many lighting troubles can be traced to unseen corrosion between the surfaces of a perfectly tight joint, and in the case of the battery, this corrosion takes place much more frequently than at other electrical contacts. See also battery manufacturers instructions regarding maintenance.

IMPORTANT

6 volt rectifier lighting

Provided that the positive battery lead is suitably insulated and the wiring is in good condition, no damage to the rectifier will occur if the engine is used without the battery. In order to prevent " blowing " of the bulbs it should be noted that high engine speeds should be avoided if the switch is set to other than the " OFF " or " DIRECT " position.

12 volt rectifier lighting

In this installation it is necessary to disconnect from the rectifier and insulate the black core of the twin cable in order that the engine may be safely run with the battery disconnected.

TRACING TROUBLES

For the satisfactory running of any Villiers Engine it is essential that three main conditions are fulfilled, and by making a systematic investigation the faults can usually be located. If the engine stops, symptoms will generally give a clue to the cause, but where this is not the case, the trouble can be more easily traced by following a definite method of investigation. The three conditions mentioned above are as follows:—

(1) The required quantity of petrol-and-air mixture must enter the engine, which means that a proper supply of fuel has to be available from the carburetter, and that the throttle should open and close freely.

(2) The sparking plug must give a good spark, at the right time in relation to the position of the piston on its upward stroke.

(3) The engine must be in good mechanical condition, with no air leaks at the various joints.

There must also be no loss of compression either in the cylinder head or crankcase. This can be easily checked by putting the gears into the neutral position and rotating the engine by means of the kickstarter. The throttle, of course, must be open so as to allow air to enter the crankcase. On every revolution a definite resistance should be felt by the air being compressed in the cylinder head.

MAKING A PRELIMINARY CHECK

When the cause of the trouble is not evident, carry out a preliminary check covering the following points. If this fails to trace the cause, reference should be made to the Fault Finding Chart on pages 18 and 19.

Having made sure that there is " petroil " in the tank, and that the tap is in the " ON " position, depress the tickler on the carburetter body to ensure that there is no blockage in the fuel supply, either in the tap, banjo, union or fuel needle seating. If the fuel supply is clear, fuel will spurt from the vent hole in the side of the tickler cap.

Being satisfied that fuel is reaching the carburetter, next unscrew the sparking plug, and with the high tension lead still attached, lay the plug on the cylinder head. Turn the engine by means of the starter, and if the magneto and high tension lead are in order, there should be a good spark at the plug electrodes.

Finally, examine the carburetter controls to make certain that the throttle is actually opening when the control lever is moved, and that the strangler slide cable and control, if fitted, are operating satisfactorily.

FAULT FINDING CHART

Sequence of Testing	Possible Trouble	Remedy
Engine will not start		
Depress tickler on carburetter to check whether fuel is reaching carburetter.	No fuel reaching carburetter. Air lock in petrol pipe.	Turn tap to ON, refill tank, clear air vent in filler cap. Turn on reserve tap where fitted.
If no fuel, even when tap is on and fuel is in tank.	Choked petrol pipe, filter on tap, filter in banjo. Fuel needle sticking in seating.	Remove and clean out. Dismantle carburetter and fit new needle.
Test for spark by holding sparking plug body on cylinder head.	Leak along insulation of plug or high tension lead.	Try a new plug of the type recommended and/or new H.T. lead.
If still no spark: Test for spark at end of H.T. lead held $\frac{1}{8}$″ from cylinder fins.	Plug points may be oily or sooted up. If no spark at end of H.T. lead, contact breaker point gap may be too narrow, or points pitted or dirty or oily.	Clean plug or fit new one. Adjust point gap to .015″. Clean.
	Moisture on insulation of condenser.	Clean and dry out.
	Damaged insulation on wires connecting contact breaker to coil or condenser.	Replace.
	Faulty condenser.	Replace.
	Faulty ignition coil.	Replace.
	Faulty insulating plate.	Replace.
If above tests are satisfactory, but engine will not start.	Mixture may be too rich due to use of strangler, or incorrect setting of taper needle.	Open throttle wide and depress kickstarter several times to clear engine of petrol. Adjust taper needle.
	Air leaks at carburetter stub or inlet pipe joint, causing weak mixture.	Correct.
	Incorrect ignition timing.	Check, following instructions given.
Engine four or eight strokes		
Strangler may not be fully open or taper needle in a too high position. Air filter may need cleaning.	Mixture too rich.	Lower taper needle by adjuster screw fitted in throttle.
Check by watching for excessive smoke from exhaust pipe or silencer.	Engine may four stroke for a little while after standing due to accumulation of oil in crankcase.	Usually ceases when engine has been running for a few minutes unless too much oil has been mixed with the petrol.
	Flooding of carburetter.	Persistent flooding is usually due to dirt under fuel needle seating, or sticking fuel needle, damaged seating or punctured float.

