# MAINTENANCE MANUAL

*for*

Villiers

# MARK 1F.

## 98 c.c., 2-Speed Engine Unit

*Manufacturers*

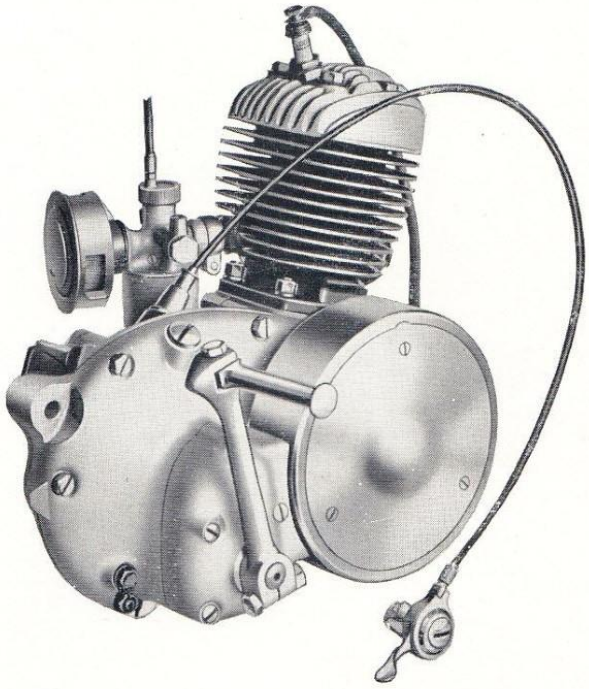
THE VILLIERS ENGINEERING CO. LTD.

WOLVERHAMPTON ENGLAND

# VILLIERS MK. 1F. UNIT

## INDEX

Villiers



98 c.c. - 2-Speed

# MK. 1F. UNIT

For Lightweight Motorcycles

# VILLIERS MK. 1F. UNIT

## TECHNICAL DATA.

CYLINDER BORE ... ... 47 mm.—1.8504"/1.8499"

STROKE ... ... ... ... 57 mm.—2.244"

CUBIC CAPACITY ... ... 98 cc.—6 cu. ins.

THREAD FOR SECURING ENGINE SPROCKET :
$\frac{7}{8}$" dia. × 16 T.P.I. Whit. Form.

THREAD FOR SECURING FLYWHEEL :
$\frac{9}{16}$" dia. × 20 T.P.I.

### BALL BEARINGS.

DRIVING SHAFT : 25 × 52 × 15 mm. 2. 3 spot

CLUTCH SHAFT ... 20 × 42 × 9 mm. 1. 3 spot

HIGH GEAR WHEEL : 25 × 52 × 9 mm. 1. 3 spot

CLUTCH BALL RACE ... ... ... 33—$\frac{1}{8}$" balls

KICK STARTER PEDAL ... ... 1—$\frac{1}{4}$" ball

### BIG END BEARING.

CRANK PIN DIAMETER ... ... .6565"/.65625"
Replacement sizes .6575"/.65725"

CRANK PIN ROLLERS : .1876"/.1874" dia.
.1877"/.1873" long

NUMBER OF ROLLERS ... ... ... 28

CONNECTING ROD DIAMETER : 1.0323"/1.0318"
Replacement sizes 1.0333"/1.0328"

CONNECTING ROD WIDTH ... .378"/.375"

SIDE CLEARANCE ... ... ... .007"/.004"

### SMALL END BEARINGS.

GUDGEON PIN DIAMETER ... ... .3660"/.3655"

GUDGEON PIN BUSH IN PISTON : .3665"/.3660"

GUDGEON PIN BUSH IN CON. ROD .3675"/.3665"

FLOATING BUSH IN CON. ROD

COMPRESSION RINGS : 1.8500" dia. × .0938"/.0928" wide. 2 off.

GAP AT JOINT ... ... ... ... .011"/.007"

MAXIMUM PERMISSIBLE GAP ... ... .03"

RING CLEARANCE IN GROOVE (TOTAL) : .006"/.004"

OVERSIZE PISTON RINGS :
1.850" dia. plus .015" and .030"

### CHAINS.

Front 56 pitches, $\frac{3}{8}$" pitch × .155" wide, $\frac{1}{4}$" roller—Endless

Rear $\frac{1}{2}$" pitch, .305" dia., roller .192" wide

### SPROCKETS.

ENGINE : 17 teeth for $\frac{3}{8}$" pitch × .250" roller × .155" wide.

CLUTCH : 42 teeth for $\frac{3}{8}$" pitch × .250" roller × .155" wide.

GEARBOX : 14 teeth for $\frac{1}{2}$" pitch × .305" roller × .192" wide chain.

### CAPACITIES.

PETROL AND OIL MIXTURE (PETROIL) : 1 part SAE30 to 16 parts gasoline.

GEARCASE : Fill to the height of the level plug on the side of the clutch case with gear oil SAE140. For cold conditions SAE90 may be used, and for extremely cold conditions SAE80 will be satisfactory.

### CARBURETTER.

VILLIERS ... ... ... ... ... TYPE 6/0

NOMINAL NEEDLE SETTING ... ... 29/32"
Needle No. 2½

JET SIZE ... ... ... ... ... ... 8

### IGNITION.

VILLIERS 6-pole flywheel magneto. Contact breaker point gap .012"/.015"

IGNITION SETTING : Points commence to open when piston is $\frac{1}{8}$" before top of stroke.

SPARKING PLUG :
Lodge type H14 or Champion J10 Com. (U.S.A.)
Thread ... ... ... 14 mm. short reach
Point Gap ... ... ... ... ... .020"

# VILLIERS MK. 1F. UNIT

## OPERATION — MAINTENANCE — LUBRICATION

**1 THE VILLIERS MK. IF. UNIT** consists of a 98 cc. two-stroke engine and two-speed gearbox with two-plate cork insert clutch, the clutch, gears and primary chain being all contained in one common casing. The gear selector mechanism consists of a sliding sleeve with face "dogs" which engages either top or bottom gear, and operated by a bell crank lever connected by a Bowden control to a lever on the handle bar. It is, therefore, possible to change gear without removing the hand from the handle bar, a light pressure with the finger or thumb being all that is needed. This engine is air cooled and of the deflectorless piston type. Ignition is by the Villiers flywheel magneto which also provides current for battery charging through a metal rectifier. The Villiers single lever carburetter gives a correct mixture under all conditions, and is fitted with a combined air cleaner and strangler.

### 2 OPERATION OF TWO STROKE ENGINE.

In the cylinder walls are arranged four holes or ports, viz., one exhaust port through which the burned charge is allowed to escape, two symmetrical transfer ports which, through passages on the side of the cylinder, are in communication with the crankcase, and one inlet port which permits the air-fuel mixture to enter the crankcase. Movement of the piston in a vertical direction is arranged to cover and uncover the ports at suitable times so that the mixture is first drawn from the carburetter through the inlet port into the crankcase. There it is compressed and then forced through the transfer passage into the cylinder above the piston, where it is further compressed. It is then ignited by a spark from the plug, and after expansion due to heat, escapes through the exhaust port, to the silencer.

The cycle of operations is as follows :

**(*a*) Upward Stroke of Piston.**

**Crankcase.** The exhaust and transfer parts are first covered by the movement of the piston, thus sealing the crankcase from the cylinder. Further movement reduces the pressure in the crankcase below that of the atmosphere, and when the inlet port is uncovered by the piston at the top of this stroke, a mixture of fuel and air enters the crankcase.

**Cylinder.** After the closing of these ports a charge above the piston which enters during a downward stroke will be compressed and then ignited by the sparking plug when the piston is near to the top of the stroke.

**(*b*) Downward Stroke of Piston.**

**Crankcase.** The piston movement closes the inlet port, and consequently, the charge in the crankcase is compressed until near the bottom of the stroke the transfer port is uncovered by the piston top passing the port. This allows the mixture to enter the cylinder through the transfer passages which are arranged in such a direction that the incoming charge is forced to the side of the cylinder remote from the exhaust port and at an angle which causes it to be deflected towards the cylinder head where it reverses its direction and drives out the remaining exhaust gas through the exhaust port.

**Cylinder.** The temperature of combustion causes a very high pressure above the piston, forcing it to descend. Near the end of this stroke the piston uncovers the exhaust port and the remaining pressure causes the burnt charge to escape rapidly through the port into the silencer. Shortly after the exhaust port is opened the transfer port is uncovered allowing the compressed charge in the crankcase to enter the cylinder above the piston.

From the above description it will be seen that an upward stroke of the piston causes a charge to enter the crankcase, and compresses a previous charge in the cylinder head. On the downward stroke the charge in the crankcase is being compressed while the ignited charge in the cylinder is expanding.

### 3 MAINTENANCE OF ENGINE POWER.

The performance of the engine largely depends on the fit of the piston and rings in the cylinder bore, the disposition and area of ports, and the gas tightness of crankcase and cylinder head. To obtain maximum power it is, therefore, necessary to keep all ports free from excessive carbon deposits, and maintain good compression in the cylinder and in the crankcase by attention to all cylinder head and crankcase joints.

### 4 LUBRICATION OF ENGINE.

In order to maintain the efficiency of the engine and gearbox and to reduce wear to a minimum it is essential that all moving parts are adequately lubricated. The system adopted with this engine is known as the Petroil system, in which the correct quantity of oil is first mixed with petrol (gasoline) before pouring into the tank.

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## LUBRICATION — RUNNING-IN — PERIODICAL ATTENTION

### LUBRICATION—*Contd.*

As the mixture first enters the crankcase and then into the cylinder, all working parts are adequately lubricated, and as the amount of fuel used will increase with the power output, it will be seen that under arduous conditions a greater quantity of oil will automatically be supplied. The correct proportions are ½ pint of oil SAE30 to one gallon of petrol. Make sure that it is well mixed before putting into the tank, otherwise undiluted oil is likely to get into the carburetter and cause considerable trouble through choking the passages.

We recommend the use of Wakefields Castrol XL oil for this engine, but in parts of the world where this is not obtainable, Shell X 100, SAE.30, Double Shell or Mobiloil A may be substituted.

For the gearcase SAE.140 or other high grade gear oil should be poured through the filler plug hole (Fig. 1) up to the height of the level plug (Fig. 1). SAE.90 should be used for cold conditions, or SAE.80 for extreme cold climates.

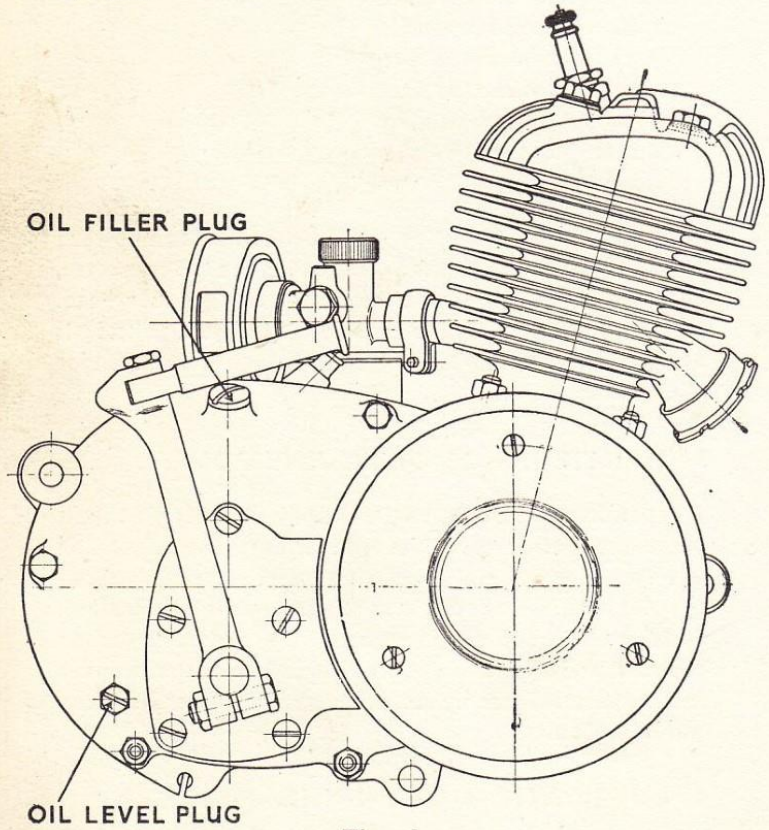


Fig. 1.

### 5 RUNNING IN.

The best results with these engines, as with all internal combustion engines, is obtained by using no more than half throttle during the first 300 miles, three-quarter throttle for the next 200 miles.

### 6 PERIODICAL ATTENTION.

It is advisable in order to enjoy trouble-free riding, that the engine and machine should have periodical attention. The following hints will help to keep the engine and machine in good running order :

Daily check level of gasoline-oil mixture in tank, and fill up if necessary.

Every 500 miles inspect level of oil in gearcase by removing level screw (Fig. 1) at rear of kick starter housing, fill up if necessary with oil, previously recommended.

Examine the contact breaker points after **first** 500 miles have been completed, as the points may require slight adjustment after initial bedding-in. The correct gap when points are fully open is .015". They should also be kept free from oil.

Every 2,000 miles remove cylinder head and scrape out carbon. The edges of the exhaust port in the cylinder can be cleaned when the piston is at the bottom of the stroke. Clean piston top. It should NOT be necessary to remove barrel and piston every 2,000 miles. Every 4,000 miles should be sufficient.

Every 2,000 miles remove and clean silencer and exhaust pipe.

Every 5,000 miles remove and wash out air cleaner with gasoline. Leave to dry, dip into oil and leave to drain before replacing.

Clean spark plug points and set gap to .020". Do not overtighten when refitting plug.

Occasionally check clutch and gear control cable adjustment. There should be a very small amount of slack in the clutch cable when clutch is engaged and in gear control cable when in top gear. Adjust clutch cable by means of adjusting screw on clutch bridge casting. Screw the adjuster in until there is just a trace of slack in the cable ; this is essential, otherwise the clutch may be slightly disengaged and cause slipping. Tighten locknut after adjusting.

Adjust gear control cable by means of cable adjuster on handlebar lever. This is best done in top gear, that is when the lever is in the closed position. There should be a trace of slack in the cable to ensure that top gear is fully engaged. If there is excessive slack, bottom gear will not be fully engaged, which will lead to rapid wear of the engaging dogs.

Occasionally examine joints, cylinder head, cylinder base, crankcase and clutch case for gas or oil leaks, and tighten if necessary.

Examine all visible nuts, bolts and screws for looseness.

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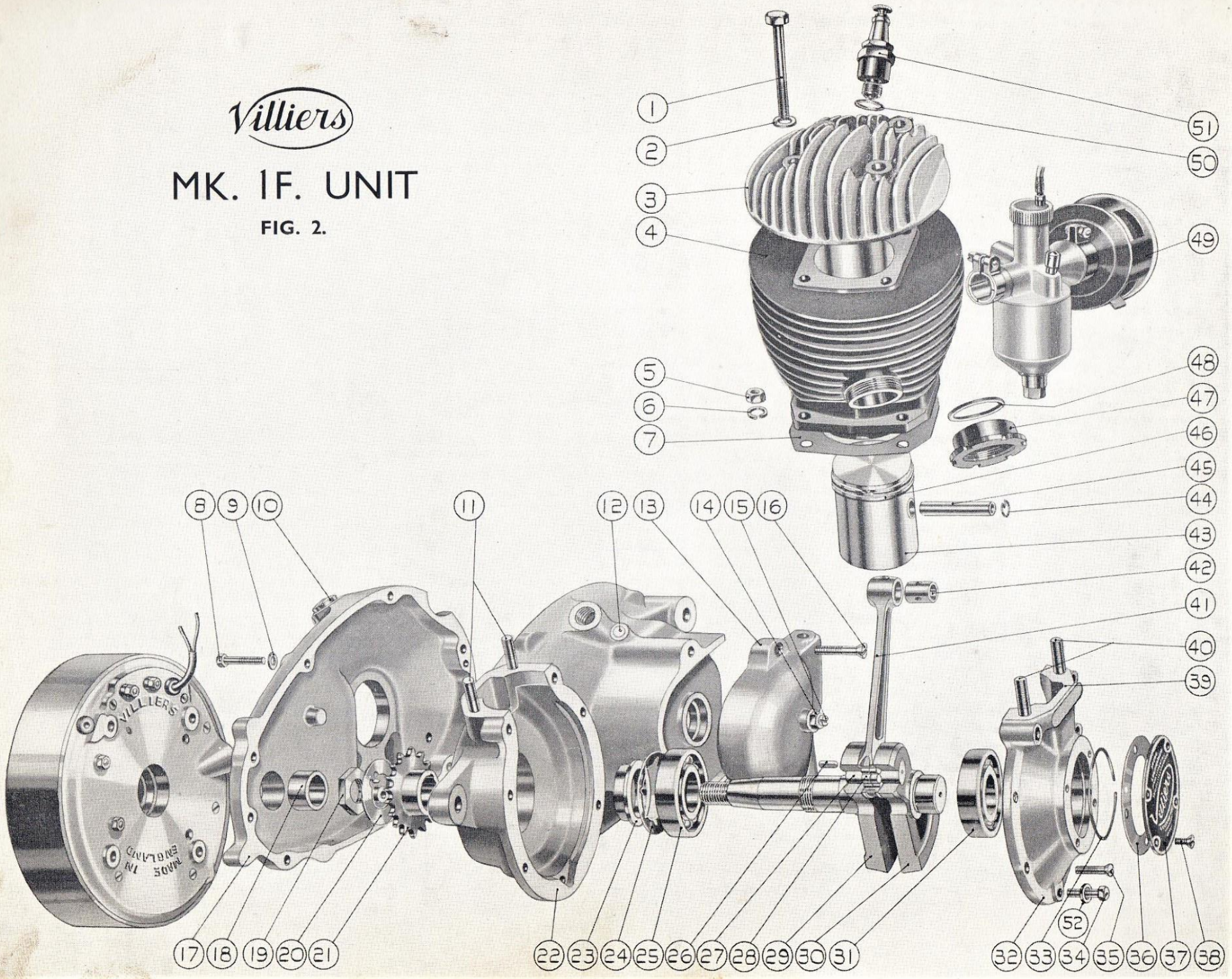
**FIG. 2.**



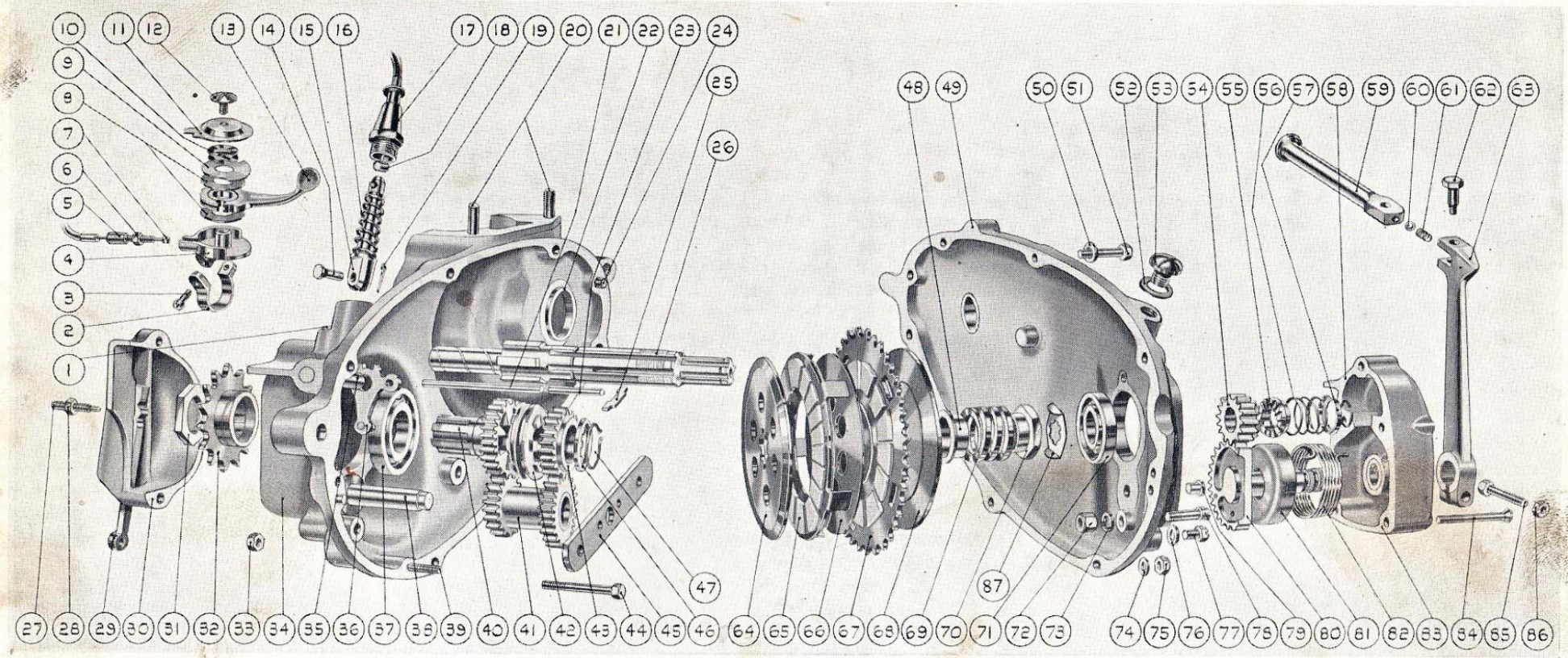



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**FIG. 5.**

# VILLIERS MK. 1F. UNIT

## STARTING — DRIVING HINTS — DECARBONISING

### 7 STARTING THE ENGINE.

See that the handlebar gear lever is in neutral, indicated by "N" on gear control top plate.

When the engine is **cold,** turn on the fuel tap, depress the tickler on carburetter until fuel appears showing the float chamber is full, close the strangler on the air cleaner, open the throttle approximately a quarter of the total movement of the twist grip. Depress the kick starter once or twice to draw an initial charge of mixture into the engine, then give a sharp kick downwards, when the engine should start. Open the strangler fully as soon as the engine is sufficiently warm to run with it in the open position. The engine should not be run on the road with the strangler closed, as this may cause oiling up of sparking plug, lack of power, and waste of fuel.

When the engine is **hot,** do NOT flood the carburetter or close the strangler ; start as before. If the engine fails to start it is probably due to too rich a mixture. Depress kick starter several times vigorously with throttle wide open to clear engine of excess fuel. Close throttle to normal starting position and try again.

If further attempts fail to start the engine, take out the sparking plug ; if it is wet with fuel and oil, clean the points and dry or use another plug. Test ignition by holding plug body on cylinder head fins with the sparking plug wire attached to the plug and depress kick starter. Take care not to touch the high tension terminal when testing plug as the result may be unpleasant. If a good spark is obtained replace the plug in cylinder head and try again. If no spark is obtained see that the contact breaker points are clean and set to the correct gap.

Difficulty in starting is sometimes caused by slight flooding of the carburetter when the machine is standing. This allows neat fuel to enter the crankcase resulting in a rich mixture. It is wise, therefore, to close the fuel tap if the machine is being left for any length of time, but the difficulty in starting due to this cause can usually be overcome by using a wide throttle opening, but it may in some cases be necessary to drain the crankcase by removing drain plug (No. 34 Fig. 2). If this procedure fails, reference to the possible cause is given in the chart given later in these pages.

### 8 DRIVING HINTS.

Before using a new machine make sure that the gearcase is filled to the level plug with the correct grade gear oil, that there is fuel in the tank, note that engine oil should be mixed with petrol (gasoline) in the proportion of 1 part of oil to 16 parts of petrol. This should be well mixed before being put into the tank. Before actually starting up, it is advisable to sit astride the machine and familiarise yourself with the various controls.

Note that the throttle is controlled by means of a twist grip or single lever on the right hand side of the handlebar, the gear control by a single lever on the same side. Note that the top plate is marked—High, N., Low—indicating the position of the lever for the two gears and the neutral position.

When engaging bottom gear the lever should be pushed over to the low position as far as cable will allow without undue strain so as to fully engage bottom gear, and for top gear the lever should be pulled up to the stop on the control body.

The clutch lever is on the left hand side of the handlebar. This machine is designed to negotiate most mainroad hills in top gear ; do not make excessive use of bottom gear, it is only intended for starting, traffic work and steep hills.

Do not slip the clutch unduly, a neutral is provided for stopping in traffic, etc. It will only result in wear of the works and upset clutch adjustment which will make gear changing difficult.

