WORKSHOP MAINTENANCE MANUAL for the

ROYAL ENFIELD

SEVEN-FIFTY INTERCEPTOR

SERIES II MOTOR CYCLE

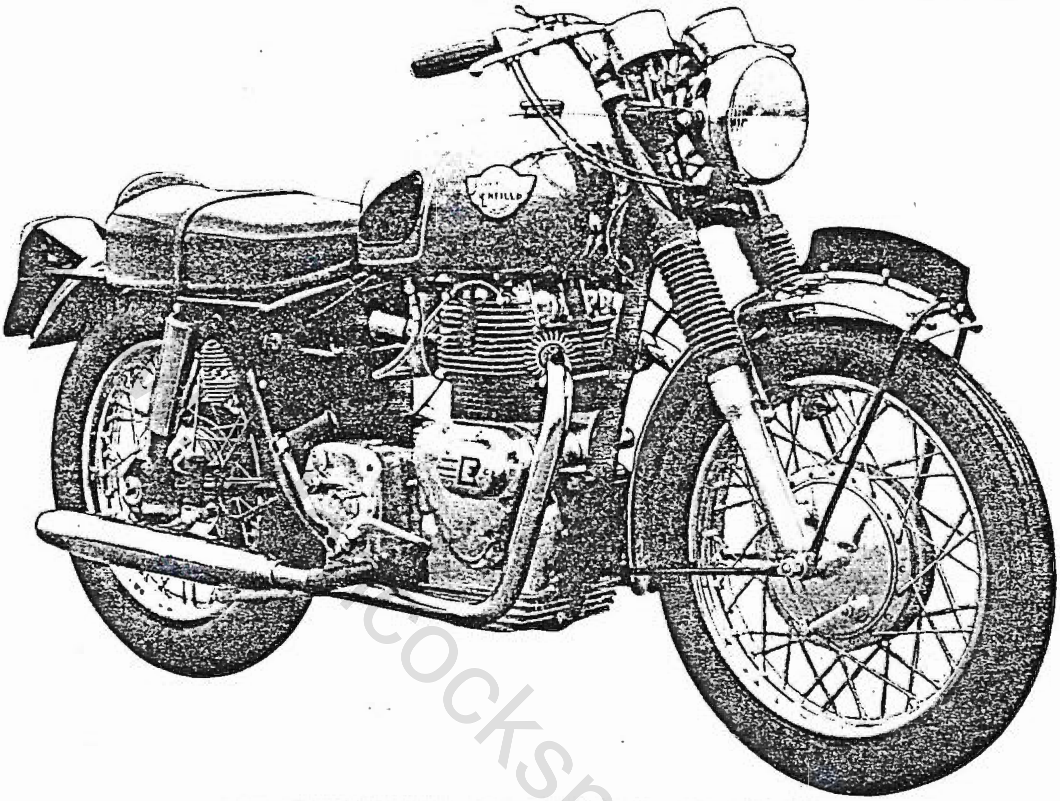
ENFIELD

Enfield Precision Engineers Ltd.