Sequence of Testing	Possible Trouble	Remedy
Engine lacks power		
	Engine out of tune, bearings worn. Unsuitable sparking plug.	Overhaul. Replace with recommended type.
	Loss of compression.	Tighten cylinder head bolts. Replace worn piston rings.
	Incorrect "petroil" mixture.	See page 4.
	Excessive carbon deposit on piston crown, cylinder head, inlet, exhaust and transfer ports.	Decarbonise.
	Exhaust system choked with carbon.	Clean out silencer and exhaust pipes.
	Incorrect carburetter setting.	Check and adjust.
	Air filter choked.	Clean. See instructions on air filter.
	Obstruction in fuel supply.	Clean out tap, fuel pipe and filters.
	Incorrect ignition timing.	Check and adjust.
	Brakes binding.	Adjust.
	Driving chains too tight.	Adjust.
Engine will not run slowly		
	Weak mixture due to air leaks at carburetter stub or inlet pipe, crankcase and cylinder base joints.	Tighten all joints.
	Crankcase drain screw loose or missing.	Tighten or replace.
	Worn crankshaft bearings or leaking oil seals.	Replace.
	Ignition timing too far advanced.	Correct, following instructions given on page 9.
Engine suddenly stops firing		
	Sparking plug lead detached.	Replace.
	Plug points bridged by oil, carbon, or deposit caused by use of leaded petrol.	Clean or replace.
	Short circuit of high tension current by water on H.T. lead.	Dry out.

See separate leaflet for fault finding on Self-Starter equipment.

OVERHAULING

DECARBONISING

The places where carbon forms most rapidly are the Cylinder Head top of Piston, Exhaust Port and Silencer. It will be appreciated that excessive carbon in the Combustion Chamber reduces compression space and probably causes pre-ignition and rough running. Heavy carbon deposits in the Exhaust Pipe and Silencer will cause back pressure coupled with heavy fuel consumption, loss of power and over heating.

In order to maintain engine efficiency it is advisable about every 2,000 miles to remove all carbon from inside the Cylinder Head, the top of the Piston and the edges of the ports. The Exhaust Pipe and Silencer should also be cleaned out. Before commencing to decarbonise, disconnect the Petrol Pipe and Carburetter and also remove Sparking Plug from Cylinder Head. Unscrew the 4 Cylinder Head Fixing Bolts. The Head can now be lifted clear of the Cylinder, and although the Gasket fitted between the Cylinder Head and Cylinder Barrel may not be damaged, it is advisable to fit a new one. Where engines are fitted with cowling, this must first be removed to obtain access to the cylinder head.

With a soft copper scraper, remove all deposit from the inside of the Head, taking care not to damage the joint faces. With the Piston at the top of the stroke, remove all carbon from the Piston top. Wipe off any loose carbon from around the edge of the Piston, then unscrew the Exhaust Pipe Nut and remove Silencer and Exhaust Pipe. Move the Piston to the bottom of its stroke and scrape out any carbon from Exhaust Stub and from the edges of the port in the Cylinder bore. This is best done from the outside of the Cylinder, taking care to avoid scratching the Cylinder bore. A piece of soft cloth placed in Cylinder bore will help to prevent the scraper causing damage and also prevent any particles of loose carbon from falling down through transfer passages. Make sure there is no loose carbon about before assembly. Remove any accumulation of mud or grit from the Cylinder fins.