### 9 DECARBONISING.

In order to maintain engine efficiency it is advisable about every 2,000 miles to remove all carbon deposit from inside the cylinder head, the top of the piston and the edges of the ports. The exhaust pipe and silencer and fish tail or pipe should also be cleaned out.

### 10 TO REMOVE CYLINDER HEAD.

Disconnect the sparking plug wire from the sparking plug and remove the sparking plug from cylinder head. Unscrew the four cylinder head fixing bolts ; the head can now be lifted off. With a soft copper scraper remove all carbon deposit from the inside of the head, taking care not to damage the joint face, as a leak may be caused. 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 great 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 assembling. Remove any accumulation of mud or grit from the fins.

### 11 TO REPLACE CYLINDER HEAD.

No gasket is fitted between cylinder head and barrel ; these joint faces must be perfectly clean and flat, and free from scratches or bruises. Place head in position, the sparking plug being at the rear. Each cylinder head bolt should have a thick plain steel washer under its head. Screw down each bolt finger tight ; finally screw down each bolt half a turn at a time until all are fully tight. Clean and re-adjust plug points if necessary and replace plug. Replace high tension lead, silencer and exhaust pipe.

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## DECARBONISING — REBORING

### 12 TO REMOVE CYLINDER BARREL.

Remove cylinder head (see para. 10), remove carburetter by undoing square headed screw fitted to carburetter clip. Disconnect the fuel pipe from the carburetter and tank. The carburetter can either be left attached to its cables or it can be removed by unscrewing the top ring nut (No. 4, Fig. 25), and removing the throttle slide (No. 11, Fig. 25) complete with needle. Care should be taken to see that the throttle slide and needle are not left in such a position that they can be damaged. Unscrew exhaust pipe ring nut (No. 47, Fig. 2) using E7531 spanner. Remove cylinder base nuts (No. 5, Fig. 2.) and washers (No. 6, Fig. 2). Rotate crankshaft until piston is at bottom of stroke. Raise cylinder until clear of piston, but do not twist cylinder, otherwise the ends of piston rings may come in contact with the edges of the ports which may cause rings to fracture. Cover the opening into crankcase with a piece of clean rag.

### 13 TO REMOVE PISTON.

Remove one of the two gudgeon pin circlips (No. 44, Fig. 2) using special round nosed circlip pliers. Push gudgeon pin (No. 45, Fig. 2) out of piston. If carbon deposits prevent removal by hand the use of an extractor of the band type is recommended, although it may be effected by tapping gently with a hammer. In that case be sure to support the piston to avoid any strain being placed upon the connecting rod. Lift piston away, and mark the inside of the skirt to enable it to be refitted in the same position relative to the cylinder.

**Note.** The gudgeon pin is a sliding fit in the piston and connecting rod small end bush. The small end bush is also a floating fit in the connecting rod.

The piston rings may be removed without risk of damage by introducing behind the ring three pieces of thin brass strip spaced (Fig. 3) and then sliding off the rings. Do not scratch the piston. It is desirable to ensure that each ring is refitted in its original groove.

### 14 RE-BORING OF CYLINDER.

When it has been established that re-boring is necessary and the size of bore to which it will be finished has been decided, *i.e.*, .015″ or .030″ oversize, the following method should be adopted :

**Choice of Machine.**

This may be any precision fine boring machine such as Heald 48A Borematic or Excello type 309, or alternatively any boring bar of repute, such as Van Norman, etc.

**Choice of Tool.**

This should preferably be tipped with tungsten carbide equivalent to the Wimit Grade "N."

**Location.**

This is done off the spigot at the base of the cylinder, which should be clamped against an angle bracket by two clamps bearing on the cylinder head joint face.

**Boring.**

When it has been determined that the location of the cylinder is perfectly concentric to the boring bar (this is checked by revolving the boring bar into the cylinder leaving a witness mark on the whole of the circumference) a preliminary cut of .010″ is taken over the full length of the cylinder. The recommended feed for this cut is from between .003″ and .005″ per rev. This is followed up in the case of the .015″ oversize cylinder by a finish cut of approx. .004″ to .0045″ on diameter with a feed of .0002″ per rev., thus leaving from .0005″ to .001″ for honing. In the case of the .030″ oversize bore a preliminary cut of .015″ with a .005″ feed per rev. is taken. This is followed on by a second cut of .010″ with the same feed and finished by a last cut of from .004″ to .0045″ with a .0002″ feed per rev. for finishing.

### 15 HONING.

**Choice of Machine.**

The machine may be any of the vertical or horizontal reciprocating type honing machine. In the latter type fixed hones should be used, but preference is given to the vertical machine where a floating hone may be employed.

**Grade of Stone.**

This should be 320M or its equivalent. This grade is made by the Universal Grinding Co., and is a general purpose stone.

**Coolent.**

This is very important and good quality paraffin (kerosene) mixed with up to 25% lard oil should be used. Care should be taken firstly that a liberal flow of coolent is directed well in the cylinder bore, secondly that an adequate filter is installed in the coolent circuit to separate the particles of abrasive. As a guidance, the finish to be obtained from honing should be from 5 to 10 micro. inches. In the absence of suitable equipment for measuring the surface finish we recommend that a comparison check is taken with either a new cylinder or a test block which has the required surface finish.

### 16 GAUGING.

This may be done by any of the various cylinder gauges which are on the market. We, however, recommend as the most suitable type an internal dial gauge, for measuring cylinder bores, such as are made by Messrs. Brown and Sharpe, Starratt, or Mercer, etc.

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## REBORING — REMOVING UNIT FROM FRAME

The tolerances to which the bore should be finished are as follows :

(*a*) .015" oversize should be 1.8654"/1.8649"

(*b*) .030" oversize should be 1.8804"/1.8799"

### 17 TO RE-FIT CYLINDER AND PISTON.

Before fitting the cylinder, the bore should be checked for wear by means of a dial gauge. If the wear exceeds .008" the cylinder should be rebored to the next oversize. Even if the wear is not serious, but there are scars or scratches reboring will be necessary. The pistons should also be checked for wear. The standard sizes of pistons available are :

(1) Standard diameter.

(2) .015" oversize.

(3) .030" oversize.

**When fitting a new piston remember to fit two circlips,** one on each side of the gudgeon pin.

All parts must be clean (see para. 9). Before replacing rings on piston they should be checked for wear by inserting each ring into the least worn parts of the cylinder barrel, *i.e.*, at the bottom, and checking width of ring gap with a feeler gauge. The ring must be placed so that it lies square in the bore to obtain a correct reading.

If gap measures .030" or more, fit new rings to give a minimum gap of .007". The maximum gap permissible for new rings is .011".

Place rings on piston using three pieces of thin brass (see Fig. 3), radial location being made by the pegs fitted in the grooves. Place piston over connecting rod, ensuring that it is in the correct position as originally fitted, that is, with the same rubbing faces together. Smear gudgeon pin with engine oil and fit it into piston, and pass it through the connecting rod small end bush until it butts against the circlip which was left in the piston. Re-fit the other circlip and make quite sure that each circlip lies snugly in its groove. **This is essential.**

**Note.** Circlips bent or damaged in any way should be discarded and new circlips fitted. Remove rag from crankcase opening. It is essential to make a gas tight joint, so therefore, the joint faces must be clean and undamaged.

Fit new cylinder base washer to crankcase (No. 22, Fig. 2). No jointing solution should be used. Smear cylinder bore and piston surfaces with engine oil and fit cylinder barrel over piston taking every care not to twist the cylinder which would cause the ring ends to foul ports.

Ensure each piston ring is fully compressed in its groove with the ends correctly fitting on the pegs in turn, as the barrel passes over it. Replace cylinder barrel holding nuts (No. 5, Fig. 2) and washers (No. 6, Fig. 2), screwing each in turn until all are fully tight.

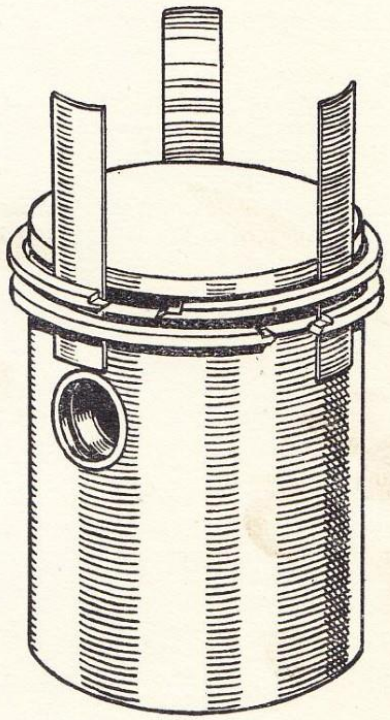

**FIG. 3.**

### 18 TO REMOVE COMPLETE POWER UNIT FROM FRAME.

Remove exhaust pipe ring nut (No. 47, Fig. 2) securing the exhaust pipe with spanner E7531. Remove copper asbestos washer (No. 48, Fig. 2). Remove petrol pipe by unscrewing union nut at tank end and banjo bolt at carburetter end. Release square head bolt (No. 19, Fig. 25) securing carburetter to inlet stub and remove carburetter complete. Disconnect gear control cable at handle bar end by dismantling control, and at engine end by unscrewing cable stop (No. 17, Fig. 5), and pushing cable nipple (No. 18, Fig. 5) out of slot in the top of the forked joint (No. 15, Fig. 5). Remove rear chain guard. Remove spring connecting link from rear chain and withdraw chain from small gearbox sprocket. Release clutch cable at gearbox end. Disconnect lighting cable at connector. Remove nuts from three main engine fixing bolts, and support the engine while the three bolts are removed. The engine should be removed from the right hand side of the frame.

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## DISMANTLING UNIT.

### 19 TO DISMANTLE ENGINE AND GEARBOX UNIT.

Remove the unit from the frame (see para. 18) and mount on dismantling jig (ST143) such as is shown on Fig. 4.

**Remove :**

Magneto flywheel and armature plate.

Flywheel by unscrewing centre nut (No. 35, Fig. 2) anti-clockwise, preferably using the special "hammer-tight" spanner obtainable from service agents. The nut is imprisoned and acts as an extractor.

The armature plate from crankcase by unscrewing four countersunk headed screws found between the ends of the coils.

Kickstarter cover plate by unscrewing five countersunk headed screws.

Paper joint washer.

Clutch bridge with operating lever (No. 30 and 29, Fig. 5) after removing two screws.

The two lengths of push rod in the centre of the clutch shaft should be taken out by tipping the engine on its side.

Cylinder head (see para. 10).

Cylinder barrel (see para. 12).

Piston (see para. 13).

Cylinder base washer.

### 20 DISMANTLING GEARCASE AND CRANKCASE.

Remove nameplate (No. 37, Fig. 2) from left hand crank-case and seven screws securing the left hand crankcase to main gearbox case. Use extractor ST112, Fig. 6 to withdraw left hand crankcase from crankshaft. Remove screws and nuts holding the clutch casing (No. 49, Fig. 5). This can be detached by means of extractor ST148, Fig. 7 fitted to the kickstarter face. The engine shaft nut (No. 19, Fig. 2) can be removed after turning down the tang of the lockwasher (No. 20, Fig. 2), the sprocket (No. 21, Fig. 2) being held by the locking plate ST144, Fig. 8 engaging with the teeth. Sprocket, clutch shaft and chain can then be removed as a unit. The sliding dog can now be withdrawn from the operating peg on the selector lever. The crankshaft should then be tapped out of the case by means of a wooden or rubber mallet which will avoid damage to the threads, or by using extractor ST127, Fig. 9. The final drive sprocket (No. 32 Fig. 2.) can be withdrawn after removing the locking screw and nut (No. 31, Fig. 5).

The sprocket should be prevented from turning by using the service locking plate ST115, Fig. 10 secured by two screws to casing and fitting round teeth. The high gear pinion can then be tapped out of the bearing. The ball bearing may then be removed from the crankcase by means of an expanding extractor ST137, Fig. 11. Alternatively, the case may be heated by dipping in boiling water when the bearings may be pushed out easily. If the bearings should remain on the shafts instead of in the cases, they may be removed by means of an extractor as shown on ST204, Fig. 12. The gearcase and clutch case halves now being separated, the countershaft bridge can be removed.

**Note.** The bolts securing the countershaft bridge are stabbed to prevent the nuts loosening. It is advisable to leave these undisturbed unless it is absolutely necessary.

If it **is** necessary to remove the countershaft, undo the two nuts on the bridge bolts found on the outside of the case and remove the bolts. Two tapped holes in the plate will facilitate its removal by screwing in two screws $\frac{1}{4}$" dia. × 26 Thds./1", thus forcing the plate off the end of the spindle. The one-piece countershaft double gear can then be withdrawn. If necessary, for replacement purposes the countershaft spindle can be pushed out of the case by means of fixture (ST149, Fig. 13). The fork joint (No. 15, Fig. 5) and selector lever (No. 36, Fig. 5) can now be removed, after removal of the split pin and the pivot pin.

### 21 TO DISMANTLE KICK STARTER SHAFT ASSEMBLY.

Remove kick starter lever pinch bolt and nut. The lever can then be withdrawn from the splined shaft. The kick starter shaft (No. 80, Fig. 5), spring (No. 82, Fig. 5), and spring cover (No. 81, Fig. 5) will then slide out of the casing.

### 22 DISMANTLING AND RE-ASSEMBLING DRIVING SHAFT ASSEMBLY.

The removal of the crankpin requires a special fixture, ST117, Fig. 14 in which the shafts are held whilst the crankpin is removed. The side float of the big end is allowed for when building. Do not mistake this float for up and down play ; a small amount of "rock" is of no importance.

The re-assembly of the crankshaft and connecting rod can only be carried out properly by the use of special assembly ST174, Fig. 15, and trueing fixtures, and quite a lot of experience is necessary before a really satisfactory result can be obtained. In the event of a failure of the big end, we recommend that a complete crankshaft and connecting rod assembly, made in the factory, should be used as a replacement. This will ensure that the necessary degree of accuracy of this assembly is obtained,

# VILLIERS MK. 1F. UNIT

## DISMANTLING UNIT.

**DISMANTLING**—*Contd.*

and that the correct parts have been used. Where this is impossible it should be noted that the required amount of interference between the crankpin and the hole in the crankshaft can only be obtained by the use of an oversize crankpin, which also makes it necessary to use an oversize connecting rod.

The following is a description of the methods used in the factory for the assembly of these components.

One end of the crankpin is pressed into the crankpin hole of one of the shafts, being guided in such a manner that the pin is kept square with the face of the crankshaft. When replacements are necessary the crankpin is made .001" larger than the standard size as previously mentioned. The crankpin is of course, assembled from the inside face of the driving shaft to prevent the possibility of the roller track being damaged through passing through an interference hole. The connecting rod is next fitted over the crankpin, and two rows of rollers, 14 in each row, are then placed around the crankpin. These rollers are accurately made to a size of .1875" diameter and .1875" long. Ordinary engine oil is then poured into the roller track, and then the other side of the crankshaft is placed on to the crankpin and lined up as accurately as possible with the first shaft. It is then pressed home on to the crankpin using a gauge of pen steel .010" thick between the face of the connecting rod and the crankshaft. After the removal of this gauge there should be between .004" and .007" clearance. The pressure in assembling the crankpin must obviously be applied directly over the crankpin and not on the centre of the driving shaft, as this will cause very severe distortion of the whole assembly. After this assembly process a trueing fixture is used. The driving shafts are placed between centres (see Fig. 16), and the whole assembly is rotated by hand by means of the connecting rod and the alignment of the shaft checked by clock gauges, as illustrated. Correctness of alignment is then obtained by tapping the balance weight of the crankshaft with a lead hammer until the eccentricity of the shafts is shown on the clock gauge is not more than .001". It will be appreciated that it is only by experience that this trueing process can be carried out effectively.

### 23 TO DISMANTLE CLUTCH SHAFT.

This is easily done by means of fixture as shown on (illus. ST114, Fig. 17), but if this is not available, it can be dismantled as follows :

Grip large spline end in lead clamps in vice and unscrew large hexagon nut (No. 70, Fig. 5) retaining clutch spring, which will allow the spring (No. 69, Fig. 5), inner sleeve (No. 48, Fig. 5), outer clutch plate (No. 68, Fig. 5) and chain wheel (No. 67, Fig. 5), complete with ball races to be removed. This will permit the clutch cotter to be withdrawn from its slot. The remaining clutch plates can then be removed. The seeger circlip can be removed with special pliers. The brass thrust washer and low gear wheel will now slide off the shaft.

**Note.** The clutch case, gearcase, left half crankcase are machined together to form a complete assembly, and are not interchangeable.

### 24 BALL BEARINGS.

The bearings should be examined before re-assembly to ascertain whether they require replacement, as the result of wear. Generally speaking, wear will only occur due to dust or other foreign matter reaching the ball track, or through insufficient lubrication. The bearings should spin freely without harshness, and of course, without appreciable radial slackness. If it is found necessary to replace these bearings, it should be noted that the type having the correct initial clearance is used. Bearings are obtainable with different degrees of initial radial clearance, usually denoted on the side of the bearing by ground circles, and are known as 1, 2 or 3 spot bearings. The object of this is to indicate the amount of initial clearance on the ball track. The type required for this engine is the 3 spot, which has the greatest radial clearance and permits the required degree of interference of the bearing on the crankcase and in the bearing housing, without exerting any initial pressure on the ball track after assembly.

In the assembly of the bearing it is essential that the inner and outer members should be started absolutely square with the shaft or housing, as otherwise it would be impossible to fit the bearing correctly. The load required to fit the bearing in the housing should always be applied on the outer race, and the inner race should be supported while pressing the shaft into the bearing. If this is not done correctly, there is a very serious danger that the ball track may be indented, which will make quiet running quite impossible, and will lead to rapid failure of the ball track.

# VILLIERS MK. 1F. UNIT

## ENGINE AND GEAR ASSEMBLY

### 25 ENGINE ASSEMBLY.

Before commencing to assemble the engine make sure that all the parts have been washed and thoroughly cleaned.

First fit the gland bush (No. 23, Fig. 2). It should be perfectly clean and should form an effective seal against the crankcase face, otherwise it will be impossible to obtain a good performance from the engine. Fit spring (No. 24 Fig. 2) to driving shaft bearing housing. Note that the spring is fitted so that the inner diameter presses the gland bush against the case. The ball races can either be assembled into the case by means of a hand press or by heating the case in boiling water and pressing the bearings in by hand. Assemble ball bearings in gearcase using fixture ST208, Fig. 18, pressing well down into the housing, also fit a high gear wheel bearing at the same time using fixture ST141, Fig. 19. All bearings should be well oiled before assembly. The high gear wheel can now be pushed through the bearing, the sprocket fitted, and the nut tightened up very tightly. The sprocket can be prevented from rotating by using the locking plate ST115, Fig. 10. Fit locking screw to prevent nut loosening.

Assemble one ball bearing on the left hand driving shaft by supporting the shaft between the crank cheeks on an inverted "U" shaped bracket to avoid distorting shaft assembly (see Fig. 20), and pressing the bearing down to the shoulder. Next fit driving shaft assembly by supporting the driving shaft ball race on a tubular pillar, and press the crankshaft into its bearing. It is most important that a wedge be fitted lightly between the balance weight cheeks, as shown in illus. No. ST142, Fig. 21, to avoid distorting the driving shaft.

Heat the left hand crankcase in boiling water and assemble on the gearcase. The crankcase should easily slip over the ball race. Care should be taken to see that the spigot on the left hand crankcase fits the recess in the right hand case and that the dowel enters the hole correctly, otherwise the joint may be damaged. (Seccotine or jointing compound should be applied to the joint on the gearcase before the left hand crankcase is applied). Screw up tightly with six countersunk headed screws. Note that a special HEXAGON SCREW is fitted at the **bottom** of the crankcase as a drain screw. A fibre washer (No. 52, Fig. 2) is required.

The driving shaft should revolve freely when the case is bolted up. A light tap on the end of the shaft while the case is hot is usually sufficient to remove any tightness. Replace the nameplate, fit new joint washer and secure with the four countersunk headed screws. It is essential that this joint is airtight, and if the nameplate is buckled or damaged, it should be replaced. If the countershaft has been removed it should now be refitted. Apply plenty of oil to the spindle and bushes.

If it has been necessary to replace countershaft bushes these should be reamered to suit the countershaft spindle leaving suitable clearance on shaft.

Re-fit countershaft bridge and bolt up tightly. The bolts should be fitted from the inside of the case, nuts on the outside. The end of the bolt should be stabbed or riveted over to secure nuts. Check up to ensure that the gears revolve freely after assembly.

Re-fit cylinder and piston (see para. 17).

Re-fit cylinder head (see para. 11).

### 26 RE-ASSEMBLE CLUTCH SHAFT.

Oil low gear wheel bearing. Assemble wheel, brass washer and circlip, using special pliers. Next assemble clutch plates in order shown in Fig. 5. Note that the outer plate with holes goes next to the circlip. Next the tanged plate, the tangs pointing away from the circlip, then the crank plate, the dished side toward the tanged plate. The cotter should next be fitted into the shaft in the slot, then the chain wheel (No. 67, Fig. 5) complete with ball race. Apply oil to the ball race before fitting and finally replace the outer plate (No. 68, Fig. 5), sleeve (No. 48, Fig. 5), spring (No. 69, Fig. 5) Nut (No. 70, Fig. 5). This nut can be assembled by putting in a vice and forcing the clutch shaft against it compressing the spring, but it may be assembled more easily by means of an assembly fixture ST114, Fig. 17. The nut should be flush with the end of the thread on the shaft. If it is necessary to re-cork the clutch plates, the thickness of the inserts should be reduced to $\frac{5}{16}$" by grinding after assembly ST139, Fig. 22, taking care to see that the corks project an equal amount on either side of the plates see ST140, Fig. 23.

Next replace the ball race on the right hand end of the clutch shaft. Fit the ball race, ratchet pinion (No. 54 Fig. 5), ratchet (No. 55, Fig. 5), spring (No. 56, Fig. 5), cap (No. 57, Fig. 5), and circlip. Make sure that all these parts are well oiled and work freely.

Re-assemble selector lever (No. 36, Fig. 2) and fork joint (No. 15 Fig. 5.), complete with spring (No. 16 Fig. 2), pivot pin (No. 14, Fig. 2) and split pin (No. 19, Fig. 2). The sliding dog should next be fitted, the dogs engaging in the slots in the high gear wheel. Make sure that the peg on the selector lever engages in the groove in the sliding dog.

### 27 GEAR ASSEMBLY.

Fit key into driving shaft, making sure that it is well down in the recess. Assemble engine sprocket (No. 21 Fig. 5.), chain and clutch assembly, and fit into gearcase as a unit. The clutch shaft assembly should be passed through the splined hole in the sliding dog and into the high gear wheel. The engine sprocket should be fitted to the driving shaft with the boss fitting inside the gland bush, taking care that the keyway engages the key correctly.

# VILLIERS MK. 1F. UNIT

## KICK STARTER — MAGNETO

**ENGINE ASSEMBLY**—*Contd.*

Fit locking plate (No. 20, Fig. 2) and nut (No. 19, Fig. 2), and tighten very tightly using a fixture for holding sprocket ST144, Fig. 8. Turn up edge of locking plate with a chisel or similar tool so that the nut will be secure. Fit new clutch case paper washer ; the clutch cover should then be heated in boiling water and fitted, taking care that the dowel holes fit correctly, and that the bearing housing locates over the clutch shaft ball bearing. Tighten up all nuts and screws.

**Note.** Three countersunk screws at driving shaft end, two nuts on the studs at the bottom, and three hexagon screws at the top. Do not forget the washers.

### 28 RE-ASSEMBLING KICK STARTER.

Fit kick starter cover joint washer. If the kick starter shaft had been removed from the casing, re-fit, taking care that the ends of the return spring fit into the holes in the cover and gear. The correct hole in the gear is $\frac{1}{8}$" dia. nearest to the flat. The spring should be wound up by means of the lever and the cover fitted to the clutch case. Make sure that the stop and gear engage correctly with the pin (No. 78, Fig. 5) on the case. Tighten up the five screws tightly. The lever should be fitted to the splined shaft so that it makes an angle of about 15° with the vertical line of the case. Fit and tighten up the pinch bolt (No. 85, Fig. 5) and nut (No. 86, Fig. 5). Replace clutch operating rods, the short one first. Fit the clutch bridge (No. 13, Fig. 2), together with clutch operating lever, using two screws (No. 16, Fig. 2).