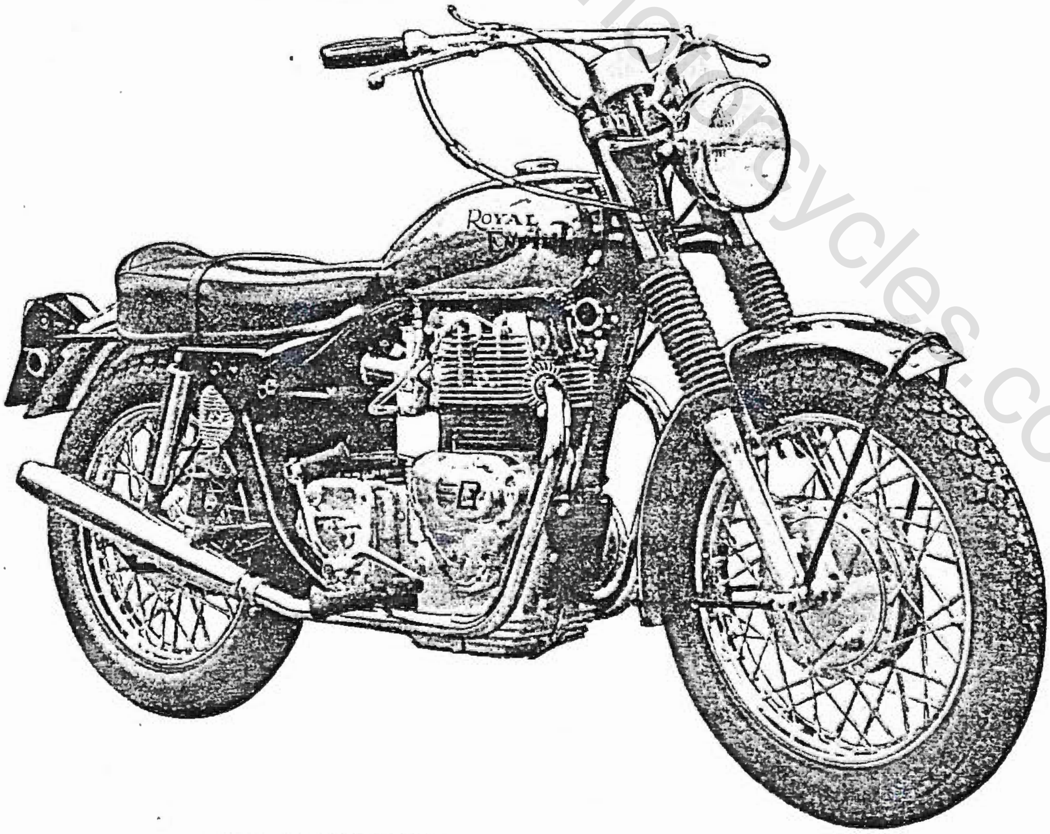
UPPER WESTWOOD · BRADFORD-ON-AVON · WILTS