For advice regarding the method of cleaning the Exhaust Pipe and Silencer internally, apply to the manufacturer of your motor-cycle.

If it is necessary at any time to remove the Cylinder, the 4 Nuts and Spring Washers fitted to the Studs securing the Cylinder to the Crankcase must be removed. Rotate Crankshaft until Piston is at bottom of stroke. Following this, the Cylinder may be taken off, but it is important not to twist the Cylinder in relation to the Piston, otherwise there is danger of the ends of the Piston Rings springing into the ports and consequent breakage. Take advantage of the cylinder being off to remove all trace of carbon deposit from inlet and exhæust ports; also from the transfer ports, which are not completely accessessible when the head only is removed.

To remove the Piston from the Connecting Rod a pair of thin nosed pliers should be used to take out one of the spring circlips which retain the Gudgeon Pin in position. When this has been done, the Gudgeon Pin can be pushed clear of the Small End Bush and the Piston lifted away. If carbon deposits prevent removal by hand, the use of an extractor of the band type is recommended, in which case if will be necessary to remove both circlips. So that the Piston may be re-fitted in the same way it is marked " front."

Carbon will also form in the grooves behind the Piston Rings and to remove this deposit it will be necessary to spring the rings out of the grooves. Rings may be removed without risk of damage by introducing behind the Ring 3 pieces of thin brass strip equally spaced around the Piston and then sliding off the Rings. It is desirable to ensure that each Ring is re-fitted in its original groove. Behind the lower Ring will be found an Expander Ring, fitted to prevent noise due to ' Piston Slap ' whilst the engine is cold. This Ring will have to be cleared of carbon and may, in time, lose its " temper " because of the heat, therefore, it is advisable to renew it when decarbonising.

Each Piston Ring should be bright all round and over the width indicating that the whole of the Piston Ring area is in contact with the Cylinder bore. If the gap between the ends of the Rings when in the Cylinder, exceeds .030″, then they should be discarded and replaced. The amount of gap can be checked by placing the Ring inside the Cylinder bore and pushing in a little way with the skirt of the Piston. This ensures that the Ring is square to the bore, and the gap can then be checked by Feeler Gauges.

Where new Rings of the standard size are required it is necessary to check the gap before fitting to the Piston. Place the Ring squarely in the Cylinder bore when the gap between the ends of the Ring should be a maximum of .011″ and a minimum of .007″.

RE-BORING

After the machine has done a considerable mileage the Cylinder bore may become worn as indicated by a ridge at the top of the bore, therefore, before fitting the Cylinder the bore should be checked by means of a dial gauge. If the bore is .008″ or more larger than the original size, the Cylinder should be returned to the Works for reboring and fitting of an oversize Piston with Rings.

When refitting the Cylinder, fit new Base Washer to Crankcase. Smear Cylinder bore and Piston surfaces with clean engine oil and fit Cylinder Barrel over Piston, taking every care not to twist the Cylinder. Ensure each Piston Ring is fully compressed in its groove with the ends correctly fitting on the Locating Pegs as the Barrel passes over it. Replace the 4 Nuts on Cylinder Base Studs and tighten equally. Re-fit Cylinder Head with new Gasket in position and tighten the 4 Bolts in diagonal rotation to prevent any possibility of Cylinder Head distortion.

This Booklet is not intended to contain full details for carrying out major repairs to your engine. In our opinion, it is inadvisable for the owner to attempt full dismantling of his engine, since without proper tools and facilities, damage may be caused to parts which are machined and assembled within very fine limits.

If your Unit needs expert attention you will be wise to contact your nearest Dealer, or you may approach us direct. Our fully-equipped Service Department is at your disposal to give you any help that you may need.