### 29 RE-FITTING MAGNETO.

The armature plate is located on a spigot on the clutch casing and is secured by four long screws. The high tension lead faces forwards towards the front engine lug. Before mounting the flywheel on the shaft remove all traces of oil from both shaft taper and bore of flywheel cam, otherwise slipping is likely to occur. The felt pad should be slightly oily before fitting the flywheel.

### 30 TIMING OF MAGNETO.

The contact breaker points should commence to open when the piston is $\frac{1}{8}$" before top of stroke. Timing marks are stamped on both the armature plate and flywheel rim (Fig. 24). The mark on the armature plate is stamped on a small boss on the rim of the armature plate, and the mark on the flywheel rim coincides with it when the piston is at the top of the stroke. On checking timing it is only necessary to remove the sparking plug ; turn flywheel until the two marks are opposite, when the piston should be at top of stroke.

When timing ignition after dismantling, loosely fit flywheel to shaft, and having set piston at top of stroke by looking through plug hole in the cylinder head, rotate flywheel without turning the crankshaft until the marks on the rim and on the armature plate coincide.

Tighten up flywheel centre nut sufficiently tight for crankshaft to be rotated. Check to see that the flywheel has not slipped. Finally tighten the centre nut with the special hammer tight spanner (Fig. 24). Re-fit cover and screws.

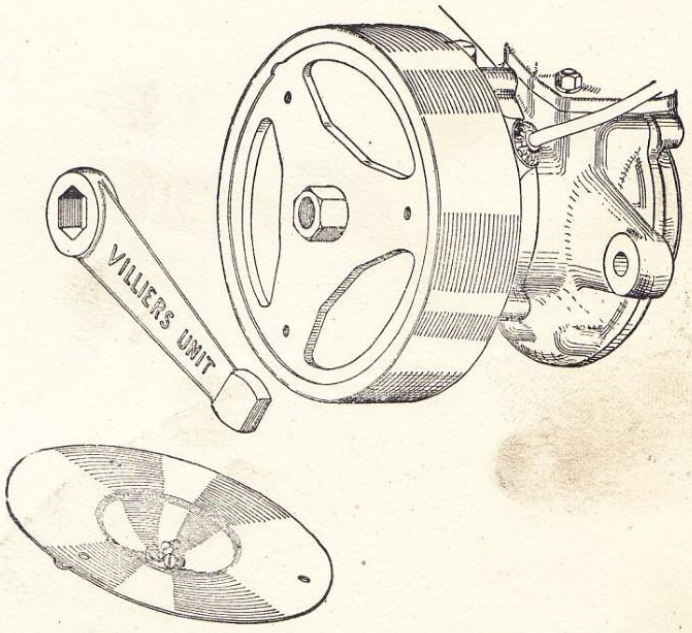



**FIG. 24.**

# VILLIERS MK. 1F. UNIT

## NOTES

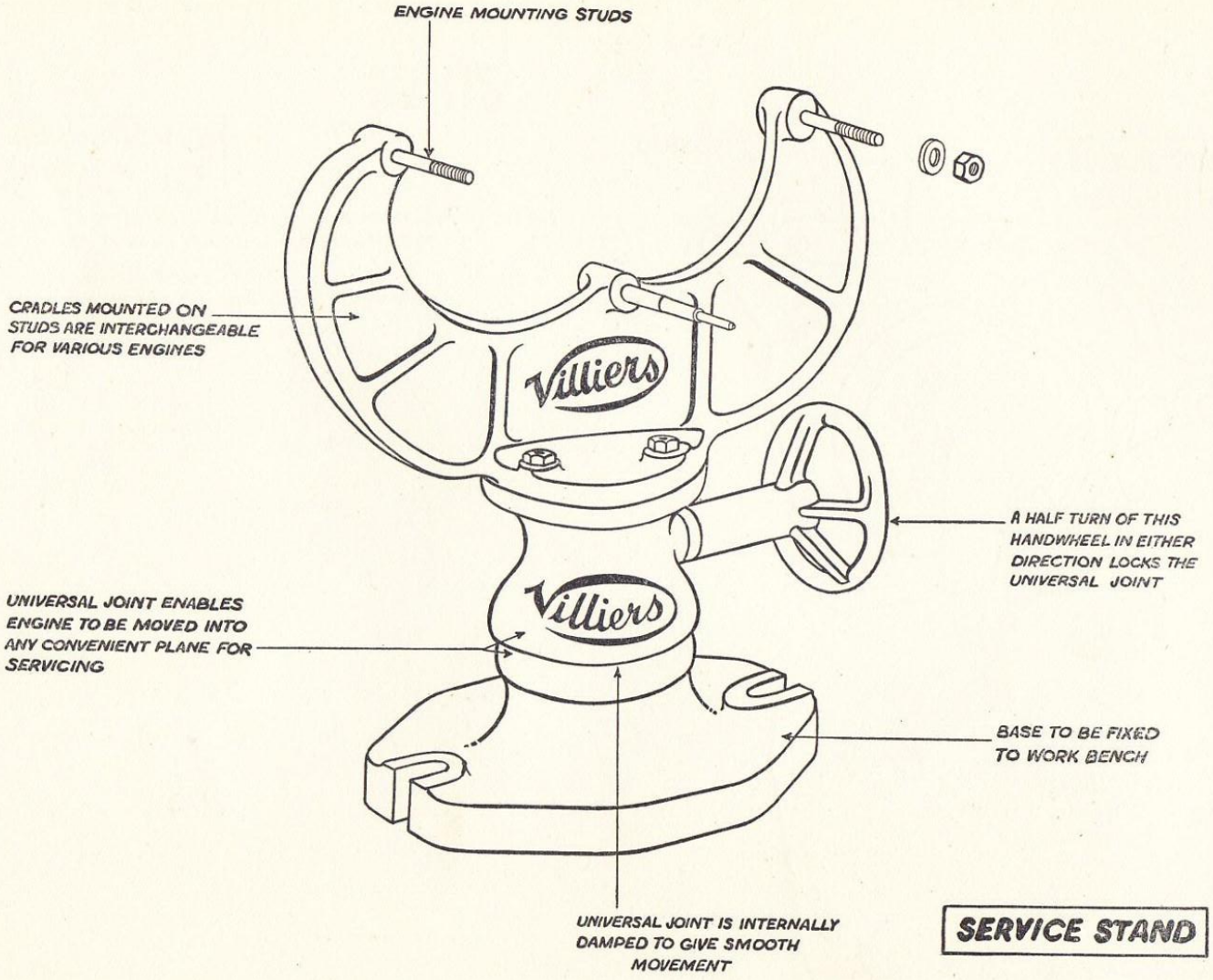
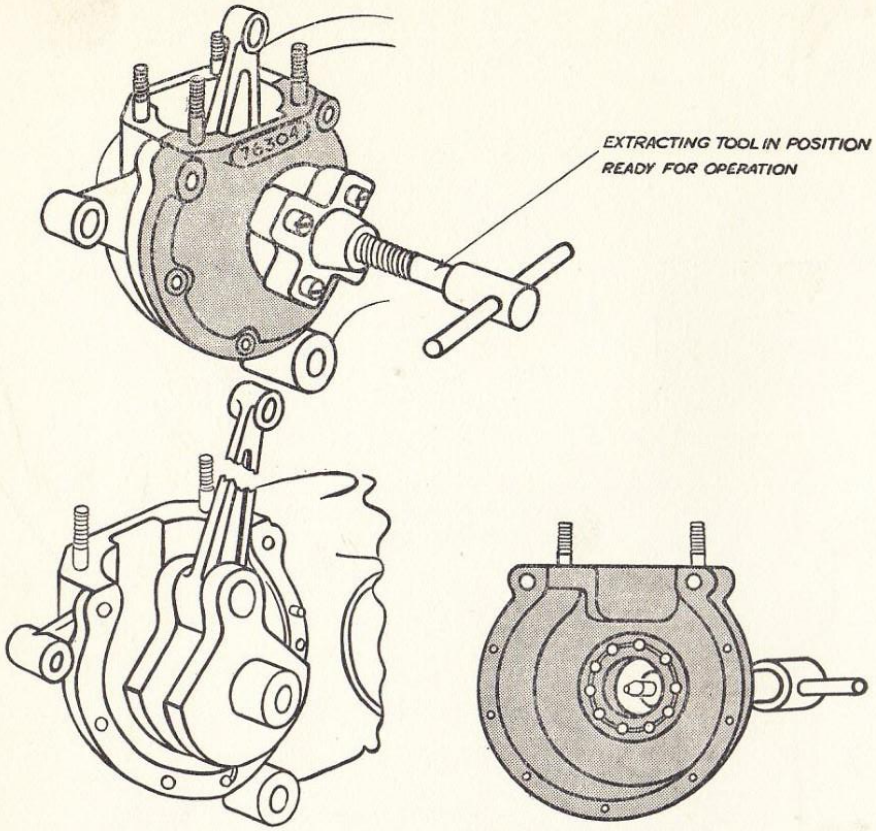

ENGINE MOUNTING STUDS
CRADLES MOUNTED ON STUDS ARE INTERCHANGEABLE FOR VARIOUS ENGINES
A HALF TURN OF THIS HANDWHEEL IN EITHER DIRECTION LOCKS THE UNIVERSAL JOINT
UNIVERSAL JOINT ENABLES ENGINE TO BE MOVED INTO ANY CONVENIENT PLANE FOR SERVICING
BASE TO BE FIXED TO WORK BENCH
UNIVERSAL JOINT IS INTERNALLY DAMPED TO GIVE SMOOTH MOVEMENT
Villiers
Villiers
SERVICE STAND
S.T. 143

FIG. 4.



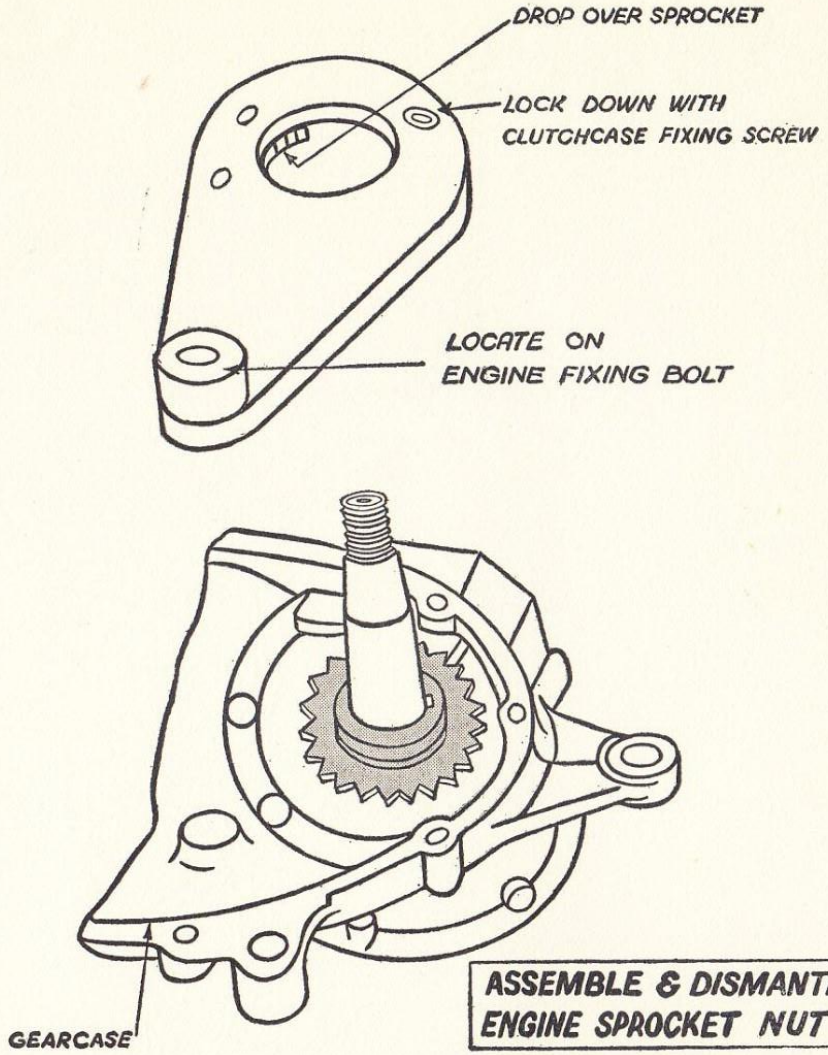

VIEW SHOWING LEFT HAND C/CASE WITHDRAWN
COMPLETE WITH BEARING

(IN THE EVENT OF BEARING BEING RETAINED ON
DRIVING SHAFT USE SPECIAL BEARING EXTRACTOR ST. 204)

**EXTRACTOR FOR LEFT HAND C/CASE**

**S.T. 112**

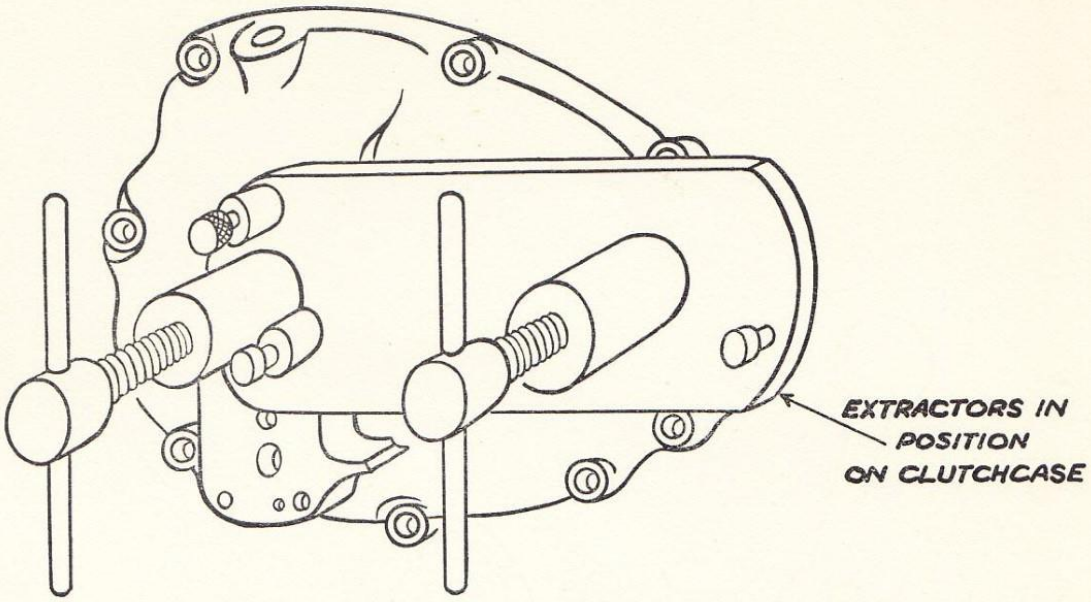
FIG. 6.

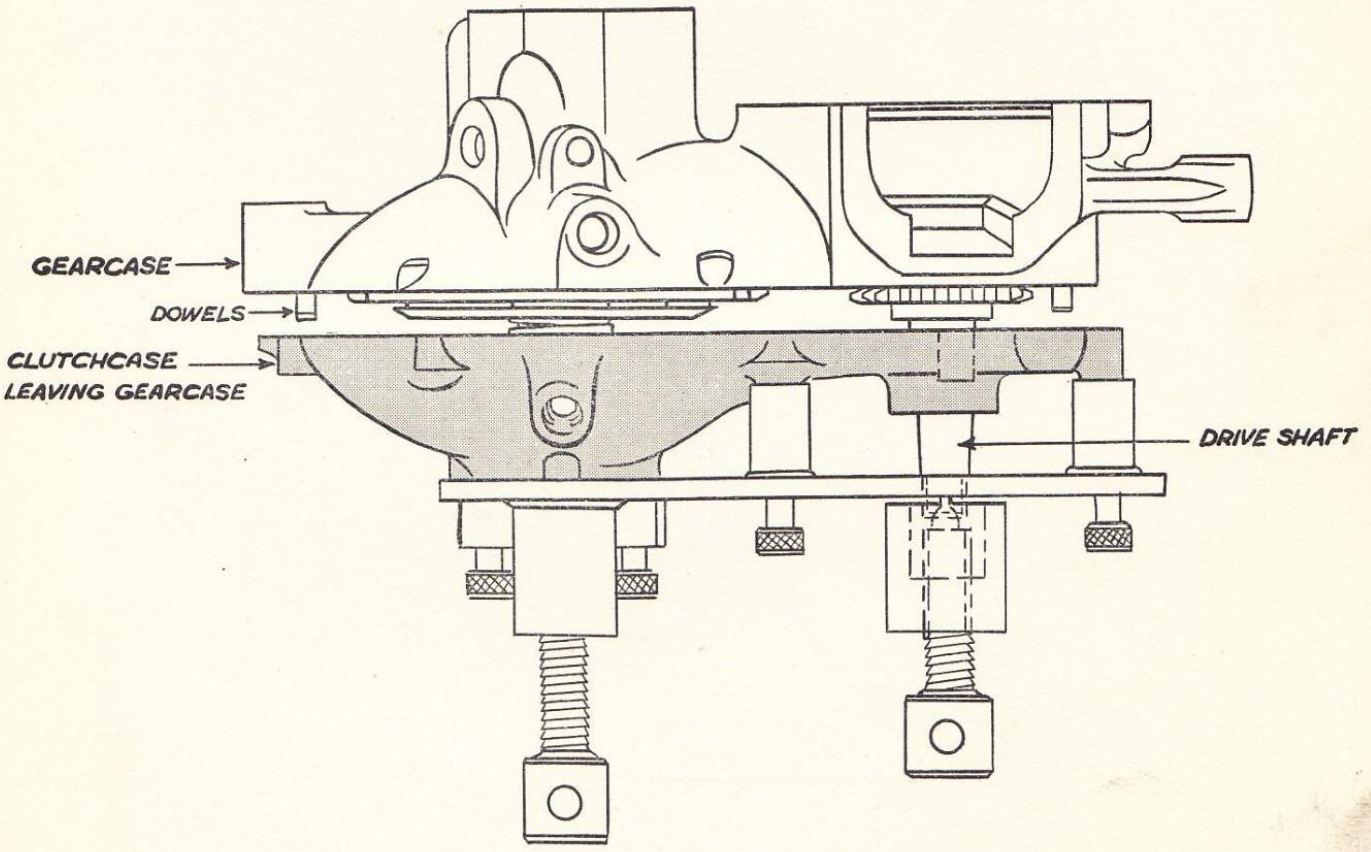



**ASSEMBLE & DISMANTLE ENGINE SPROCKET NUT**

**S.T. 144**

FIG. 8.




EXTRACTOR FOR CLUTCHCASE

S.T.148

FIG. 7.

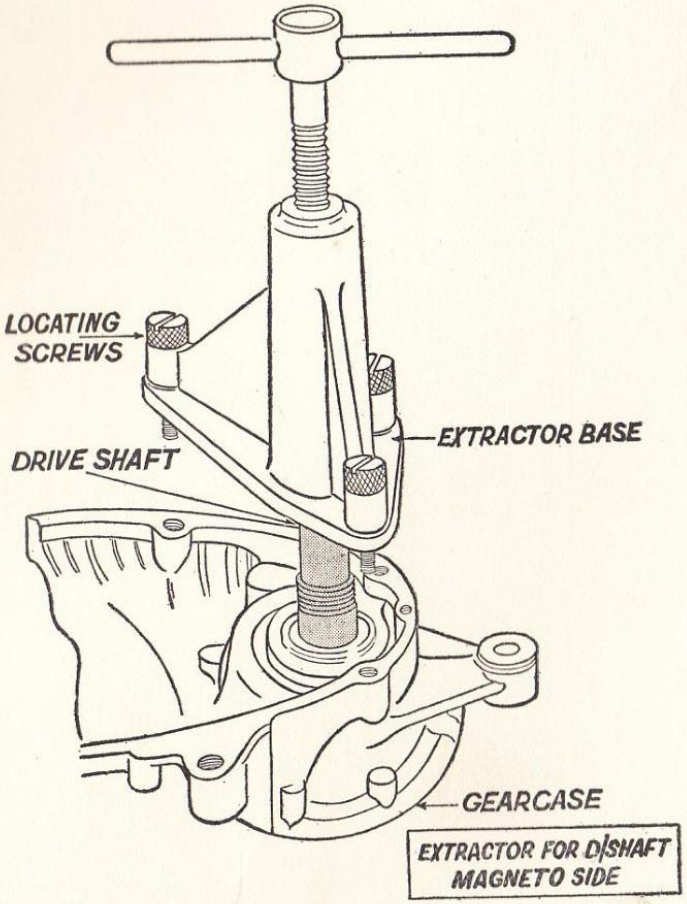

LOCATING SCREWS
EXTRACTOR BASE
DRIVE SHAFT
GEARCASE
EXTRACTOR FOR D/SHAFT MAGNETO SIDE
S.T.127

FIG. 9.

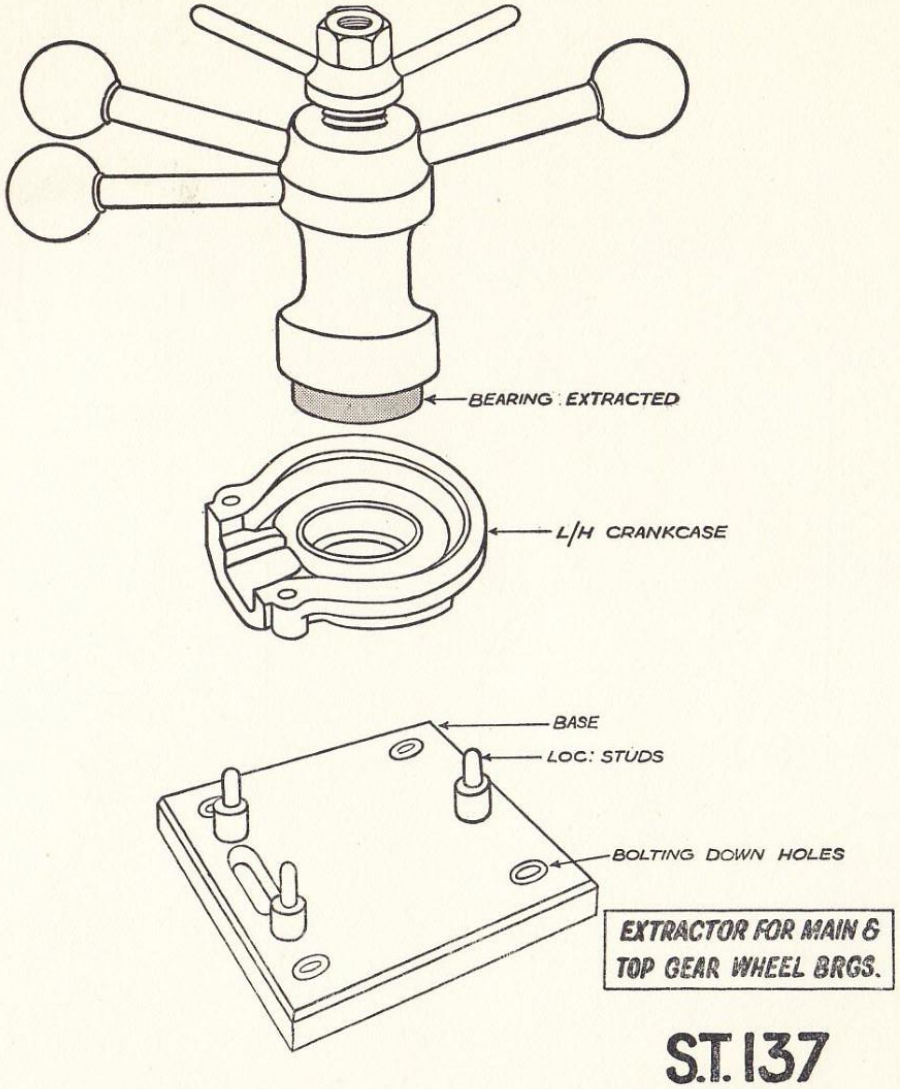

BEARING EXTRACTED
L/H CRANKCASE
BASE
LOC: STUDS
BOLTING DOWN HOLES
EXTRACTOR FOR MAIN & TOP GEAR WHEEL BRGS.
S.T.137

FIG. 11.

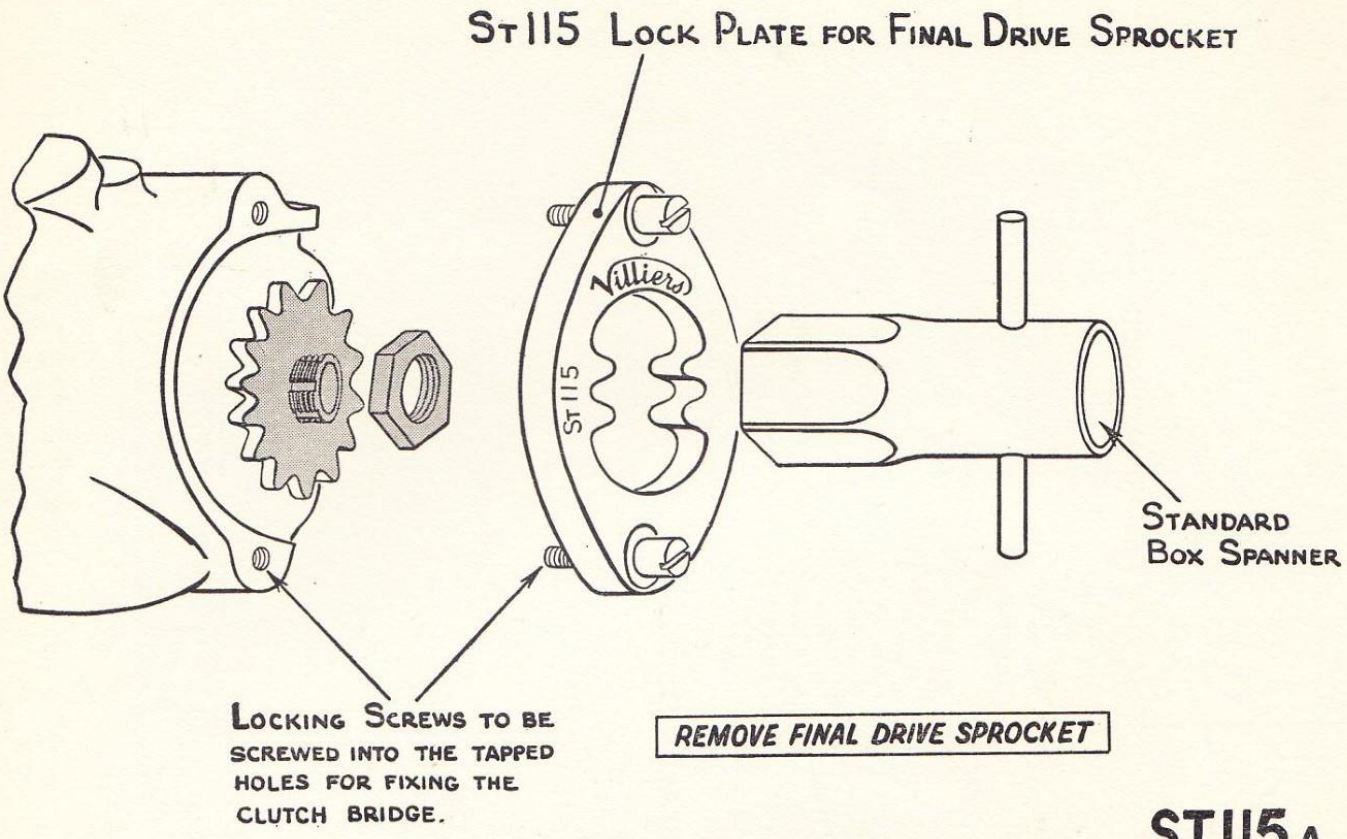

ST115 LOCK PLATE FOR FINAL DRIVE SPROCKET
Villiers
ST115
STANDARD
BOX SPANNER
LOCKING SCREWS TO BE SCREWED INTO THE TAPPED HOLES FOR FIXING THE CLUTCH BRIDGE.
REMOVE FINAL DRIVE SPROCKET
S.T.115 A.

FIG. 10.

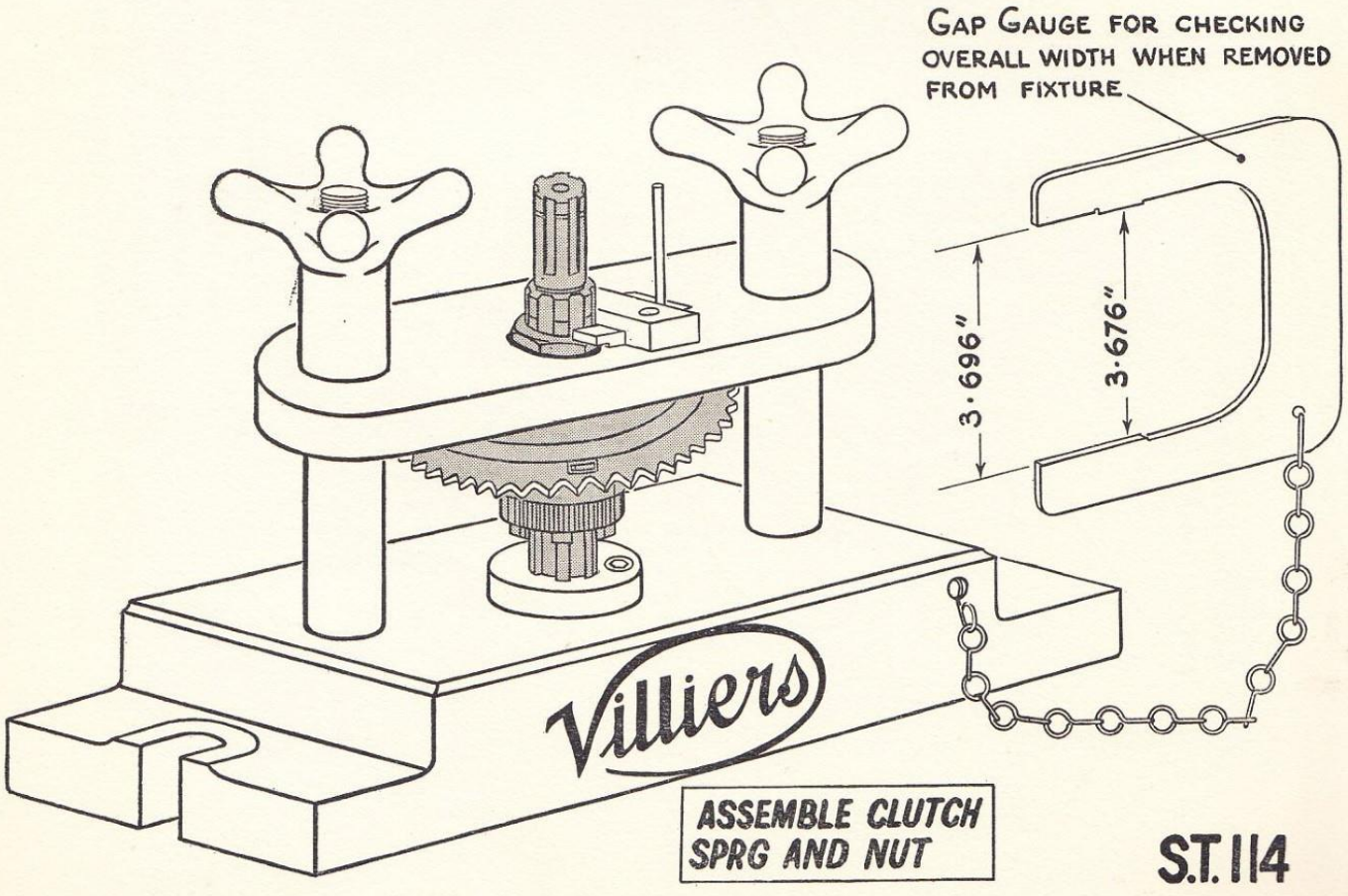
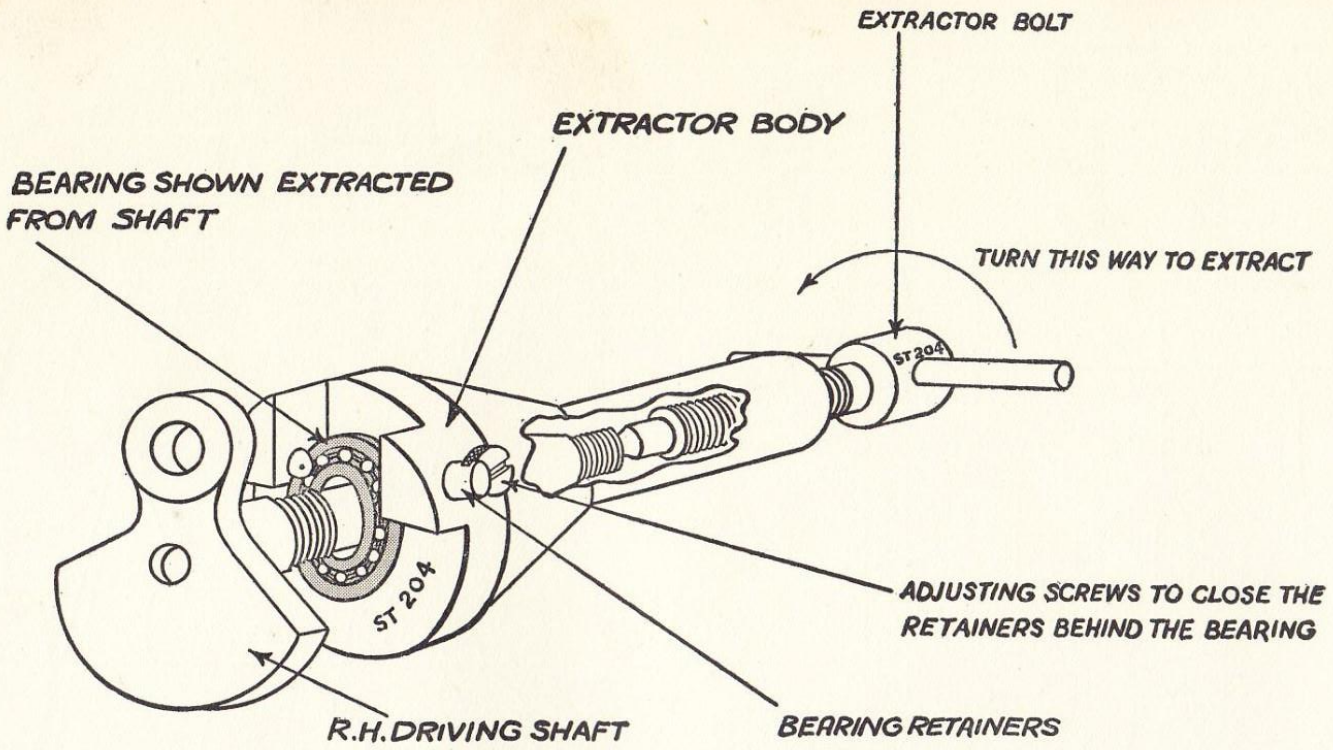
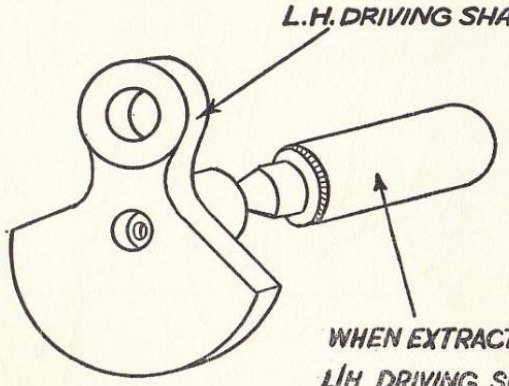

GAP GAUGE FOR CHECKING OVERALL WIDTH WHEN REMOVED FROM FIXTURE
3·696"
3·676"
Villiers
ASSEMBLE CLUTCH SPRG AND NUT
S.T.114

FIG. 17.



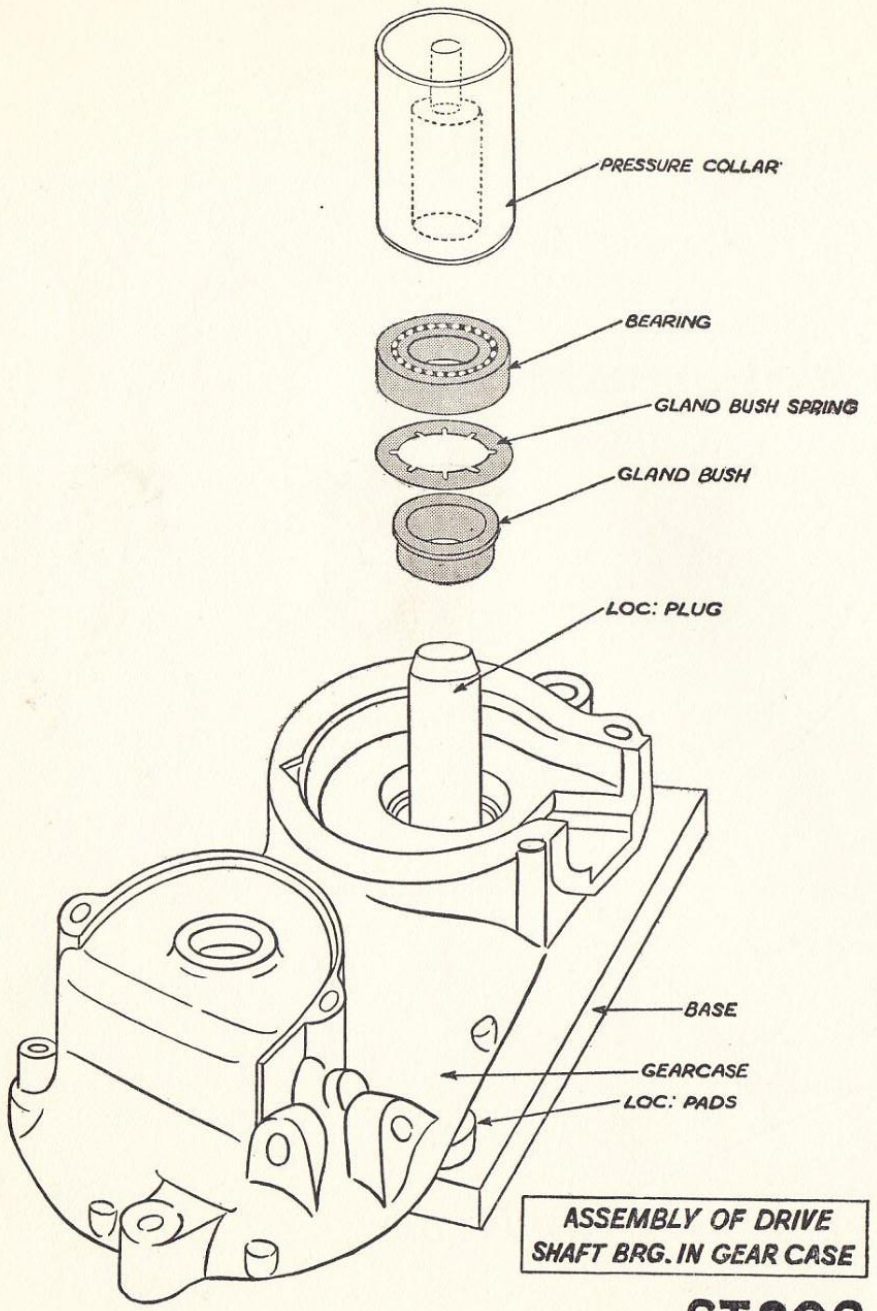




WHEN EXTRACTING THE BEARING FROM THE L/H DRIVING SHAFT, USE THE SAME EXTRACTOR BODY, BUT SLIDE IN THIS PUSH ROD FIRST, TO MAKE UP FOR SHORTER LENGTH OF SHANK

D/SHAFT BRG. EXTRACTOR

**S.T.204**

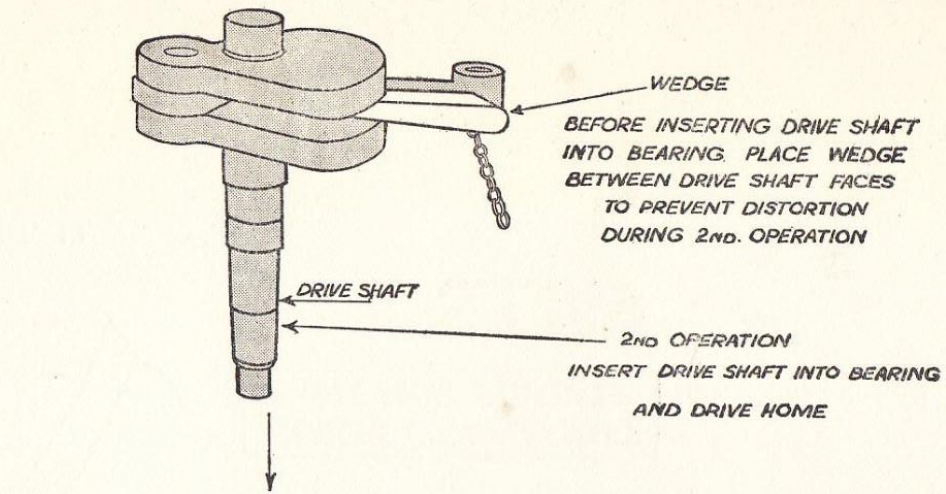
FIG. 12.

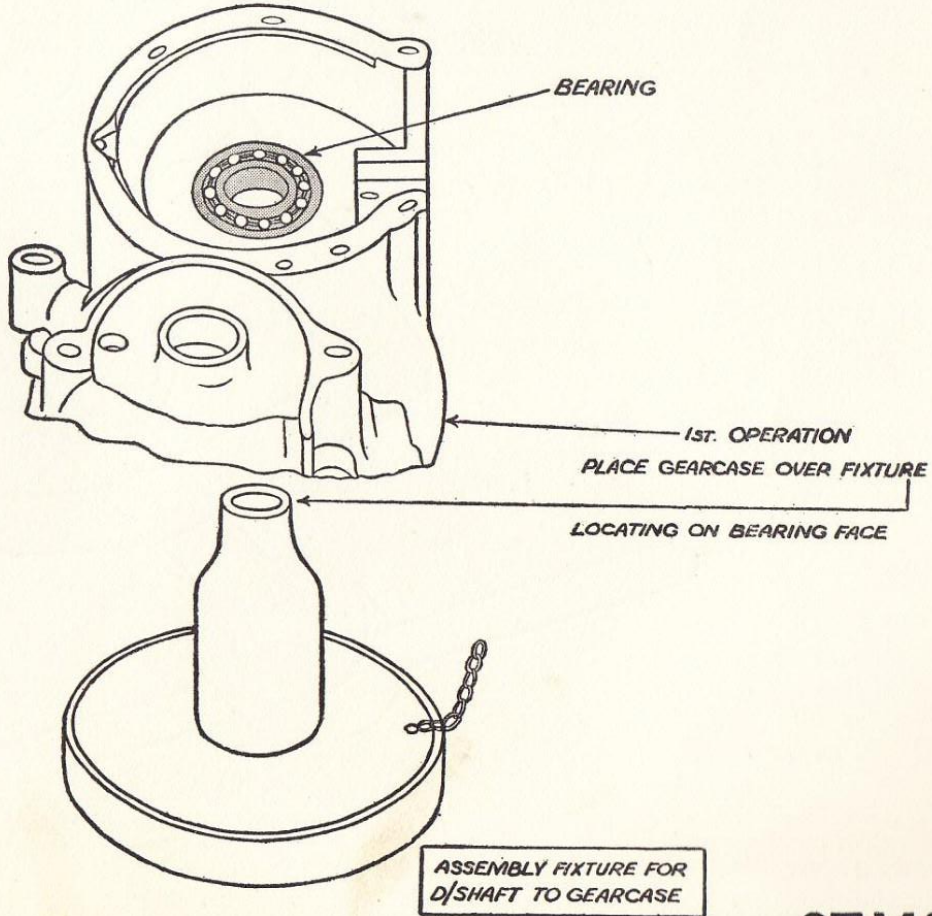



ASSEMBLY OF DRIVE SHAFT BRG. IN GEAR CASE

S.T.208

FIG. 18.




ASSEMBLY FIXTURE FOR D/SHAFT TO GEARCASE

FIG. 21.

S.T.142

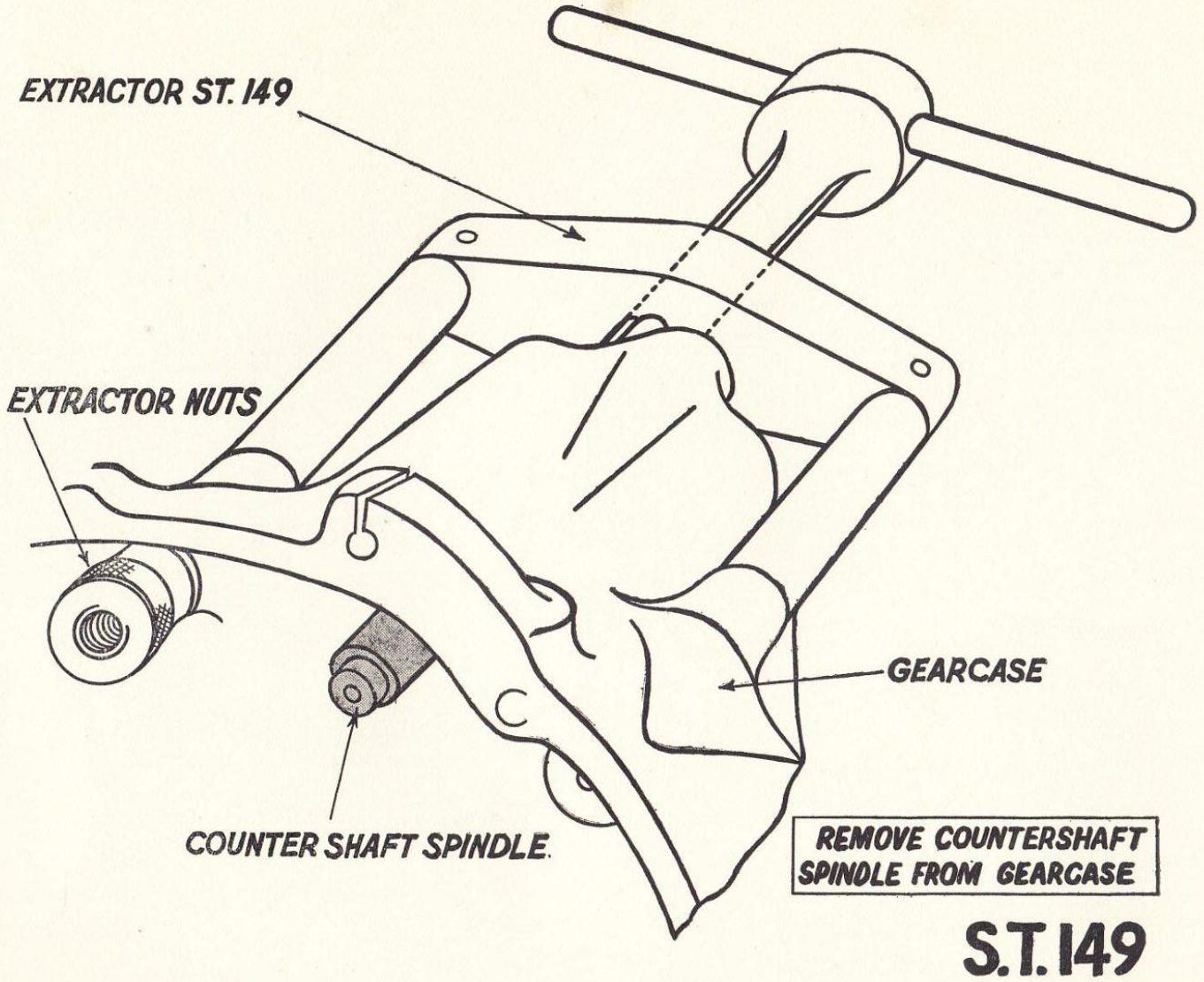

EXTRACTOR ST. 149
EXTRACTOR NUTS
GEARCASE
COUNTER SHAFT SPINDLE.
REMOVE COUNTERSHAFT SPINDLE FROM GEARCASE
S.T.149

FIG. 13.