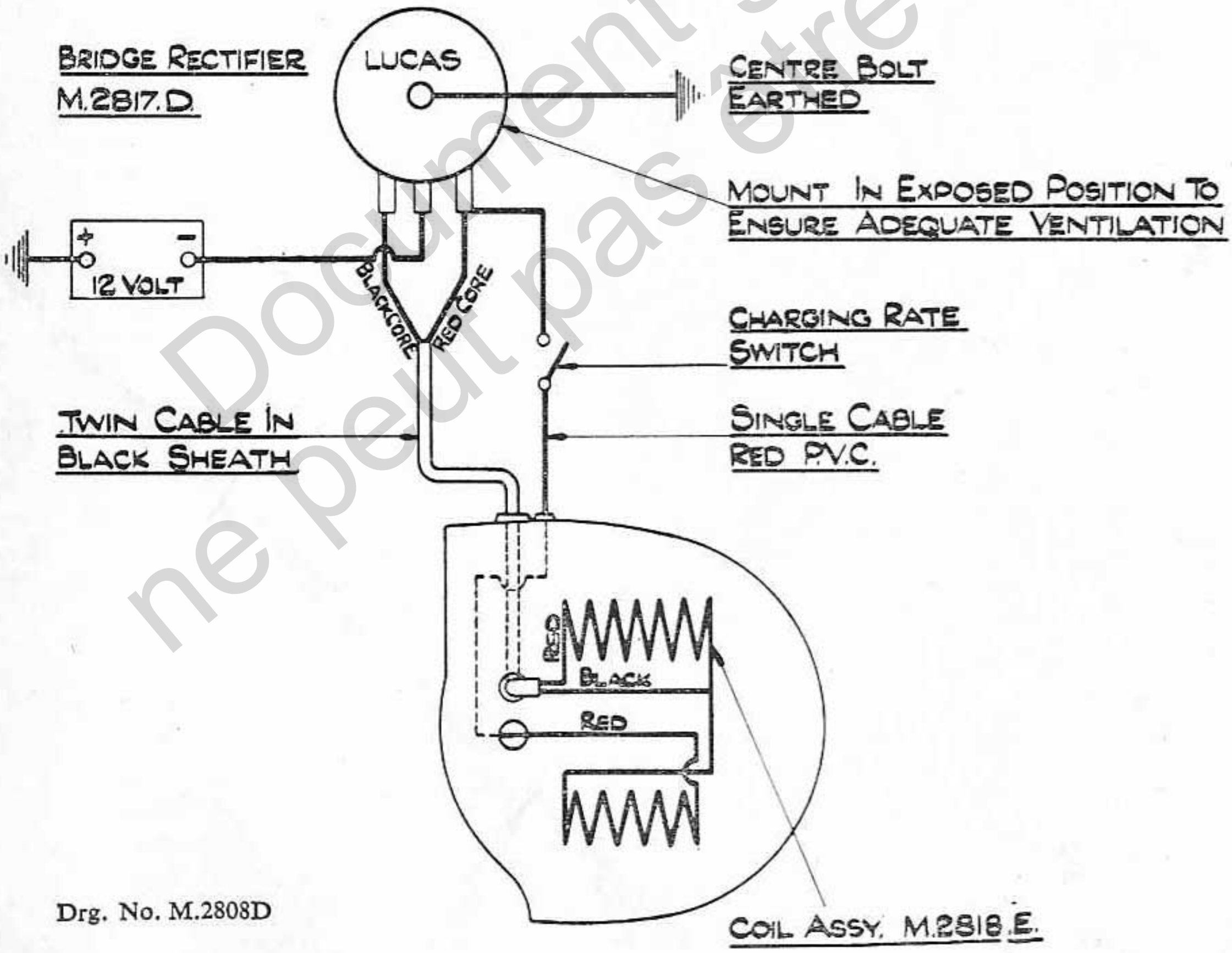
GEAR RATIO TABLES

3-SPEED GEARBOX

Gears	Ratios	
	Standard	Wide
Top Gear	1—1	1—1
Second Gear ...	1.34	1.7
First Gear	2.55	3.25

4-SPEED GEARBOX

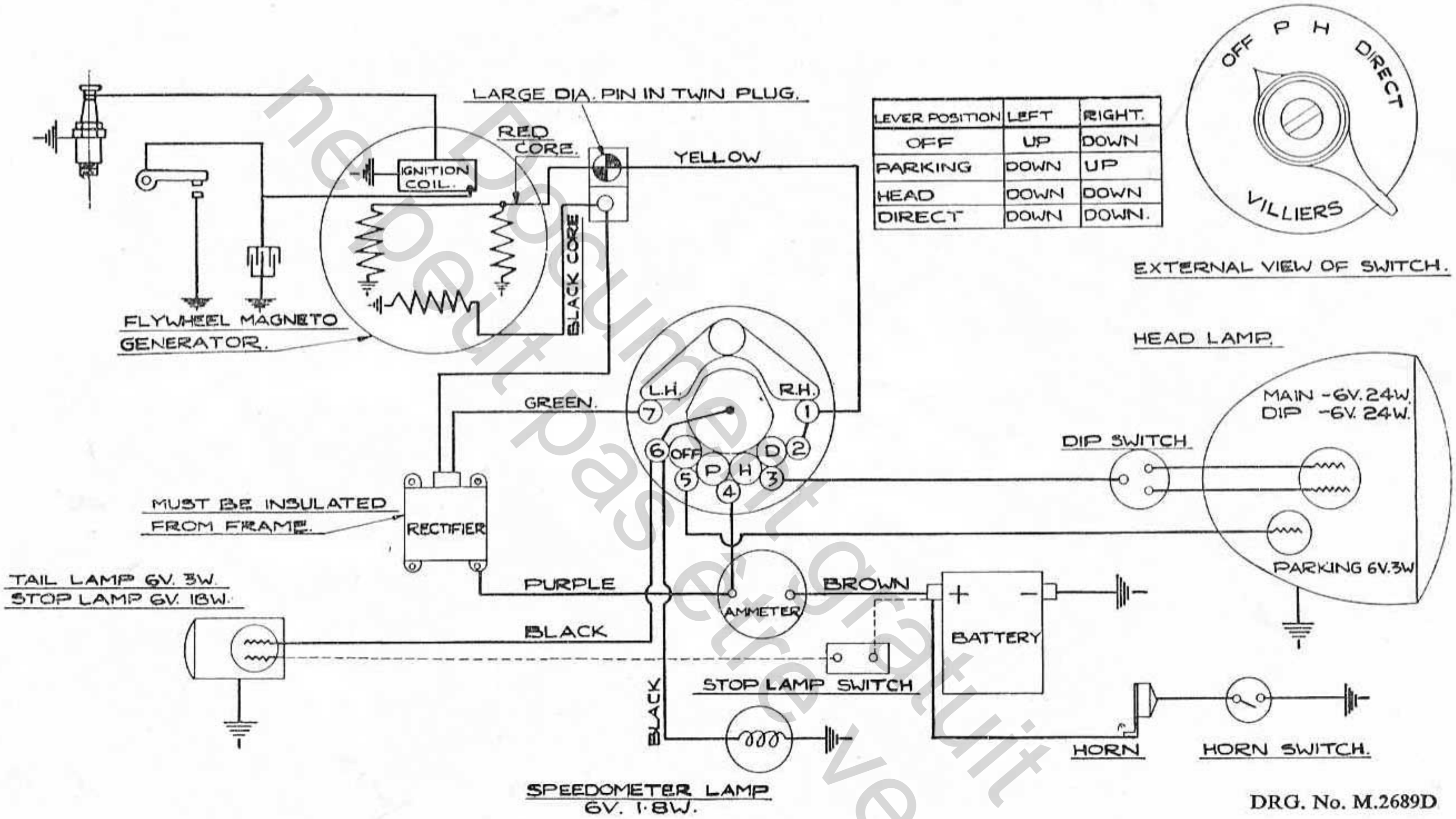
Gears	Ratios	
	Standard	Wide
Top Gear	1—1	1—1
Third Gear ...	1.27	1.34
Second Gear ...	1.78	2.4
First Gear	2.94	3.6