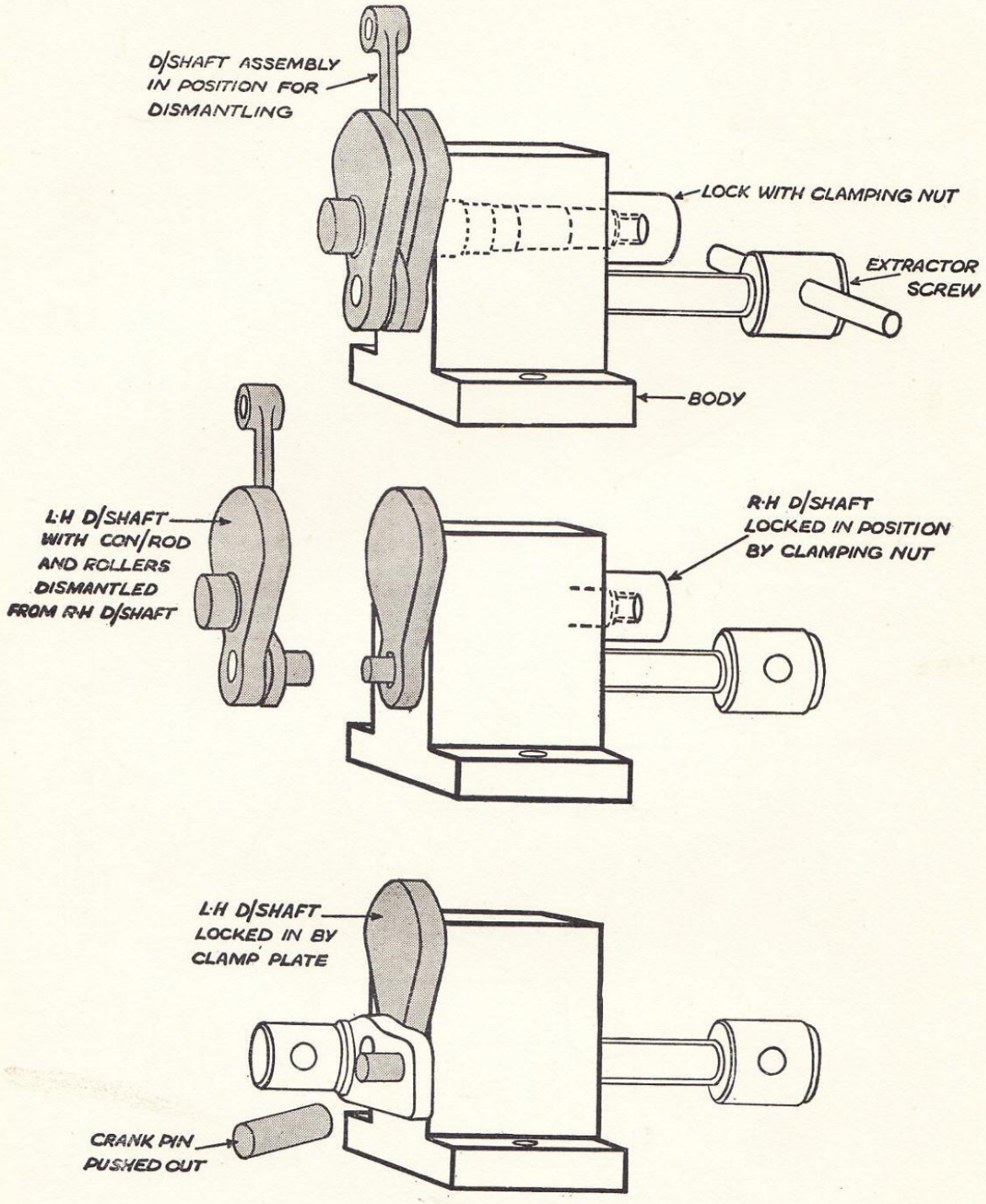
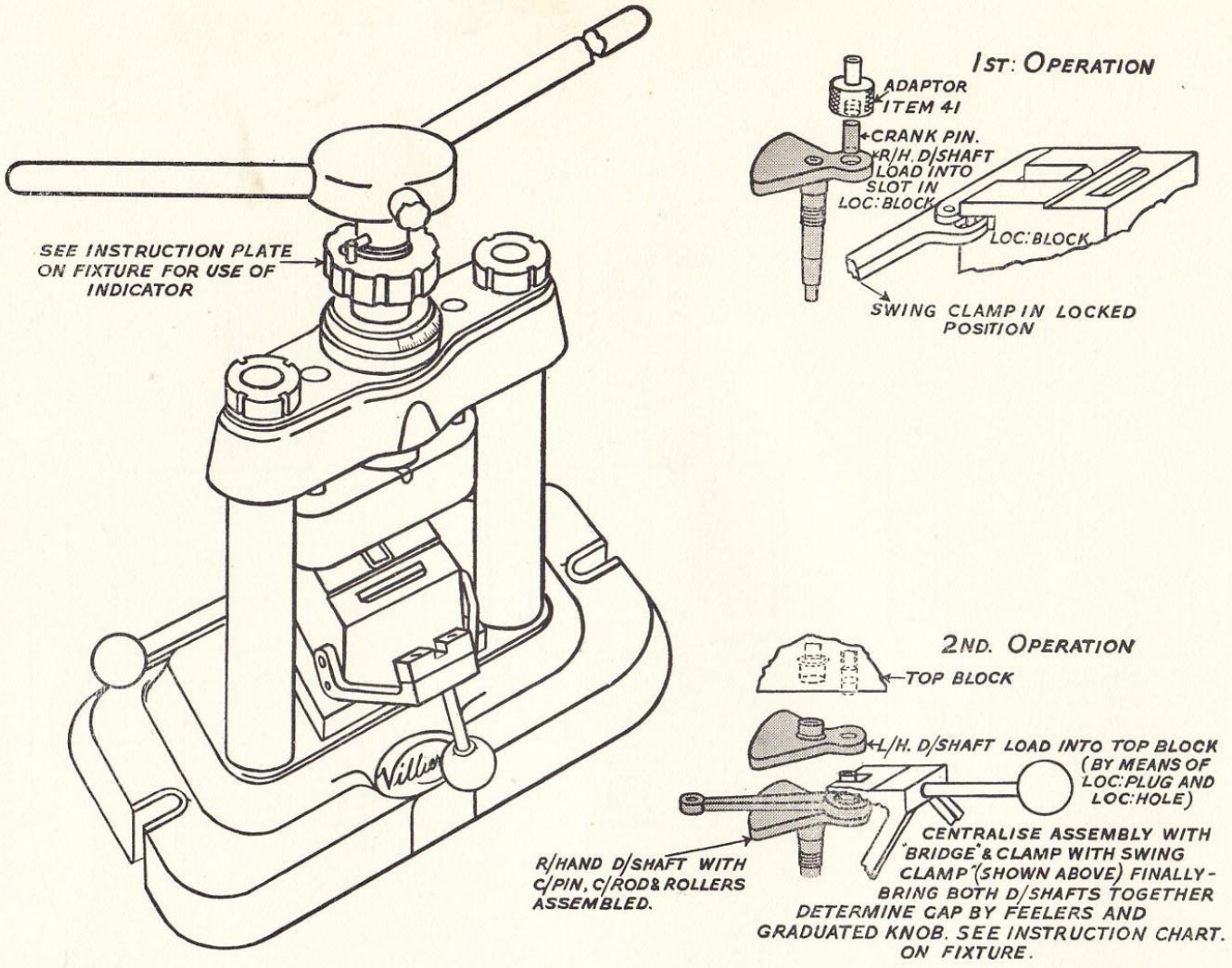

D/SHAFT ASSEMBLY IN POSITION FOR DISMANTLING
LOCK WITH CLAMPING NUT
EXTRACTOR SCREW
BODY
L·H D/SHAFT WITH CON/ROD AND ROLLERS DISMANTLED FROM R·H D/SHAFT
R·H D/SHAFT LOCKED IN POSITION BY CLAMPING NUT
L·H D/SHAFT LOCKED IN BY CLAMP PLATE
CRANK PIN PUSHED OUT
DISMANTLE DRIVE SHAFTS
S.T. 117

FIG. 14.




**ASSEMBLY OF DRIVE SHAFTS**

**S.T.174**

FIG. 15.

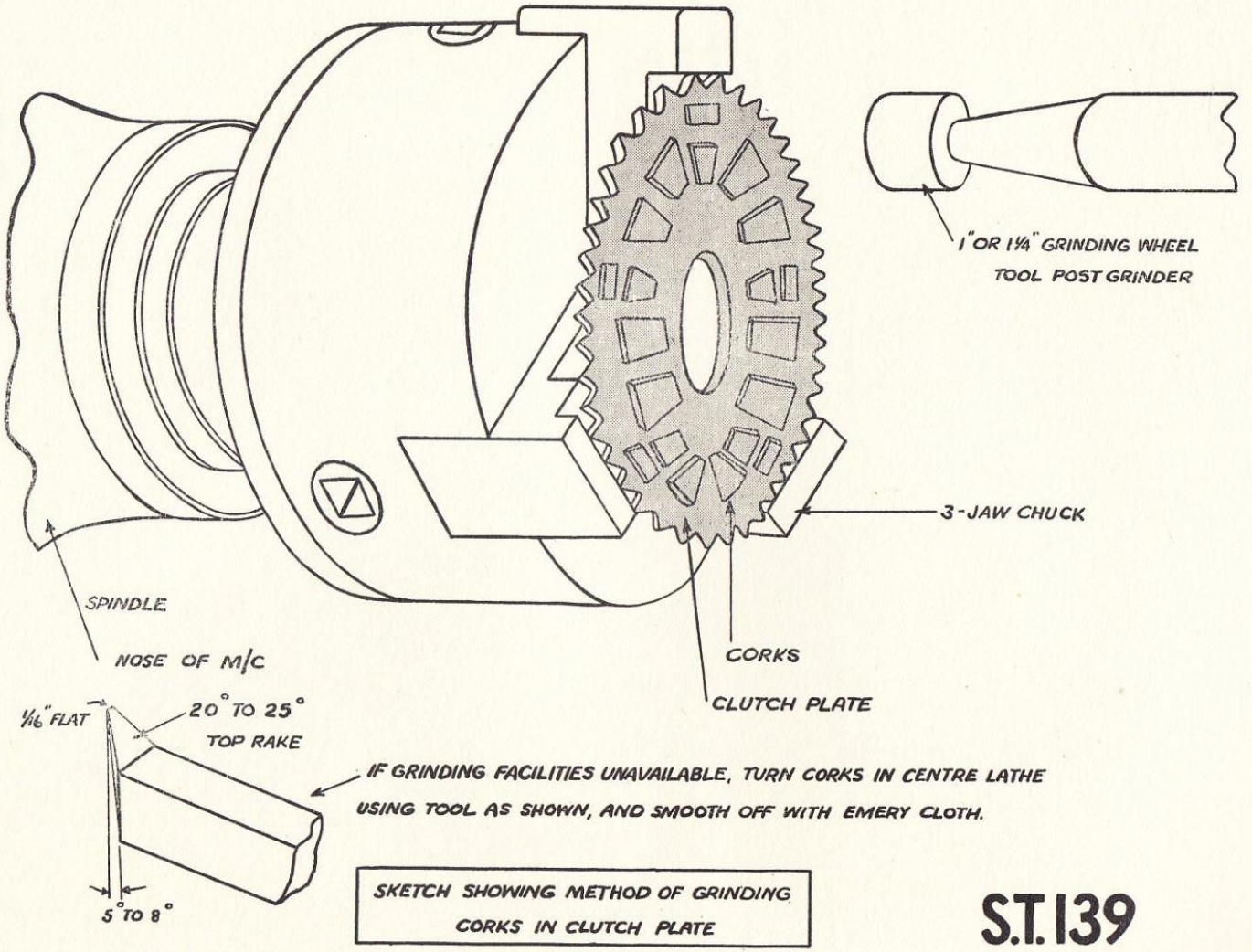

1" OR 1¼" GRINDING WHEEL
TOOL POST GRINDER
3-JAW CHUCK
SPINDLE
NOSE OF M/C
CORKS
CLUTCH PLATE
1/16" FLAT
20° TO 25°
TOP RAKE
5° TO 8°
IF GRINDING FACILITIES UNAVAILABLE, TURN CORKS IN CENTRE LATHE
USING TOOL AS SHOWN, AND SMOOTH OFF WITH EMERY CLOTH.
SKETCH SHOWING METHOD OF GRINDING
CORKS IN CLUTCH PLATE
S.T.139

**FIG. 22.**

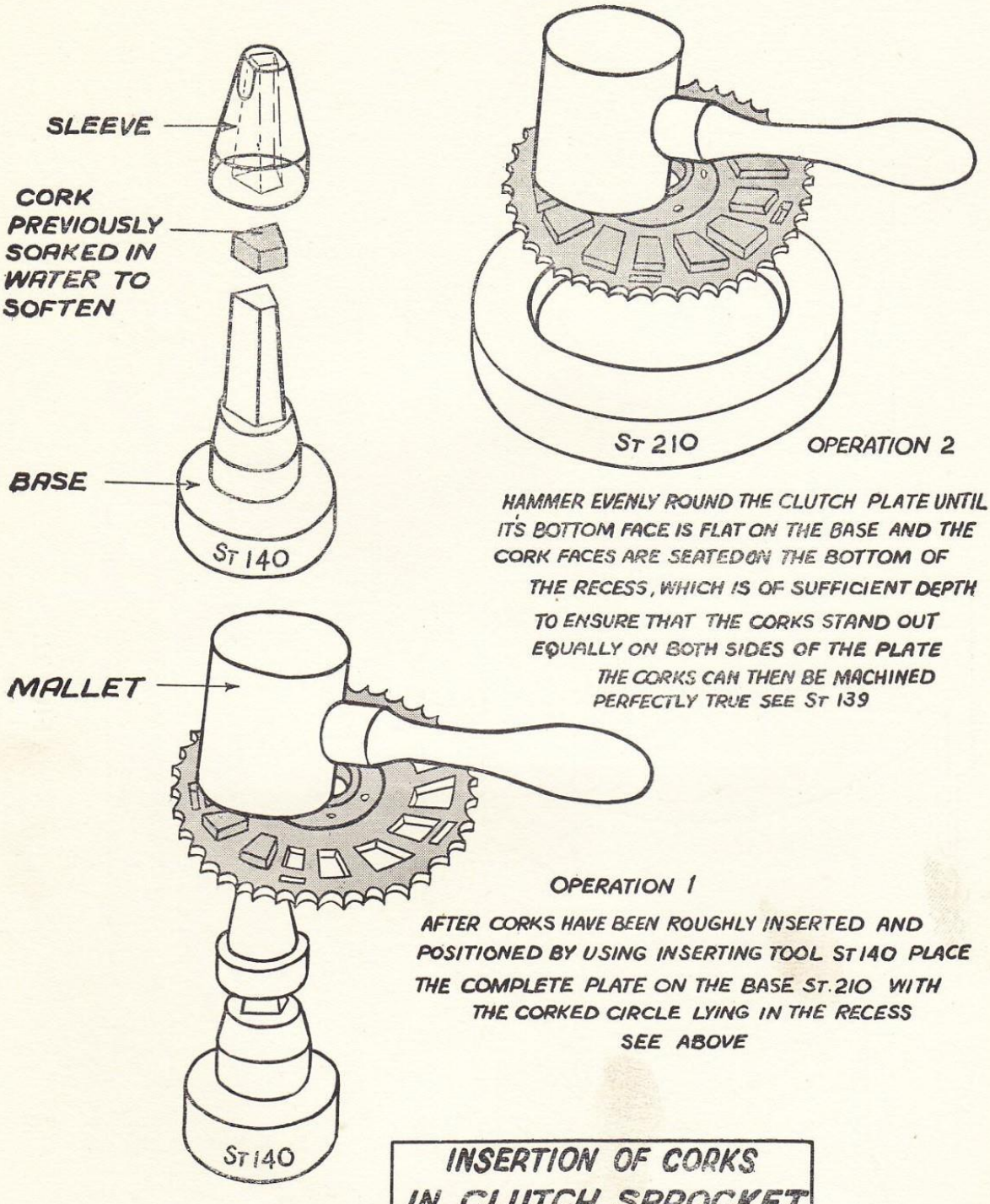

SLEEVE
CORK PREVIOUSLY SOAKED IN WATER TO SOFTEN
BASE
ST 140
MALLET
ST 140
ST 210
OPERATION 2
HAMMER EVENLY ROUND THE CLUTCH PLATE UNTIL ITS BOTTOM FACE IS FLAT ON THE BASE AND THE CORK FACES ARE SEATED ON THE BOTTOM OF THE RECESS, WHICH IS OF SUFFICIENT DEPTH TO ENSURE THAT THE CORKS STAND OUT EQUALLY ON BOTH SIDES OF THE PLATE THE CORKS CAN THEN BE MACHINED PERFECTLY TRUE SEE ST 139
OPERATION 1
AFTER CORKS HAVE BEEN ROUGHLY INSERTED AND POSITIONED BY USING INSERTING TOOL ST 140 PLACE THE COMPLETE PLATE ON THE BASE ST. 210 WITH THE CORKED CIRCLE LYING IN THE RECESS SEE ABOVE
INSERTION OF CORKS IN CLUTCH SPROCKET
S.T. 140

FIG. 23.

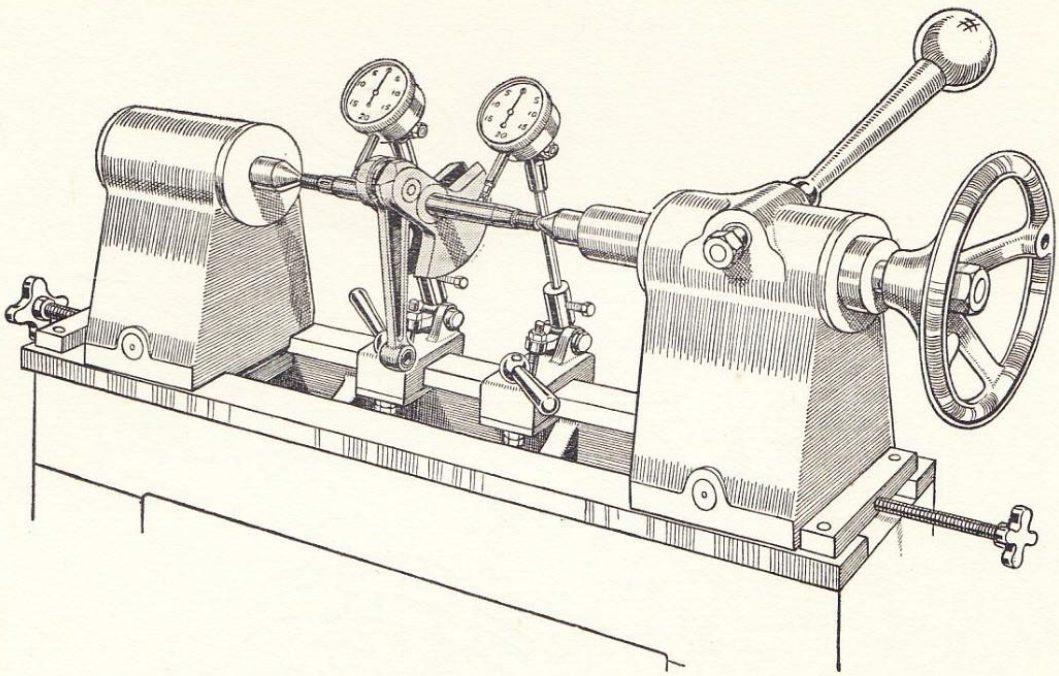


FIG. 16.

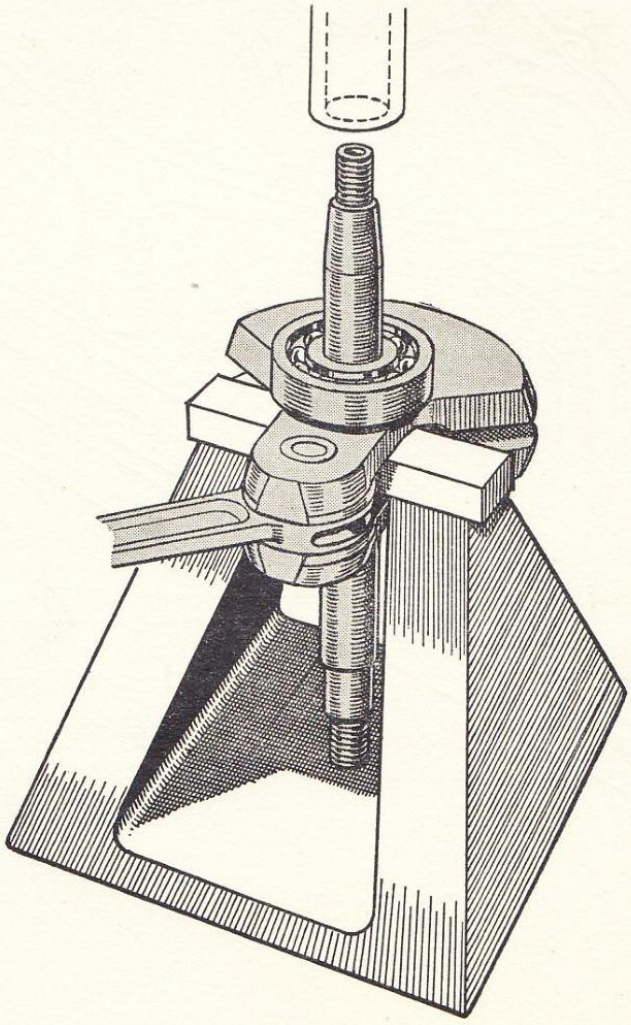


FIG. 20.

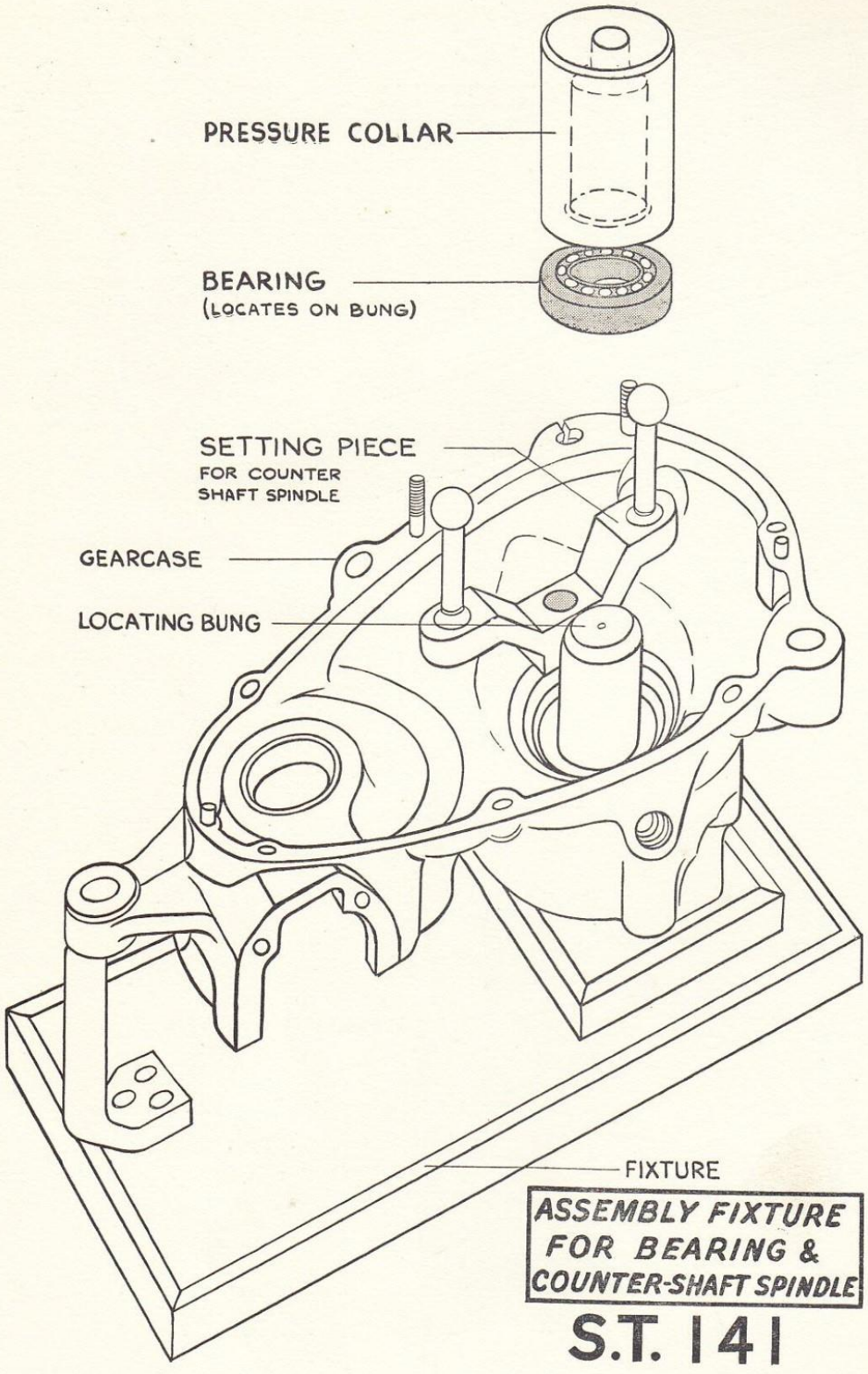

PRESSURE COLLAR
BEARING
(LOCATES ON BUNG)
SETTING PIECE
FOR COUNTER
SHAFT SPINDLE
GEARCASE
LOCATING BUNG
FIXTURE
ASSEMBLY FIXTURE
FOR BEARING &
COUNTER-SHAFT SPINDLE
S.T. 141

FIG. 19.