Drg. No. M.2808D

WIRING DIAGRAM (BASIC CIRCUIT) Fig. 8

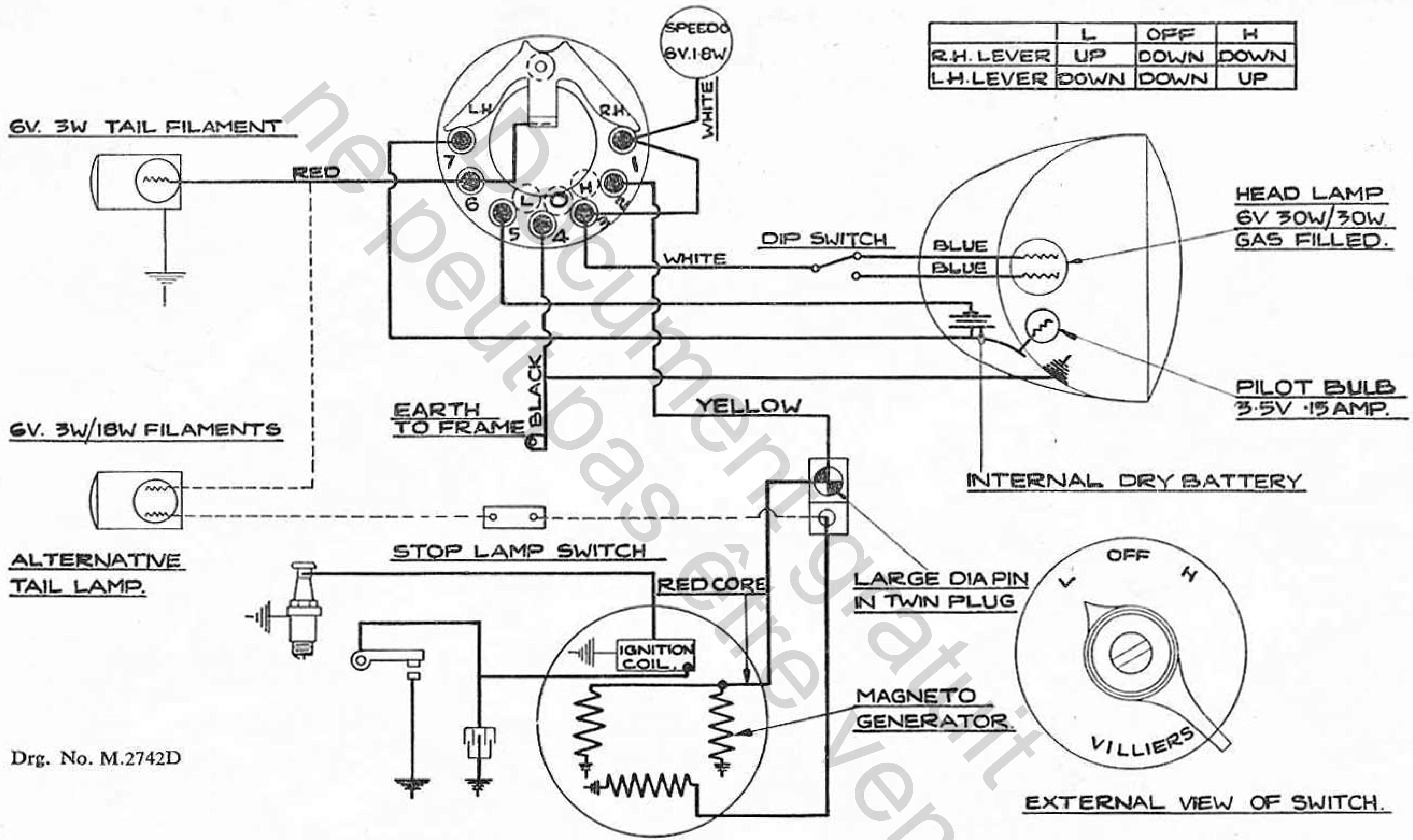
Villiers 12v. Magneto Generator



LEVER POSITION	LEFT	RIGHT.
OFF	UP	DOWN
PARKING	DOWN	UP
HEAD	DOWN	DOWN
DIRECT	DOWN	DOWN.

DRG. No. M.2689D

TYPICAL WIRING DIAGRAM (RECTIFIER LIGHTING) Fig. 9
using VILLIERS 6v. Magneto Generator.