# VILLIERS MK. 1F. UNIT

## CARBURETTER.

### 31 CARBURETTER.

A Villiers type 6/0 carburetter (Fig. 25) is fitted to this engine ; these figures will be found stamped on the stub immediately behind the clip (No. 20, Fig. 25). It should not be necessary to alter the setting obtained by the maker after road testing the machine, except in exceptional conditions.

### 32 OPERATION OF CARBURETTER.

The function of the carburetter is to supply a mixture of fuel and air in correct proportion under all conditions. In the Villiers carburetter the float chamber (No. 23, Fig. 25) surrounds the jet centre piece (No. 12, Fig. 25), and in it an annular float (No. 22, Fig. 25) rises as the fuel enters the chamber until the correct level is obtained, then the forked lever (No. 38, Fig. 25) which rests on top of the float lifts the fuel needle (No. 37, Fig. 25) which has a conical end and shuts off the fuel supply by closing the hole in bush (A) Fig. 26.

Fuel enters the jet body through hole (B) and passes through calibrated jet (C) and passes up centre piece.

The slide (No. 11, Fig. 25) operated by the cable opens up the air supply and is fitted with taper needle (No. 10, Fig. 25) which extends below the slide through the centre piece. When the throttle slide closes the air supply, the largest diameter of the needle nearly closes the fuel outlet, but when the slide is lifted admitting more air, the smaller diameter of the needle now in the centre piece allows more fuel to pass. A suitable combination of jet size, needle position and taper, will give a correct mixture strength at all throttle openings.

A further refinement to compensate for engine speed which also assists in atomising the fuel is provided. The offset hole (D, Fig. 26) in the centre piece allows air to enter just above the jet orifice, which it should be noted, is submerged. This hole communicates with the atmosphere through the passage (E), and the size of hole in the centre piece determines the amount of correction provided.

### 33 SERVICE.

The fuel level is maintained by a float (No. 22, Fig. 25), and needle valve (No. 37, Fig. 25), and in no circumstances should any alteration be made to this by bending the float lever (No. 38, Fig. 25), or altering the needle length.

The amount of fuel supplied to the engine is controlled by one jet which is fixed in the bottom of the centre piece (No. 12, Fig. 25), and by the taper needle (No. 10, Fig. 25), which is carried in the throttle (No. 11, Fig. 25), and operates in the top end of the centre piece.

The jet is not detachable from the centre piece and is not supplied separately.

The carburetter is automatic in action and gives a correct mixture over the whole range of throttle opening, the only available adjustment being the position of the taper needle in the throttle (which controls the size of the jet orifice) and which is necessary to suit individual engines. The needle controls the mixture strength from tick-over to approximately two-thirds throttle, the jet controls the remainder.

The position of the taper needle in the throttle is determined during testing at the works, but should it be necessary to alter the setting, this is done by the needle adjusting screw (No. 7, Fig. 25) situated in the centre and at top of throttle. Screw in to weaken mixture, (i.e., lower needle). The screw should not be loose in the throttle slide as it is likely to move and alter the setting. It is split to make it grip the hole. Should the screw be loose the split portion should be gently prised apart.

**Note.** That the taper needle spring should be fitted with the small coil under the head of the needle.

### 34 TO DISMANTLE CARBURETTER.

To remove throttle from body :

Open throttle to full open, undo top ring (No. 4, Fig. 25) ; the throttle can now be withdrawn. Take care not to damage or bend the taper needle.

Turn control to fully closed position, the top disc with guide peg (No. 5, Fig. 25) can now be removed and the needle adjusting screw (No. 7, Fig. 25) is seen in the centre of throttle.

If necessary the control cable can be detached by compressing throttle spring, the inner cable then being lifted out through the slot.

### 35 TO REMOVE CENTRE PIECE AND FUEL NEEDLE.

Unscrew the bottom nut (No. 25, Fig. 25) underneath the float chamber cup.

Next remove the fibre washer (No. 24, Fig. 25), the cup (No. 23, Fig. 25) with float inside, and if loose, the fibre washer (No. 21, Fig. 25) between cup and carburetter body.

Then remove the small centre piece locking screw situated below and to the rear of the banjo petrol pipe union ; the centre piece (No. 12, Fig. 25) with fibre washer (No. 13 Fig. 25) under head can now be pushed up through the throttle bore.

When the centre piece is removed, the fuel needle lever (No. 38, Fig. 25) can swing round and will thus allow

# VILLIERS MK. 1F. UNIT

## CARBURETTER.

the fuel needle (No. 37, Fig. 25) to drop out of its seating ; the needle should, therefore, be removed at the same time as the centre piece and kept in a safe place until required for re-assembly. No attempt should be made to remove the fuel needle lever from the carburetter body.

### 36 TO REMOVE TICKLER

This should not be necessary unless the vent hole in base of body is blocked, in which case remove the split cotter pin at end of tickler, which will release the tickler and its spring.

One vent hole is at bottom of the hole where the spring fits, the other being in the side of the tickler cap.

### 37 TO REMOVE AIR CLEANER.

The air cleaner which is held on to carburetter body by a clip, should be removed approximately every 5,000 miles and cleaned by immersing in gasoline ; when dry, dip in thin machine oil and allow to drain before re-fitting.

### 38 CARBURETTER SETTING.

The carburetter is fitted with a taper needle marked 2½ on parallel portion under head, a centre piece marked J8 on the head, and the jet (which is not detachable) marked 8 on the hexagon portion. The normal needle setting is 29/32" from the bottom of the throttle to the end of the needle, but this is usually a matter of individual adjustment to suit each engine.

### 39 RE-ASSEMBLY OF CARBURETTER.

This, of course, is the reverse process to that described ; the fuel needle should be fitted point first, the fuel needle lever should then be placed so that it will hold the needle in position while the centre piece is replaced. Care should be taken to see that the centre piece complete with fibre washer is fitted so that the locking screw locates in the slot in the head of the centre piece. When re-fitting float cup do not over tighten bottom nut as this may distort the jet.

### 40 CARBURETTER TUNING HINTS.

Erratic running at low speeds may be due to :

Air leaks, either at carburetter stub joint, due to carburetter not being pushed home, cylinder base joint, crankcase joint face, crankcase nameplate or gland bushes.

Ignition too far advanced.

Sparking plug points too close, corroded or dirty.

Contact breaker points dirty, pitted, loose or set too closely.

High tension wire defective.

### 41 WEAK MIXTURE.

This may be caused by choked gauzes in petrol supply system. After considerable mileage, wear of the throttle slide and/or carburetter body may cause weak mixture.

**Heavy petrol consumption may be due to :**

Late ignition setting.

Carburetter flooding due to leaking float, or bad seating of fuel needle and bush. This may be caused by dirt or wear. A worn fuel needle bush can be replaced by drilling out and fitting oversize bush, but this is rarely necessary.

Worn centre piece hole and/or taper needle, usually after considerable mileage. Remedy is to replace worn parts.

Taper needle adjustment too rich.

Poor compression due to worn piston rings and/or worn cylinder bore.

**General.**

Choked silencer and exhaust system. Incorrect petrol-oil mixture, i.e., more or less than half pint of oil to one gallon of gasoline, also high altitudes may have an effect on carburation.

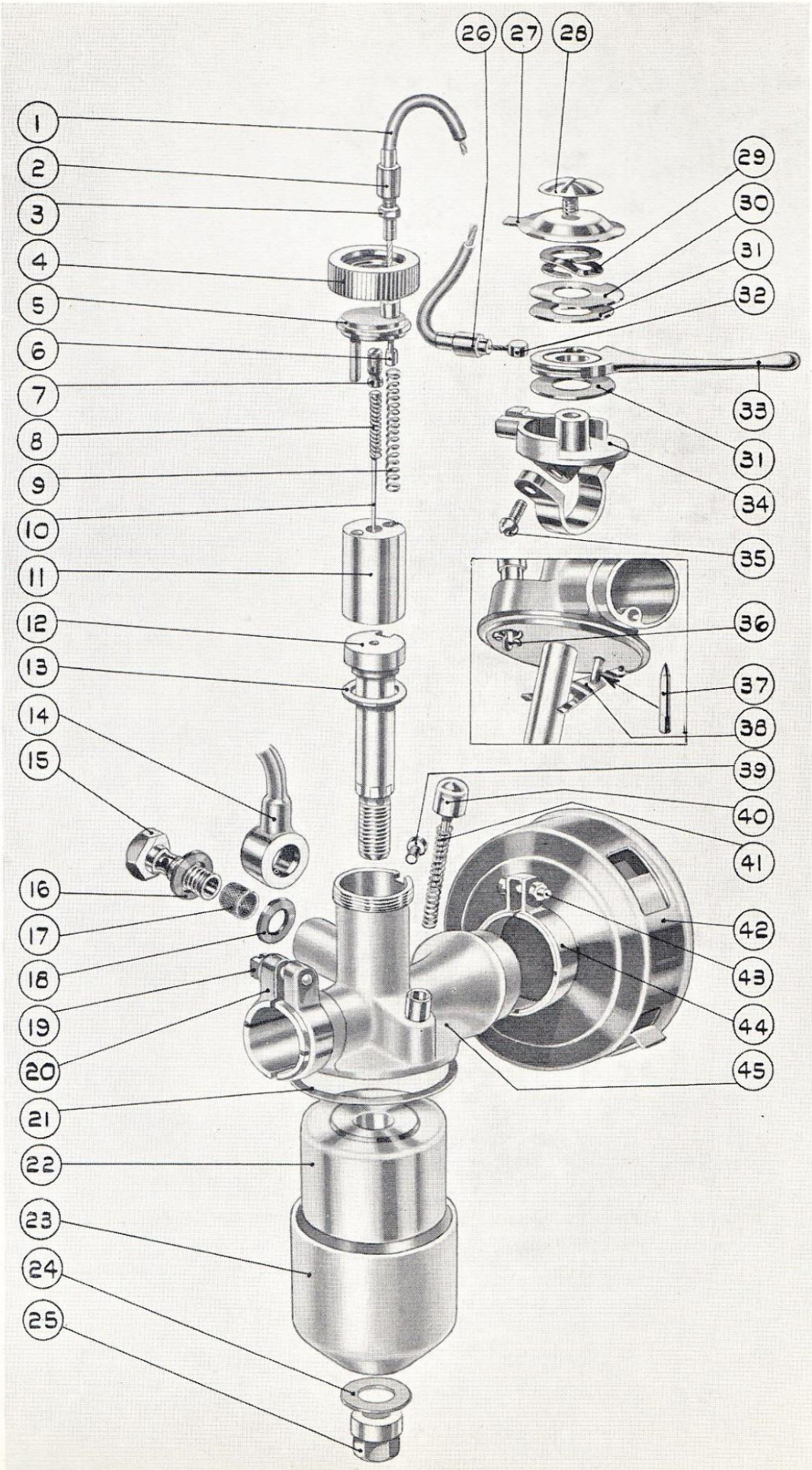

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FIG. 25.

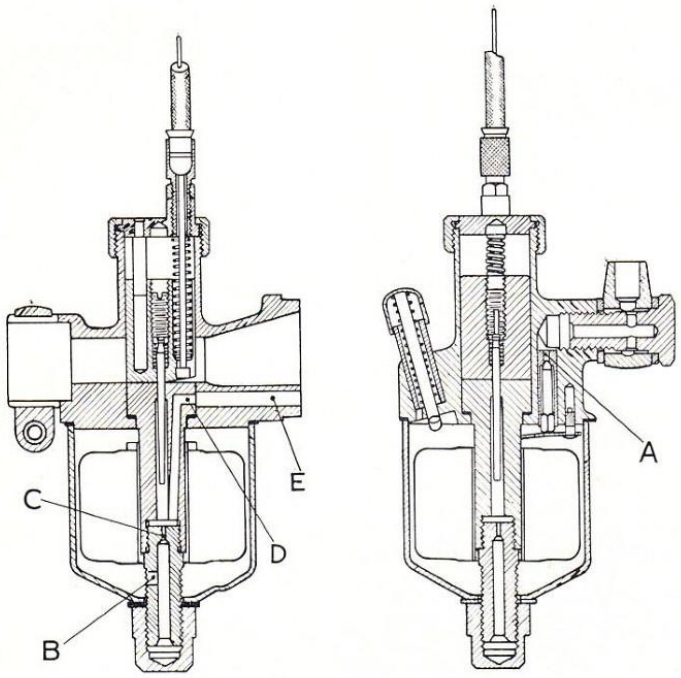


**FIG. 26.**

# VILLIERS MK. 1F. UNIT

## MAGNETO.

### 42 OPERATION OF THE I.F. MAGNETO.

The purpose of the high tension magneto is to produce a hot spark across the points of the sparking plug. The voltage required to produce this spark will vary according to the conditions. In a cold engine the voltage may have to be as high as 10,000 volts, but when the engine is warm a voltage of between 4,000 and 6,000 will be sufficient to jump across its plug points. In any magneto there have to be permanent magnets, a high tension coil, contact breaker and condenser. In the Villiers magneto the magnets are secured to the rotating flywheel, and the high tension coil, contact breaker and condenser are stationary.

It is fundamental that in order to produce a current in a coil of wire by magnetic means, there has to be a change of magnetic flux through the coils. This change is produced by the movement of the magnets in relation to the coil. The flux of one magnet in the flywheel is led by means of the soft iron poles and coil ends through the core of the ignition coil, then as the following magnet takes its place, the direction of this flux is violently reversed, due to the change of polarity of this magnet, the poles of this flywheel being N.S. N.S. N.S. The current in the primary windings of the ignition coil, which consists of about 200 turns of fairly thick wire (about $\frac{1}{32}$" dia.), passes through the contact breaker during the closed period. When the points are opened, which is arranged to take place when the current in the primary is greatest, the sudden interruption of the current produces in the secondary windings (which consist of many thousands of turns of fine wire about .003"), a very high voltage, which is sufficient even at quite low speeds of the flywheel to produce a spark at the plug. The sudden interruption of the current will produce in the primary windings a voltage tending to cause a spark across the gap of the contact breaker, and a condenser is, therefore, connected across the points to absorb the surplus energy which might otherwise be wasted by severe arcing, and thus reduce the voltage at the plug.

### 43 MAGNETIC CYCLE ON IF. MAGNETO.

The method of flux reversal used in the Villiers Mk. 1F magneto is shown in the three diagrams, Fig. 27.

Fig. 1 shows the magnetic flux path before the reversal which generates the high primary current required.

Fig. 2 shows this path just before the actual point of reversal, and Fig. 3 shows the path immediately after the reversal.

In Fig. 1 the flux from magnet (2) is seen to be passing through the coil core from left to right, and being more or less unchanging is generating no current in the primary winding.

In Fig. 2 the flux of magnets (1) and (2) is seen to be drawn out to breaking point at the left hand coil end.

In Fig. 3 we see where the flux has broken away from the attraction of the iron mass of the left hand coil end and jumped with extreme rapidity to the iron right hand coil end, where it passes through the coil core from right to left.

This rapid movement of the flux across the primary wires thus generates a high voltage in the primary winding, making a powerful electro magnet of the ignition coil and causing the fine high tension winding to be enclosed in a highly concentrated magnetic field.

At this point the contact breaker opens and causes a very rapid collapse of this field, generating in this fine secondary winding the very high voltage required to jump the points of the sparking plug in the cylinder.

This magneto comprises rotating magnets fixed in a flywheel, and the coil and contact breaker mechanism are secured to a stationary aluminium plate and the fine windings of coil do not, therefore, have to withstand the effect of centrifugal force. The stationary coil enables a direct connection to the plug wire to be made instead of having to provide a carbon brush and slip ring as with a rotating armature. All parts are very robust and the flywheel is secured to the crankshaft so that there is no possibility of wear or noise which is present when a chain or gear drive is used.

In the magneto fitted to the 1F. engine there are four magnets. Two only are required for ignition, and the additional magnets are fitted in order to provide the current for the lighting and battery charging. The same principles apply to the method by which the lighting current is produced in the lighting coils, but in this case no secondary winding or contact breaker is required.

### 44 DESCRIPTION.

The ignition coil is wound on a laminated core to give the greatest efficiency and the lighting coils are wound on special "electric iron" cores for the same purpose.

The primary connection from ignition coil to contact breaker box is made by a soldered connection at the coil end and a screw connection at the contact breaker end on the point plate.

The contact breaker is of the latest improved type needing only a screwdriver to adjust. A special thin screwdriver and spanner is supplied with the engine, the spanner fitting the old type of contact breaker point adjustment.

There are two screw holes for the clamp screw in the box so that all conditions of point and rocker arm contact pad wear can be accommodated.

It should be noted that the rocker arm itself is earthed, but that every care must be taken to see that the adjustable point plate is properly protected from the contact

# VILLIERS MK. 1F. UNIT

## MAGNETO.

breaker box itself by (1) the large insulating washer under the plate ; (2) the small insulating washer under the clamp screw brass washer ; (3) the small black insulating bush on which the point plate pivots.

These parts should be kept clean and free from any foreign matter which might cause electrical leakage and so weaken the ignition spark.

The spindle of the rocker arm runs in a self oiling bush and usually requires no further lubrication.

A felt pad is used to keep the cam in a slightly oily condition, and this is impregnated when new with grease. This can, if visibly dry, be oiled with a small amount of the heaviest oil available. It is better, however, to soak the pad in a molten high temperature grease if it is convenient to detach t he box itself for this operation.

If too mu ch oil is put on the felt pad it may creep along the rocker arm, get on the contact points and so cause ignition trouble.

### 45 SPARKING PLUG.

The plug fitted to the Villiers Mk. 1F engine is the Lodge H.14, 14 mm. short reach. The American equivalent of this plug is the Champion type J.10 com.

These plugs are capable of standing up to the maximum power output of the engine without pre-ignition. Where the machine is being used normally at comparatively low speeds, and it is found that these plugs are oiling up at frequent intervals, a type of plug which runs hotter so that it burns away the oil may be found more suitable, and we would under these circumstances recommend the Lodge C.14 or the Champion J.8 or J.9. There is, however, a tendency to pre-ignition if these plugs are run at maximum power for long periods.

The chief feature of Lodge "Sintox" insulated plugs is that the insulator is designed to run hot enough to prevent the formation of soot or other combustion deposits, which would give rise to internal shorting and resultant weak sparking. This feature thus gives the plug a self cleaning property and largely obviates the need for plug cleaning. The only servicing necessary (at intervals of approximately 3,000 miles) is that of re-setting the gap to the original size.

### 46 Roadside or Home Garage Cleaning of Detachable Lodge Plugs.

1. The plug should be dismantled by unscrewing the gland nut using a ring or box spanner on the smaller hexagon of the plug and holding the larger or body hexagon in another ring or box spanner. The use of two ring spanners, suitably positioned on the respective hexagons so that the ends of the spanners when squeezed together apply an undoing force to the gland joint is an easy method of achieving this dismantling ; but the body hexagon can be **lightly** gripped in a vice and a ring or box spanner used on the gland nut in the normal manner.

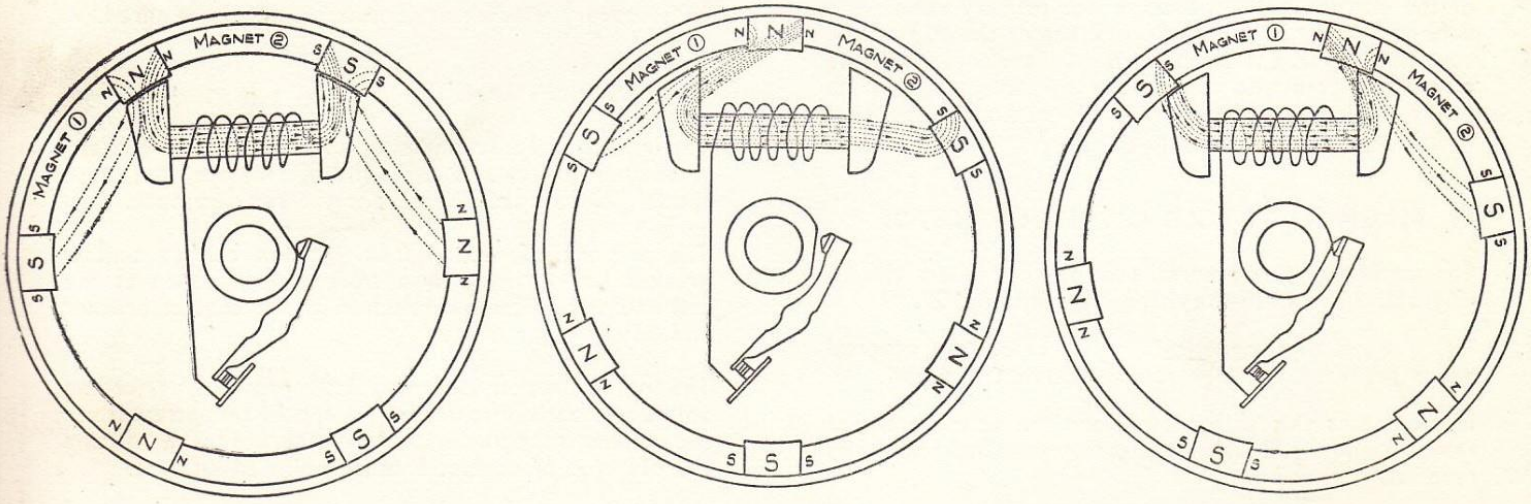


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**FIG. 27.**

# VILLIERS MK. 1F. UNIT

## MAGNETO.

2. The insulator can be scraped clean with a knife blade or wire brush and finished off by rubbing with a gasoline soaked rag. The body can be cleaned internally by scraping and again finally wiping with a gasoline soaked rag. The electrodes can be carefully scraped clean or brushed with a wire brush.

3. The plug parts can now be re-assembled as in Fig. 29, care being taken to see that the internal seating washer between the insulator and the body is correctly positioned and that **all joint faces are scrupulously clean.** The gland nut should then be lightly tightened on the insulator, the nose end of the insulator centralised within the body, and gland nut then finally tightened with normal effort, using a box spanner with no greater than 8" leverage.

4. The gaps can now be reset to the correct gauge and the plug is ready for re-fitting to the engine.

**Note.** During gap setting it is important that only the earth points should be adjusted, as any bending of the centre electrode is liable to damage the insulator.

### 47 IGNITION FAILURE.

In the event of ignition failure the cause will usually be found to be due to the condition of the sparking plug or contact breaker points, or faulty insulation of the plug wire or contact breaker connections.

Serious trouble in the form of condenser or coil breakdown is rare due to the great care in checking and rechecking these important parts both before and after assembly.

The first step in dealing with ignition trouble should, therefore, be to remove the plug from the engine and examine the points to see whether these are oily and the gap correctly set between .018" and .022". If the insulator is fouled with oil and carbon there may be sufficient leakage to prevent correct sparking, and cleaning will then be necessary. Fitting a new plug will readily show whether the failure is due to the plug or not.

The plug wire should then be examined for cracks or other faults.

The contact breaker can then be examined without removing the flywheel to see whether the points are opening correctly. When the points are fully open there should be a gap of .015". The surfaces must also be clean and free from oil and severe pitting. A piece of stiff paper will usually be capable of removing oil or grease. If the points are burned or pitted they should be cleaned with a fine carborundum stone if available, otherwise fine emery cloth can be used and afterwards wiped with a cloth moistened with gasoline to remove all traces of metal or emery dust.

As a result of wear of the heel of the rocker arm which bears on the cam, the point gap will be reduced. This wear should not be appreciable if the felt oiling pad is kept moist with suitable lubricant.

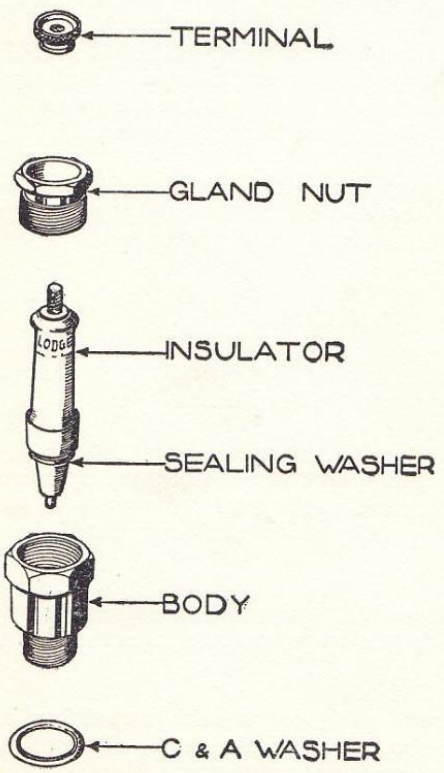


FIG. 29.

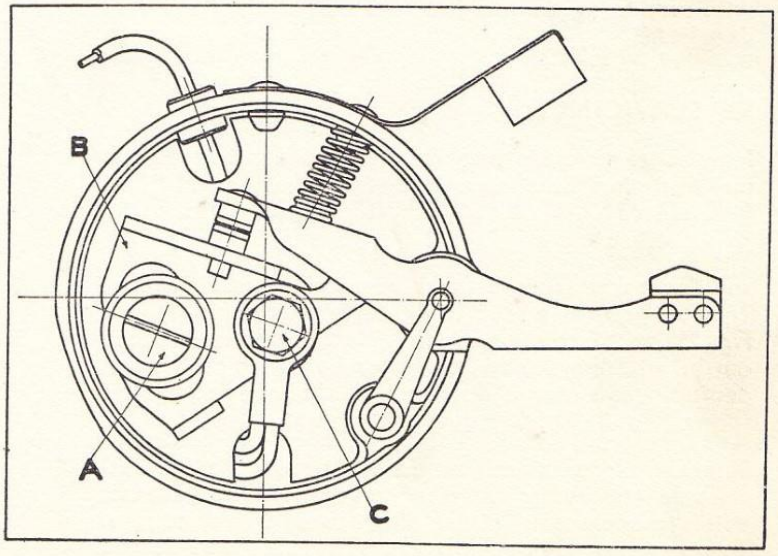


FIG. 30.

# VILLIERS MK. 1F. UNIT

## MAGNETO.

### 48 CONTACT BREAKER ADJUSTMENT (Fig. 30).

To adjust the contact breaker the flywheel should be turned to the "points open" position. Two screws are visible in the contact breaker box, and the one with a saw slot (A) for a screwdriver is the clamp screw that holds the point plate (B) to the box itself. Screw this back about half a turn with the special screwdriver spanner provided, then using this, or if preferred, a larger screwdriver, the point bracket can be levered to the correct position, using the gauge riveted to the screwdriver to get this gap correct. This gauge is .015" thick and should be a slide fit between the points when the gap is correct.

The screw should then be tightened with the screwdriver provided, this being sufficient to ensure tightness of the point bracket.

It is advisable to check the point gap after tightening.

Great accuracy of adjustment is not essential, and a variation of a few thousandths of an inch in either direction will do no harm.

### 49 INSULATION.

Trouble may also be caused if any metal particles become lodged between the adjustable point bracket and the body of the condenser box, thus earthing (grounding) the primary circuit.

The same effect will be caused if the insulating washer under the clamp screw or the fibre plate under the adjustable point bracket is cracked or faulty. If the contact breaker assembly has been dismantled it may be found that the insulating washer has been left out or the bush for the pivot of this bracket omitted. There is also the possibility that the insulating sleeve fitted over the wire connecting the coil to the contact breaker has been damaged.

### 50 SERVICING.

How to remove the magneto flywheel and instructions for re-timing have already been given under "THE ENGINE AND GEARBOX SERVICE" section (Para. 30).

The only parts liable to wear are the rocker arm spindle and the rocker arm pad which bears on the flywheel cam. The rocker arm is built as a complete assembly (No. 2, Fig. 28) with spindle, pad and fixed contact point, and can be withdrawn from condenser box after pushing on one side the spring clip ; take care that the rocker arm spring (No. 2, Fig. 28) does not fly out.

Before the rocker arm can be withdrawn the flywheel must be removed as explained in Para. 19. The contact points may become pitted after considerable mileage. This is accentuated by dirt or oil. They should be cleaned by a hone or fine emery cloth, all loose dust must afterwards be removed.

### 51 CONDENSER.

A condenser is fitted to the underside of the contact breaker or condenser box (No. 23, Fig. 28), and is held in position by the studs securing condenser box to armature plate (No. 36, Fig. 28). To replace the condenser the complete box must be removed from armature plate, but before this can be done the four armature plate fixing screws must be taken out to allow plate to come away from crankcase.

Undo the two nuts at the back of plate and unsolder the primary lead at the high tension coil ; the box can then be removed.

Unscrew the two studs holding the condenser in position, turn the box over and remove the screw holding the lead from condenser ; it will be necessary to unsolder this lead to enable same to be withdrawn through hole in box.

A faulty condenser is usually indicated by continuous and excessive sparking at the contact points, but before fitting a new condenser make sure that the studs holding the condenser are really tight to ensure a good EARTH. Occasional sparking is normal and may be ignored.

Condensers should be tested on a 200 to 250 volt direct current circuit. The reading on a micro farad meter should be between .2 and .4 micro farads. If this reading is not obtained the condenser should be discarded.

It should also be tested to ascertain that it holds the bulk of this charge for at least 15 secs. This is indicated by the sound of a good healthy spark when the tail is touched to the condenser case after this period.

It would probably function correctly if it only holds its charge for some 5 secs., but it would then be deteriorating and would cause trouble at a later date.

### 52 IGNITION COIL.

A fixture for testing ignition coils by the use of a 6 volt battery is shown in Fig. 31.

The cam should be rotated about 1,500 r.p.m. The coil is held in two V brackets, the primary contact at the coil end pressing on a spring strip on the base board which is in turn connected to the point plate of the contact breaker.

A swivelling arm as shown, holds the coil down by pressing on the high tension button, and takes the H.T. to the test gap.

A good serviceable coil should jump 5.5 mm. at least. It should also be run on a wide gap of about half an inch even if no spark occurs on this wide gap for about two minutes. If it still sparks correctly without missing on the 5.5 mm. gap after this it should be good.

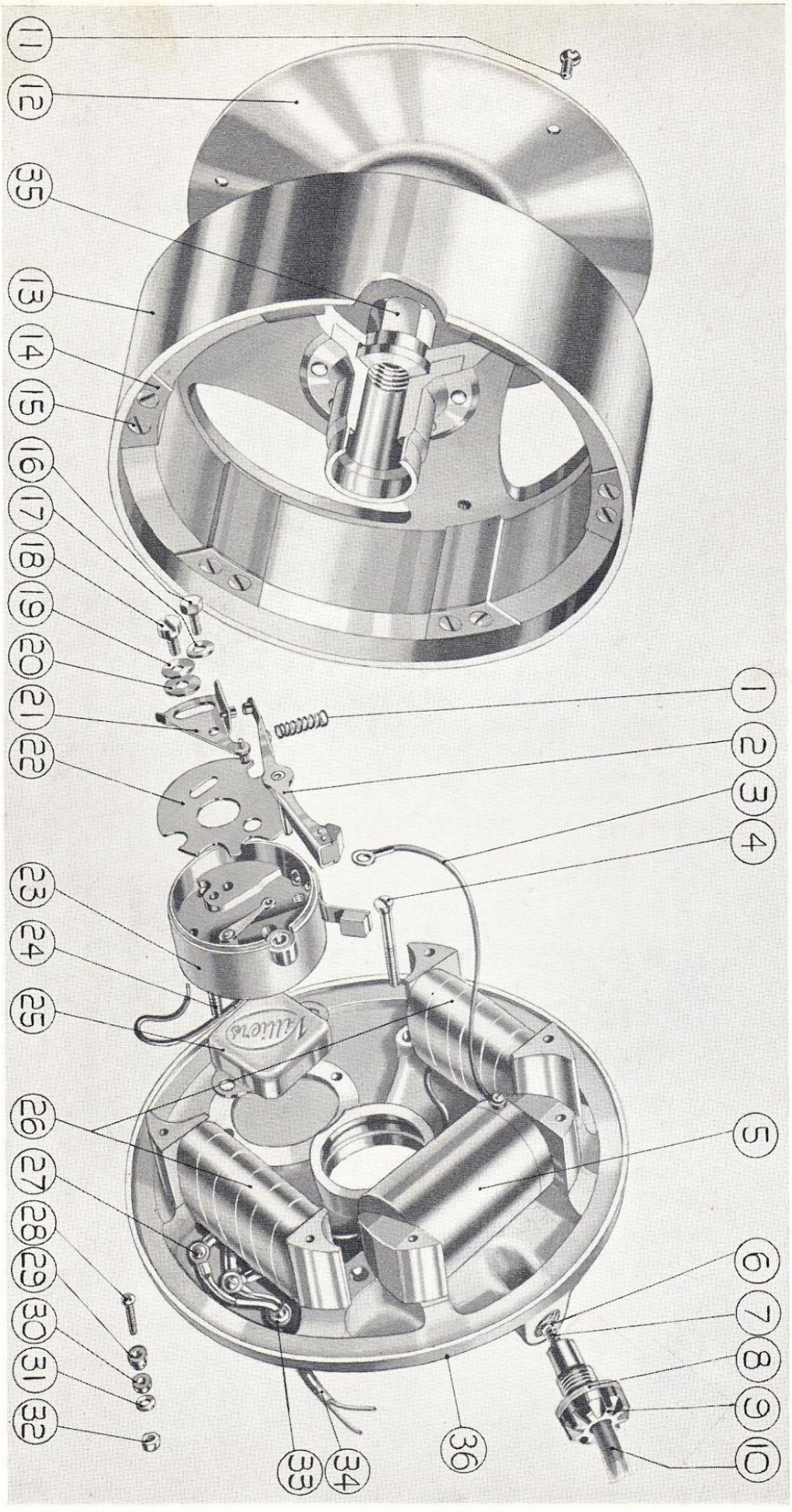
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FIG. 28.

# VILLIERS MK. 1F. UNIT

## MAGNETO.

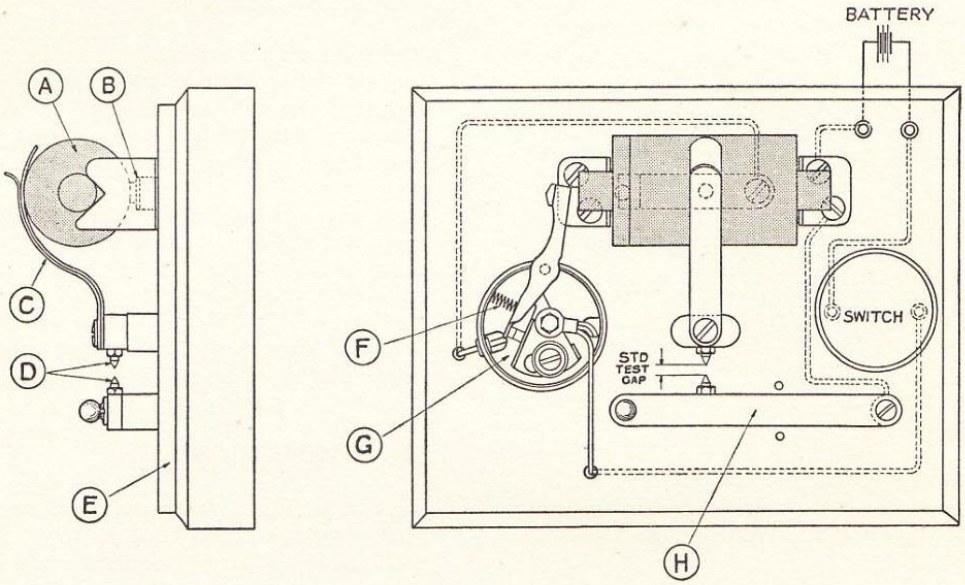



FIG. 31.

### KEY TO ILLUSTRATION.

**A.** Coil under Test.
**B.** Connection to Low Tension Coil Terminal.
**C.** Connection to High Tension Coil Terminal.
**D.** Adjustable Spark Gap Points.
**E.** Insulated Base Board.
**F.** Special Light Rocker Spring.
**G.** Standard Breaker Box with Condenser.
**H.** Movable Arm.

### OPERATION OF TESTER.

1. Contact Points normally closed until circuit is completed by Switch.
2. Current through Primary Wire magnetises Core and attracts end of Rocker Arm, thus opening Contact Breaker Points.
3. The Circuit is then broken and the spring re-closes the Contact Points. The high voltage induced in secondary winding should produce a spark across the test gap. Sequence of operations is then repeated.

Its resistance on an ohm meter should be between 2,000 and 4,000 ohms. If below 2,000 ohms it should be scrapped, if above 4,000 it may still be serviceable, but corrosion in some form may be setting in and replacement is advisable.

It is most advisable to keep a good coil available to use as a check that the apparatus itself is functioning. The 6 volt battery may be discharged and dirt or corrosion at the contacts of the tester itself may have occurred. Also the contact breaker points of the apparatus may need renewing.

The ammeter serves as a check that the primary circuit is correct.

### 53 CHECKING OF LIGHTING COILS.

Their resistance being small—of the order of $\frac{1}{4}$ ohm—it is best to disregard the normal resistance test, as such small resistances are liable to instrument errors. It is better to use the usual "growler" test with a known good coil for comparison.

As it is rare for both coils to be defective at the same time, it is generally useful to make a comparison of the separate outputs of each coil in position.

Whilst it is unlikely that these will be identical any great difference will indicate a defective coil which can then be replaced after checking for bad contacts at the connections.

# VILLIERS MK. 1F. UNIT

## MAGNETO.

### 54 REPLACING IGNITION AND LIGHTING COILS.

The ignition coil is carried in coil ends which are detachable from armature plate by removing four countersunk headed screws from the back of plate.

When replacing coil see that the contact disc on outside is in the correct position to make contact with the pick-up pad when the high tension lead terminal (No. 9, Fig. 28) is screwed in.

The two lighting coils can be detached as a unit. At the right-hand side and close to the condenser box will be found a terminal screw. Release the locknuts and disconnect the lighting lead which passes through the rubber grommet in the armature plate.

Now disconnect the short leads ; do not remove the insulating bushes.

The coils are fixed to armature plate by four screws at the back ; remove these, and the lead from condenser box to high tension coil and lighting coils can be lifted away.

When re-fitting be careful to place connecting leads of coils so that the revolving flywheel cannot foul them.

The original coils are fixed to the armature plate and then machined concentric with the spigot to ensure that the necessary fine limits of accuracy for high efficiency are obtained. Therefore, should a fault develop with the lighting or ignition coils, it is preferable that the complete armature plate assembly should be replaced or returned to a Service Depot or Villiers Works for attention.

Where this is not possible, and Villiers replacement coils are obtained, it is necessary to ensure that the machined edge of the soft iron cores on which the lighting coils are wound, or the coil end pieces of ignition coils, are fitted so that they do not project beyond the edge of the aluminium platform of the armature plate to which they are secured, so that the clearance between them and the flywheel pole pieces is not altered.

When the flywheel and armature plate have been assembled on to the engine, the clearance should be checked by inserting a feeler gauge between the coil ends and the pole pieces on the inside rim of the flywheel. The desired clearance is .010". With this method of assembly it may be difficult to obtain the exact figures. Under no circumstances, however, should the clearance between the lighting coils or ignition coil be less than .004" at any point, as otherwise severe damage is likely to result when the flywheel is rotated or when the flywheel is distorted as a result of accident. In the case of the ignition coils the clearance should not be greater than .020". Excessive clearance will reduce the efficiency of the magneto considerably.

If it is found on assembly that the coil ends do project beyond the aluminium base, slacken off the fixing screw and give the coil ends a light tap with the handle of a hammer, afterwards thoroughly tightening screws. It should be possible to correct the clearance by this means.

Absolute cleanliness is essential when overhauling a magneto, as damp, dust or other foreign matter can easily cause short circuits. It will also be appreciated that the flywheel magnets will attract any ferrous particles which may be near to them. These are likely to cause considerable damage if allowed to remain attached to the inside of the wheel.

### 55 MAGNETISING.

Very powerful magnets are used, made from the highest quality magnet material obtainable. These are extremely stable, and no loss of magnetism will occur during the life of the engine.

The flywheel can be detached from the armature plate without danger of affecting the magnetic strength, and there is no need to put a "keeper" over the flywheel even though this remains detached for long periods. No appreciable improvement will be obtained by re-magnetising, quite apart from the fact that very special equipment is necessary which is expensive to install.

### 56 CARE OF THE BATTERY.

Once a month unscrew the filler caps of each cell and pour in a small quantity of distilled water to bring the acid level with the tops of the separators. Do not use tap water as it contains impurities detrimental to the battery.

Acid should not be added unless this is accidentally spilled out of the battery. This 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.

The positive is earthed to reduce this effect to a minimum.

# VILLIERS MK. 1F. UNIT

## LIGHTING SETS.

### 57 RECTIFIER.

This will need no attention and is practically fool proof.

It is however, most desirable, that if the battery is taken off the machine the connections to the rectifier are also detached, as otherwise the full load of the dynamo may puncture the rectifying cells and cause failure.

In most cases no harm will result from a short period with the battery detached, but to be safe it is best to ALWAYS detach these wires if the battery is removed.

It is most important that the lead from the magneto to the rectifier should not short to earth as this will partially demagnetise the magneto if the battery is in circuit.

### 58 GENERAL NOTES.

It is fairly simple to check whether the rectifier, etc., is working correctly.

Switch the lights on—they will probably be down if the rectifier is suspected—then start the engine.

If the charging is in order the light will brighten when the engine is speeded up.

If the battery keeps discharging in spite of this, it is probably defective, and should be checked over by battery repairers. It is, of course, desirable to first check that the battery terminals are not corroded or the electrolyte level below the top of the plates.

### 59 LIGHTING CIRCUITS.

Alternative types of lighting sets may be fitted, although the magneto unit remains unchanged. For the battery charging set the alternating current is converted by a rectifier and charges a 6 volt accumulator. The appropriate lamps are indicated below.

With this type a "STOP" light and an electric horn can be fitted. Wiring diagram is shown on Fig. 33.

On the other type the alternating current is taken direct to the headlamp switch and a small dry battery is fitted in the headlamp shell to supply current for parking purposes. The wiring diagram is shown on Fig. 34.

The current produced is alternating which by means of Selenium type rectifier is converted to direct current so as to charge a 6 volt battery.

The operation of this rectifier can be regarded as a one-way valve which permits the current to pass in one direction, but not in the reverse direction.

The lighting current is taken from magneto by two leads, which have a detachable connector. This must be used when removing lighting cables, or taking the engine from the frame ; do not attempt to disconnect the lead from inside the magneto.

### 60 THE HEAD LAMP. (Battery Lighting Set).

Type BH (1302/A) headlamp is fitted (Fig. 32).

The pilot bulb is a 6-7 volt bulb, 3 watts.

Miniature bayonet cap.

The main bulb is a 6-7 volt bulb, with double filaments, 12 watts. S.B.C. for battery.

Note the direction in which bulb can be fitted is indicated on the cap.

### 61 REMOVING LAMP FRONT AND REFLECTOR.

To remove lamp front and reflector, unscrew the fixing clip at the bottom of the lamp. When replacing the front locate the top of the rim first, then press on at the bottom and secure by means of the fixing screw.

To remove the bulb holder, turn anti-clockwise to stop and pull out.

### 62 SETTING AND FOCUSING.

The lamp must be set to ensure that the beam is projected correctly.

To obtain the best driving light, the bulb should be correctly focused in the reflector.

Adjust by slackening the screw in the clamping band and sliding the bulb holder backwards or forwards, until the beam gives the best illumination on the road.

Tighten the screw after making the adjustment.

The reflector can be withdrawn from the lamp front when the spring clips are sprung from their locations inside the front rim.

### 63 CLEANING.

Care must be taken when handling the reflector to prevent it from becoming finger marked. It can however, be cleaned by polishing with fine chamois leather or a clean, dry soft cloth, but even this should not be done unless the reflector is very dirty indeed. Metal polishes must **not** be used.

# VILLIERS MK.1F. UNIT

## LIGHTING SETS.

### 64 LIGHTING SWITCH. On the Battery Charging Set.

When making connections to the switch, all leads should be soldered to the switch clips and pilot bulb contact. Those to the main bulb holder are held in spring clips.

### 65 THE REAR LAMP. Battery Lighting Set.

Type 477 rear lamp is fitted (Fig. 32).

The body with bulb holder, is secured to the rear number plate by three bolts, with washers and nuts.

The bulb is a twin filament 6-7 volts, 3 watts, S.B.C. tail light, 6-7 volts, 18 watts stop light.

The cover, carrying the red and white glasses is secured to the body by a bayonet joint.

To remove the cover, twist it anti-clockwise and then pull outwards.

To replace the cover, push and then turn it until the spring clip is heard to clip into its position.

Note that there are two wide tangs and one narrow to prevent assembling with the lighting aperture out of position. These must be mated correctly before turning the cover.

Note also that the bulb is fitted in the correct position so that the brake switch operates the large 18 watt filament. Should this filament be on the normal tail light circuit the extra load imposed would soon discharge the battery.

A rubber cover is fitted over the sprung wire connectors.

### 66 THE HEAD LAMP. Direct Lighting Set.

Type M.35.

Main Bulb. 6 volt, 18 watts, double filament S.B.C. Fitting position is indicated on cap.

Pilot. 3.5 volt, .15a. M.E.S.

### 67 REMOVING LAMP FRONT REFLECTOR.

Push down the clip at the bottom of lamp rim, which should then be pulled off from the bottom. (The rim pivots on the top when opening). When replacing locate the rim top first then press on at the bottom and spring the clip into position.

To remove the bulb holder, turn anti-clockwise to its stop and pull out.

### 68 SETTING AND FOCUSING.

The lamp must be set to ensure that the beam is projected correctly, and to obtain the best driving light the bulb should be set in the one of the two focus positions that appears most suitable to the user ; this is done by pushing in the bulb and turning either right hand or left hand accordingly.

The reflector can be withdrawn from the lamp front when the spring clips are sprung from their locations inside the front rim.

### 69 CLEANING.

As rectifier set.

### 70 LIGHTING SWITCH. Direct Lighting Set.

All connections are either of the screw or spring clip type and no soldering is necessary.