	L	OFF	H
R.H. LEVER	UP	DOWN	DOWN
L.H. LEVER	DOWN	DOWN	UP

TYPICAL WIRING DIAGRAM (DIRECT LIGHTING) Fig. 10

using VILLIERS 6v. Magneto Generator

RUNNING-IN NEW ENGINE

Great care is taken during manufacture to ensure accuracy of fitting, but it is very necessary to allow moving parts a certain minimum running period to " bed in " before subjecting the engine and gearbox to full loads and to permit operation at maximum speeds. The efficiency of the engine and length of useful service greatly depends upon the care exercised during the early life of the engine. Detailed procedure is as follows:—

1. For the first 500 miles the throttle should not be opened more than two thirds of full movement and use should be made of the gearbox especially when climbing hills as much harm can be done to the engine by allowing it to labour in too high a gear. On the other hand engine must not be **raced** in a low gear.

2. After the initial 500 miles the throttle can be opened progressively wider until at 1,500 miles engine may be run at full power.

3. No fixed rules can be laid down for maximum speeds—40 to 45 m.p.h. is not excessive downhill providing the throttle opening is not increased. In traffic avoid over-revving or changing to a higher gear too early, thus making engine labour or judder. Exercise restraint so that the engine at all times runs smoothly.

4. It is very important that oil in the gearbox and chaincase is renewed after the first 500 miles. Check oil levels as frequently as once per week during the first 1,500 miles and " top up " if necessary. During initial stages of " running in " the heel of the contact breaker will " bed down " and the gap may close beyond the limits allowed; re-set to .012″ to .015″ in the Villiers magneto or .020″ for electric starter models.

5. Check the rear chain alignment and adjustment—the engine driving and rear wheel sprockets must be in line. Brakes must not " bind " when levers are in the off position and other machine parts should also be " vetted " for serviceability and security. Battery leads must be in good condition and make good electrical contact with the battery, the latter being kept topped up with **distilled** water.

6. An " Approved Villiers Service Dealer " should be consulted with any doubts or queries.

GUARANTEE

WE give the following guarantee with VILLIERS Engines and Accessories in place of any implied guarantee by statute or otherwise, all such guarantees being in all cases excluded. No statement or representation contained in this catalogue shall be construed as enlarging or varying this guarantee. In the case of engines and accessories which have been used for " hiring out " purposes, or from which our trade mark, name, or manufacturing number has been removed, no guarantee of any kind is given or is to be implied.

We guarantee subject to the conditions mentioned below, that all precautions which are usual and reasonable have been taken by us to secure excellence of materials and workmanship, but this guarantee is to extend and to be in force for six months only from the date of purchase by the first owner-used and the damages for which we make ourselves responsible under this guarantee are limited to the replacement of a part manufactured by us which may have proved defective. We cannot accept responsibility for the replacement of any proprietary articles or parts not manufactured by us, unless the makers of these parts agree to replacement.

We do not undertake to refit or bear the cost of replacement or refitting such new part. We guarantee, subject to the conditions mentioned below, to make good at any time within six months any defects in these respects, As VILLIERS Engines and accessories are liable to derangement by neglect or misuse, this guarantee does not apply to defects caused by wear and tear, misuse and neglect.

CONDITIONS OF GUARANTEE

If a defective part should be found in our engines or accessories, it must be sent to us carriage paid and accompanied by an intimation from the sender that he desires to have it repaired free of charge, under our guarantee, and he must also furnish us at the same time with the number of the engine, and full particulars of purchase. Failing compliance with the above, no notice will be taken of anything that may arrive, but such articles will lie here at the risk of the sender, and this guarantee or any implied guarantee shall not be enforceable.

THE TERM " AGENT " is used in a complimentary sense only, and those firms whom we style our agents are not authorised to advertise, incur any debts or transact any business whatsoever on our account other than the sale of goods which they may purchase from us, nor are they authorised to give any warranty or make any representations on our behalf or sell subject to or with any conditions other than those contained in the above guarantee.

The guarantee becomes void if any parts not made or supplied by THE VILLIERS ENGINEERING COMPANY, LTD., are fitted to a VILLIERS engine. To safeguard his own interests, the owner should always insist upon genuine VILLIERS parts.

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E. & O. E.