### 71 REAR LAMP, Type 480. Direct Lighting Set.

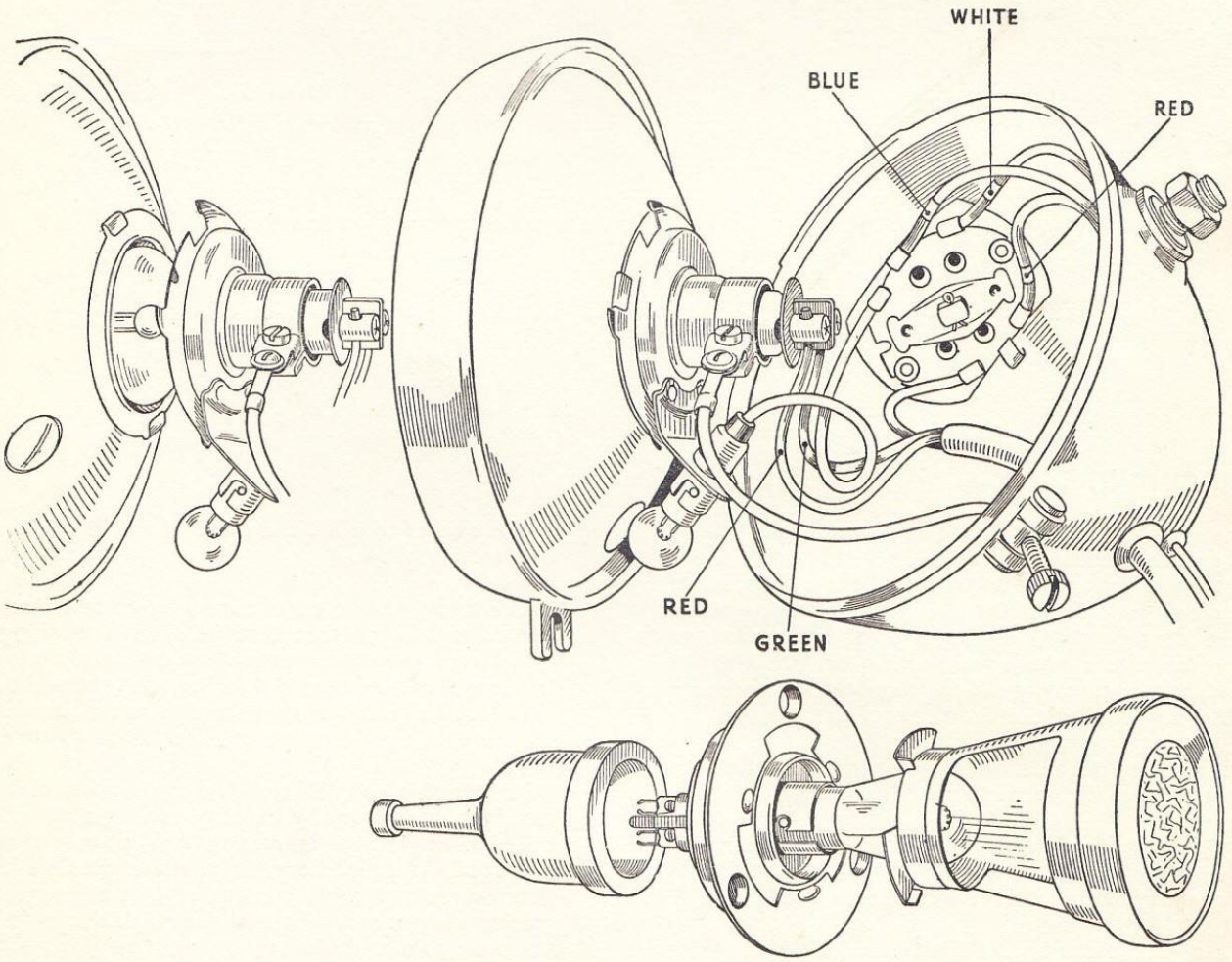
The body with bulb holder is secured to the rear number plate by three bolts with washers and nuts.

The bulb is a single filament 6-7 volts, 3 watt S.B.C. The cover carrying the red and white glasses is secured to the body by a bayonet joint.

To remove the cover twist it anti-clockwise and then pull outwards. When replacing see that the parts engage properly, then turn clockwise as far as it will go. Note that there are two wide tangs and one narrow one to prevent assembling with the lighting aperture out of position. These must be engaged correctly before turning the cover. A rubber cover is fitted over the sprung wire connectors.

# VILLIERS MK. 1F. UNIT

## LIGHTING SET.




## BATTERY LIGHTING SET.

FIG. 32.

# VILLIERS MK. 1F. UNIT

## WIRING DIAGRAMS

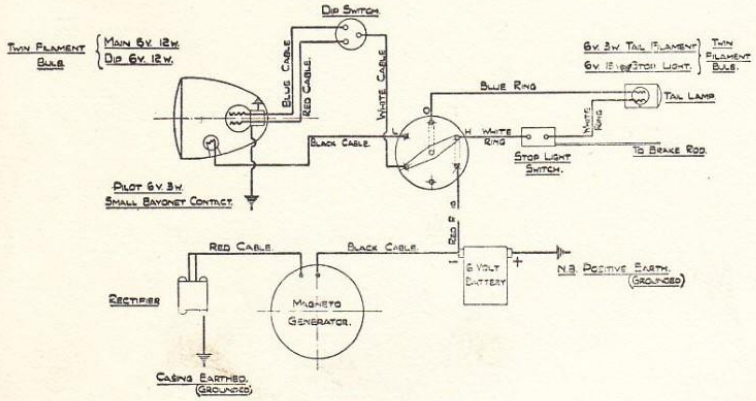



FIG. 33.

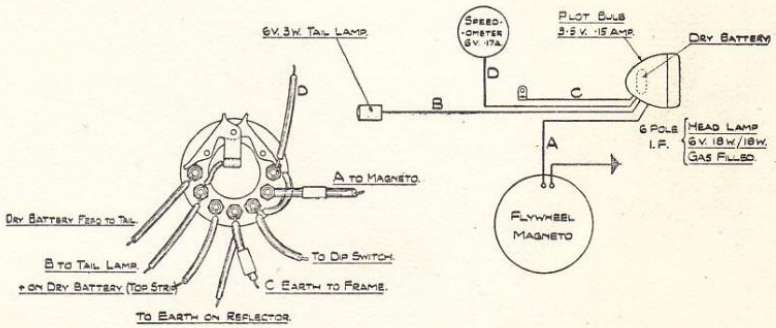



FIG. 34.

### 72 TRACING TROUBLES.

The locating and rectification of troubles with the Villiers engine can be made very simple by systematic and intelligent investigation. It is true that the symptoms of engine stoppage will usually give a clue to its cause, and that considerable experience may be needed to realise which of the number of possible eventualities has occurred, but by following a definite method of approach it is fairly easy to diagnose the cause of the trouble.

It is best to carry out tests bearing in mind that an engine will start and run satisfactorily :

(1) If there is a supply of fuel at the carburetter, and that it is introduced into the engine with a suitable quantity of air to make a combustible mixture.

(2) If a good spark occurs at the sparking plug in the cylinder at the correct time, that is, in this particular engine, when the piston is $\frac{1}{8}$" before the top of its stroke.

(3) If the engine is in mechanically good condition, that is, freedom from air leaks, has good compression both in cylinder and crankcase.

In the case of trouble, the cause of which is not evident, proceed as follows.

Work carburetter control to and fro to test that cable is not damaged, and that throttle slide is working freely. Make sure that there is fuel in tank and that the tap is turned on, depress tickler on carburetter to check that fuel has reached there and is not obstructed by a stoppage in the fuel pipe or filter in banjo union.

After assuring yourself that fuel is reaching carburetter, test for a good spark by holding sparking plug body on to cylinder head, and depressing kick starter sharply. If the spark is satisfactory, it is quite possible that the petrol-air mixture is incorrect, or that the engine is not mechanically sound. If the above quick checks fail to find the cause of the trouble, reference should be made to the charts specially prepared for the diagnosis of all kinds of troubles that can occur. See pages 45—47.

# FAULT FINDING CHART

## ENGINE WILL NOT START

| Sequence of Testing | Possible Trouble | Remedy |
|---|---|---|
| Check fuel supply. Depress tickler on carburetter to check whether fuel is reaching carburetter. | No gasoline reaching carburetter. | Turn on fuel tap, refill tank. |
| If no fuel even when tap is on and fuel is in tank. | Choked fuel pipe, filter, or carburetter fuel needle sticking. | Remove and clean out. |
| Check ignition. Test for spark by holding sparking plug body on cylinder head. | Leak along insulation of plug or spark plug wire or high tension lead. | Try another plug of the recommended type, and/or new spark plug wire. |
| If still no spark : Test for spark at end of spark plug wire held $\frac{1}{8}$" from cylinder head. | Trouble may be faulty plug, oily or sooted points, slight short on insulation inside plug. | Try another plug. |
| | If no spark at end of spark plug wire contact breaker points may not be opening sufficiently, or points dirty or pitted. | Adjust to .015". |
| | | Clean. |
| | Moisture on insulation of condenser box. | Clean and dry out. |
| | Contact breaker grounded or short circuited by the points being bridged by metal particles. | Remove. |
| | High tension pickup not making good contact on coil due to corrosion or misplacement. | Clean or correct. |
| | Cracked insulation of adjustable contact breaker point. | Renew. |
| | Insulating sleeve on wires connecting contact breaker to coil or condenser damaged. | Replace. |
| | Faulty connection to low tension wire of coil. | Correct. |
| | Faulty condenser. | Replace. |
| | Faulty coil. | Replace. |
| If above tests are O.K., but engine will not start. | Mixture may be too rich due to use of strangler when engine is warm or incorrect needle setting or water in fuel. | Open strangler and depress kick starter several times with throttle wide open to clear engine. Adjust needle, drain and remove fuel. |
| Check carburetter for flooding causing richness of mixture, etc., or weakness due to air leaks. | Air leaks at carburetter stub or joints, causing weak mixture. | Correct. |
| | Incorrect fuel, i.e., kerosene or alcohol. | Fill up with correct fuel. |
| Check over ignition timing. | Flywheel slipped giving incorrect ignition timing. | Check. Timing marks on flywheel and armature plate should coincide when piston is at top of stroke. |

# FAULT FINDING CHART

## ENGINE FOUR-STROKES

| Sequence of Testing | Possible Trouble | Remedy |
|---|---|---|
| Make sure strangler is open and air cleaner not choked. | Too rich mixture. | Try lowering jet needle by screwing down screw in centre of throttle slide. |
| Check to see if there is excessive smoking at the exhaust. | **N.B.** 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. |
| | Flooding of carburetter. | If persistent, flooding may be due to dirt under fuel needle seating, or sticking fuel needle, or damaged seating, or punctured float in carburetter. |

## ENGINE LACKS POWER

| Sequence of Testing. | Possible Trouble. | Remedy. |
|---|---|---|
| Check mechanical condition. | Engine out of tune, due to wear, etc. | Overhaul. |
| Examine spark plug. | Unsuitable plug. | Replace with recommended type. |
| Test for compression. | Loss of compression. | Check cylinder head bolt tightness. Worn piston rings. |
| | Incorrect mixture of oil and fuel. | Use correct mixture ($\frac{1}{2}$-pt. oil to 1-gall. of gasoline) |
| Examine engine for carbon deposit by removing cylinder head. | Excessive carbon deposit on piston and cylinder head. | Decarbonise. |
| Examine silencer. | Exhaust system choked. | Clean out silencer and exhaust pipe. |
| Check carburetter setting. | Incorrect carburetter setting. | Check with recommendations. |
| Check air cleaner. | Air cleaner choked. | Wash in gasoline, drain and re-oil. |
| Test brakes. | Brakes binding on motorcycle. | Adjust. |
| Check fuel supply. | Obstruction in fuel supply. | Clean out fuel pipe and filter. |
| Check ignition timing. | Incorrect ignition timing. | Check and correct. |
| Examine condition of piston, etc. | Worn or stuck piston rings. | Renew. |

# FAULT FINDING CHART

## ENGINE WILL NOT RUN SLOWLY

| Sequence of Testing. | Possible Trouble. | Remedy. |
|---|---|---|
| Check joints for air leaks. | Weak mixture due to air leaks at carburetter stub, crankcase, and/or cylinder base joints or name plates on left hand crankcase, drain screw missing. | Tighten up all joints. |
| | Crankshaft gland incorrectly assembled. | Replace. |
| Check ignition timing. | Ignition timing too far advanced. | Correct. |

## ENGINE SUDDENLY STOPS

| Sequence of Testing. | Possible Trouble. | Remedy. |
|---|---|---|
| Check over ignition system. | Spark plug wire disconnected. | Replace. |
| | Spark plug points bridged by oil or foreign matter. | Remove spark plug from cylinder head and clean the points. |
| | Water causing short circuit of spark plug wire. | Dry and remove all water. |

## ENGINE MISFIRES

| Sequence of Testing. | Possible Trouble. | Remedy |
|---|---|---|
| Check ignition. | Defective sparking plug. | Try new plug. |
| | Loose connection in ignition circuit. | Check over all joints in wiring. |
| | Intermittent grounding of spark plug wire. | Replace spark plug wire if damaged. |
| | Contact breaker gap insufficient. | Adjust point gap to .015". |
| Check fuel supply. | Partial stoppage in fuel supply. | Clean out fuel pipe and filter. |
| | Fuel mixture too weak, indicated by back firing in carburetter. | Raise throttle needle by undoing screw in top of slide. |
| | Water in fuel. | Drain tank and carburetter. |

# VILLIERS MK. 1F. UNIT

## SERVICE EQUIPMENT.

Reference has been made in the preceding pages to service tools. The complete list of tools is given below. Working drawings of these tools are available, and can be obtained from the VILLIERS ENGINEERING Co. Ltd., on request at a nominal charge.

### 73 INSTRUCTIONS FOR THE USE OF 1F. SERVICE EQUIPMENT.

**ST112. Left Hand Crankcase Extractor.** (Fig. 6).

To withdraw the left hand crankcase from the crankshaft, remove the name plate and sealing washer. Place the bore of the extractor over the crankshaft. Fit the four screws into the crankcase holes, and turning the extractor spindle, withdraw the crankcase from the drive-shaft. The ball race may remain in the crankcase or be left on the drive-shaft ; instructions for removing it are given under ST137 or ST204.

**ST114. Clutch Assembly Fixture.** (Fig. 17).

To assemble the clutch to the correct overall dimensions, place the clutchshaft in the bush in the base of the fixture, engaging the splines on the peg. Assemble the clutch plates, etc., to instructions, and when the spring has been fitted, assemble the fixture top plate, and by means of the winged nuts compress the spring. There is a positive stop for the top plate and it should be screwed right down to this. Assemble the nut, finger tight, and try for height with the slide setting piece on the fixture top plate. When the nut is positioned correctly, unscrew the wing nuts and remove the clutch assembly from the fixture, check the overall dimensions of the nut and splines with the gauge provided.

**ST115. Drive Sprocket Locking Plate.** (Fig. 10).

To remove the nut from the final drive sprocket. Engage the locking plate in the sprocket teeth and screw the retaining screws into the clutch bridge mounting holes, finger tight. Straighten the locking washer and remove the nut with the tube wrench. To assemble the sprocket nut, engage plate as above, tighten the nut with the tube wrench, and bend the locking plate with the hand tools ST224 and ST222.

**ST117. Crankpin Extractor.** (Fig. 14).

To remove the crankpin from the long or flywheel side of the crankshaft. Withdraw the front plate from the two studs at the front of the fixture. Place the crankshaft spindle through the top hole in the fixture and locate the crank between the small studs at the front. Lock the crankshaft at the back of the fixture with the nut provided. Screw the extracting spindle at the back of the nut provided. Screw the extracting spindle at the back of the fixture on to the crankpin and using the tommy bar, press the crankpin out of the crank.

To remove the crankpin from the short side. Place the short shaft into the top hole in the fixture at the front, locate the crank between the two small studs. Place the front plate over the long studs, see that the middle hole in the front plate passes over the crankpin, and lock it against the crank with the two nuts provided. Using the extracting spindle, force out the crankpin as above.

**ST127. Drive Shaft Extractor.** (Fig. 9).

To remove the drive shaft from the right hand crankcase. This is done with the left hand crankcase already removed. Place the bore of the fixture over the long or flywheel side shaft and with the extended side of the fixture at the top left hand side, screw the retained screws into the three holes in the gearcase finger tight. Press out the crankshaft by screwing the extractor spindle on to the crankshaft.

**ST137. Three mounting Plates—Ball Race Extractor.** (Fig. 11).

To extract the ball race from the crankcase and the gearcase. Mount the case upon the appropriate plate. Place the expandable centre of the extractor into the bore of the ball race and, holding the bottom lever in the extractor, tighten the top nut by means of the small tommy bar, making sure that the body of the extractor is pressing against the case, this will lock the centre of the extractor into the ball race. To extract the ball race, use the long double levers, rotating them in a clockwise direction ; the provision of a thrust race in the body of the extractor prevents the body from turning and scoring the case. The ball race will leave its housing and be retained in the extractor. To release it, unscrew the top nut for about $\frac{1}{2}$", unscrew the double lever body to the top of the thread and give a sharp tap on the top nut, the expandable centre will then be released and the ball race can be removed from it.

**ST139. Grinding Clutch Corks.** (Fig. 22).

This is not a fixture, but a drawing, giving full instructions on the grinding or tuning of the clutch corks in a lathe.

**ST140. (A. and B.) Fixture for Assembling Large and Small Clutch Corks to Clutch Plates.** (Fig. 23).

When the corks have been thoroughly soaked in water, load them one at a time into the appropriate fixture, making sure that they are loaded in the right position. Place the slot in the clutch plate over the top of the fixture and press the top half of the fixture down with the clutch plate until the cork is inserted into its slot. Use ST210 to evenly distribute the cork on each side of the plate.

# VILLIERS MK. 1F. UNIT

## SERVICE EQUIPMENT.

**ST141. Fixture for Pressing H.G. Wheel Bearings and Countershaft Spindle into Gearcase.** (Fig. 19).

Place the gearcase on the fixture, locating the bearing housing over the guide pillar and the countershaft spindle hole over the spring plunger. Assemble the ball race over the guide pillar and with the pressure bush, press the ball race into its housing, by means of a standard arbor press. Remove the pressure bush, assemble the countershaft spindle washer over the spring plunger. Place the countershaft guide clamp into the bridge bolt holes and seat it down. Put the countershaft spindle into the central hole in the clamp and press it into the case.

**ST142. Assembly Fixture Drive Shaft to Right Hand Crankcase.** (Fig. 21).

To press the drive shaft into the bearing in the right-hand crankcase, place the fixture into a standard arbor press, put the crankcase on to the fixture with the gland bush locating in the pillar hole. Place the long crankshaft through the bearing and insert the tapered drift firmly between the balance weights, to avoid distorting the shaft during the pressing operation. Place the con. rod in its normal working position (to avoid fouling the crankcase), and press the drive shaft into the bearing.

**ST143. Universal Stand for Assembling and Dismantling.** (Fig. 4).

To mount the engine, place the bottom mounting hole over the extension lead on the bottom stud. Holding the engine upright, place the top mounting holes over the top studs and push the engine into position. Secure with nuts and washers provided. The engine unit can now be moved by releasing the lever at the side of the stand and may be locked in any position within an angle of approx. 30° from vertical. The most suitable positions will be found by experience, but we recommend that for mounting the magneto and timing the engine, the stand should be inclined backwards as far as it will go and locked tightly.

**ST144. Engine Sprocket Locking Plate.** (Fig. 8).

This is intended to prevent the engine sprocket rotating when tightening or removing the securing nut. Place the locking plate boss over the bottom spindle on the universal stand ST143, and engage the teeth on the sprocket, remove the nut with tube wrench. Where the stand is not available, engage the teeth in the sprocket and, using a clutch case screw, screw the locking plate to the gearcase through the countersunk hole.

**ST148. Clutch Case Extractor.** (Fig. 7).

To remove the clutch case, first remove all the screws, place the large boss of the extractor over the end of the clutch shaft. (Do not dismantle the kick starter ratchet on the clutch shaft). Engage the three screws in the kick starter box mounting holes in the clutch case finger tight, place small boss over the drive shaft and engage the two screws in the holes in the clutch case. Screw in the extracting spindles until both just engage the clutch-shaft and drive shaft respectively, then turn spindles at an even rate, withdraw the clutch case maintaining an equal gap all round, between the clutchcase and gearcase.

**ST149. Countershaft Spindle Extractor.** (Fig. 13).

Place the extractor legs through the bridge bolt holes from the outside of the gearcase, lock the legs finger tight with the nuts provided. Screw the extractor spindle down on to the countershaft spindle and the countershaft will be pressed out.

**ST204. Drive Shaft Ball Race Extractor.** (Fig. 12).

To remove the ball race from the longer shaft, place the shaft into the bore of the extractor, withdrawing the extracted spindle to allow the ball race to sink below the adjustable stops, and by means of the two knurled round nuts screw the two stops in over the ball race.

Remove the drive shaft by turning the extractor spindle and release the ball race by screwing back the nuts.

To remove ball race from the short shaft, place the additional centre piece provided into the bore before putting the shaft into it and proceed as above.

**ST208. Plate for Pressing Main Bearing into Crankcase.** (Fig. 18).

Assemble the gland bush and the plate spring in the crankcase bearing housing, put the crankcase on to the fixture, locating the gland bush over the bearing guide pillar, place the ball race over the pillar, and with the loose pressure bush, press the bearing into its housing, using a normal hand press.

**ST210. Clutch Cork Planishing Plate.** (Fig. 23).

To distribute the amount of cork evenly on both sides of the clutch plate place the clutch plate on to the fixture, the corks will then be in the recess. Tap each cork down with a hammer or mallet until it touches the bottom of the planishing plate. the corks will then be evenly distributed.

**ST174. Assembly Press for Drive Shafts.** (Fig. 15).

To assemble the drive shaft complete, place the crankpin In the holder in the ram of the press. Place the long drive shaft into the fixture on the bed of the press, centralise crankpin and hold it with the self locking clamp. Press the crankpin right home into the drive-shaft. Assemble the con. rod and roller bearings round the crankpin.

# VILLIERS MK. 1F. UNIT

## SERVICE EQUIPMENT.

Change the crankpin holder in the ram for the spring plunger (they are held in with an Allen screw).

Put the small drive shaft half into the ram locating the crankpin hole into the spring plunger and the drive shaft into the hole in the ram, there is a spring loaded ball in this hole that holds the drive shaft in position. Place the drive shaft with con. rod assembled into the fixture and locate the crankpin with the hinged location piece, lock up with the clamp.

Slacken the graduated dial by unscrewing the set screw, revolve the dial until the peg on the left hand of the set screw is in contact with the driving peg in the press, lock the set screw. Press the crankshaft half on to the crankpin, the press will come to a stop with the graduated dial at zero.

Check the gap between the con. rod face and the drive shaft with feeler gauges, the tolerance should be .004/.007". The clearance obtained will be greater than this.

To correct, re-set the stop by releasing the set screw in the graduated dial and rotating the dial to read .006" less than the feeler readings, tighten the set screw and press home the drive shaft.

Finally check the clearance.

### 74 INSTRUCTIONS FOR THE USE OF NON-STANDARD HAND TOOLS.

**ST222. Blunt Drift.**

Place the narrow end of the drift on to the engine sprocket nut locking plate, the initial bend has been put in with ST224, and using a hammer, flatten the plate on to the nut.

**ST233. Pointed Drift.**

After assembling the drive sprocket, place the pointed end of the drift into the clutch shaft, and using a hammer, tap the clutch shaft back towards the kick starter box. The movement is small but it is important that it is taken up.

**ST224. Sharp Chisel.**

Place the sharp edge of the chisel behind the engine sprocket nut locking plate, and using a hammer, bend the plate over. Finish the bending with ST222.

**ST225. Tubular Drift.**

Assemble the engine sprocket over the drive shaft and key. Place the large bore of the drift over the drive shaft, and lightly tap the sprocket home with a hammer.

**ST226. Modified Circlip Pliers.**

Place the two holes in the pliers over the legs of the clutch circlip, squeeze the plier handles together until the circlip is large enough to be drawn over the clutch shaft. Release the plier handles and withdraw the circlip from the holes.

**E7531. Spanner for Exhaust Pipe Nut.**

**"Villiers" Hand Tools.**

E7402. Spark plug spanner (supplied with each engine).

M1665. Magneto point screwdriver (supplied with each engine.).

M1239. Hammer tight flywheel spanner (obtainable from our Service Dept.).

D6161. Arrow stamp (obtainable from our Service Dept.).

**Standard Hand Tools.**

One $\frac{3}{8}$" × $\frac{5}{16}$" Whit. open-ended spanner (across flats $\frac{23}{32}$" and $\frac{19}{32}$").

One $\frac{3}{16}$" × $\frac{1}{4}$" Whit. open-ended spanner (across flats $\frac{7}{16}$" and $\frac{17}{32}$").

One $\frac{3}{16}$" stud runner.

Two $\frac{1}{4}$" × $\frac{5}{16}$" Whit. tube wrench (across flats $\frac{17}{32}$" and $\frac{19}{32}$").

One $\frac{1}{8}$" × $\frac{3}{16}$" Whit. tube wrench (across flats $\frac{11}{32}$" and $\frac{7}{16}$").

One pair snipe nosed pliers, $\frac{1}{16}$" ends for piston circlip and sprocket keys.

One centre punch $\frac{3}{8}$" dia. for locking countershaft bridge nuts.

One 8" screwdriver $\frac{7}{32}$" wide bit.

One 12" screwdriver $\frac{11}{32}$" wide bit.

One $\frac{5}{8}$" Whit. × $\frac{11}{16}$" Whit. tube wrench for clutch nut (across flats $1\frac{1}{8}$" and $1\frac{7}{32}$").

One $\frac{1}{2}$-lb. hammer and one hide mallet.

# VILLIERS MK. 1F. UNIT

## NOTES

# VILLIERS MK. 1F. UNIT

## NOTES

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