TELEPHONE BRADFORD-ON-AVON 2166-8

ENGLAND



1969 INTERCEPTOR 750 SERIES II U.K. MODEL



1969 INTERCEPTOR 750 SERIES II U.S.A. MODEL

LIST OF CONTENTS

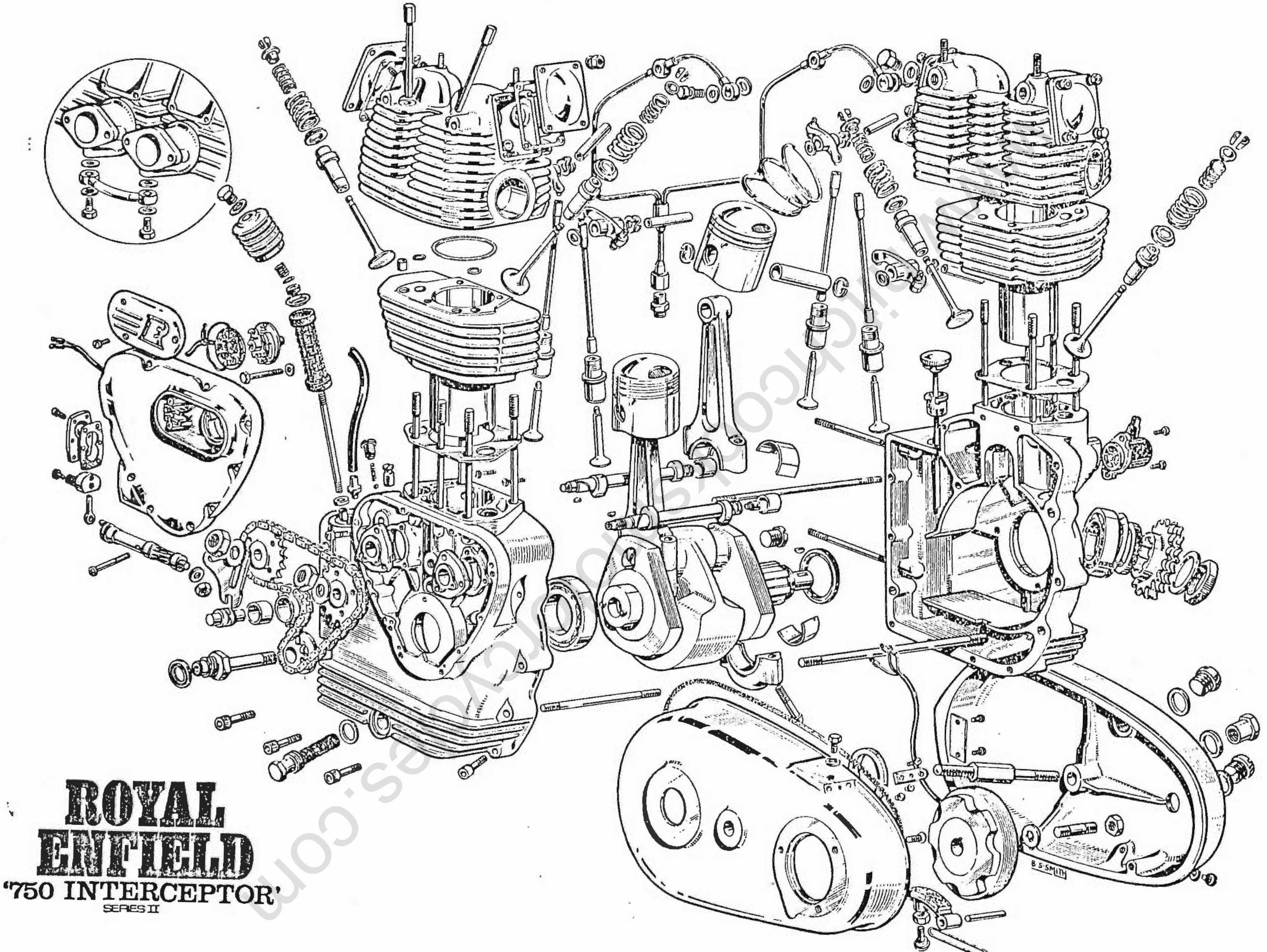


FIG. 1

ENFIELD PRECISION ENGINEERS LTD., BRADFORD-ON-AVON, WILTSHIRE, ENGLAND.

Technical Data

"Interceptor" Series II Engine

Cubic Capacity	736 c.c.
Stroke ... ... Nominal	93 mm.
Bore ... ... Nominal	71 mm.
Actual	70.92 mm./2.792 in.
Rebore to .020 in. oversize when wear exceeds .0065 in.	
Compression Ratio	8.5 to 1
Piston Diameter:—	
Bottom of Skirt—	
Fore and Aft	2.788 in.
Top Lands	2.7675 in.
Skirt is tapered and oval turned.	
Piston Rings—	
Width—Plain Rings	.0625/.0635 in.
Scraper Ring Assembly	.1510/.1560 in.
Radial Thickness	2.883/3.085 mm.
Gap when in unworn Cylinder...	.015/.020 in.
Clearance in grooves	.001/.003 in.
Renew Piston Rings when gap exceeds 1/16 in.	
Oversize Pistons and Rings available	+.020 in.
Piston Boss Internal Diameter ...	.7498/.7500 in.
Gudgeon Pin Diameter	.7498/.7500 in.
Con. Rod Small End Internal Diameter	.7507/.7505 in.
Big End Internal Diameter Con. Rod	2.0190/2.0185 in.
Big End Internal Dia. Bearing Shells	1.8750/1.8755 in.*
Crank Pin Diameter, Timing Side ...	1.8744/1.8740 in.
Crank Pin Diameter, Driving Side ...	1.8741/1.8737 in.
Driving Side Main Ball Bearing—	
Type	Hoffman 145 or R and M—LJ45
Outside Diameter	85 mm.
Inside Diameter	45 mm.
Width	19 mm.
Timing Side Main Roller Bearing—	
Type	Hoffman R145 or R and M—LR45
Outside Diameter	85 mm.
Inside Diameter	45 mm.
Width	19 mm.
Rocker Inside Diameter	.5627/.5622 in.
Rocker Bearing Inside Diameter ...	.5622/.5617 in.
Rocker Spindle Diameter	.5617/.5615 in.
Inlet Valve Stem Diameter	.3430/.3425 in.
Exhaust Valve Stem Diameter ...	.3410/.3405 in.
Valve Guide Internal Diameter ...	.3437/.3447 in.
Valve Guide External Diameter ...	.6275/.6270 in.
Valve Guide Hole in Cylinder Head Dia.	.625/.626 in.
Tappet Stem Diameter	.3747/.3744 in.
Tappet Guide Internal Diameter ...	.3758/.3753 in.
Tappet Guide External Diameter ...	1.0125/1.0130 in.
Tappet Guide Hole in Crankcase Dia.	1.011/1.010 in.
Tappet Clearance with cold engine—	
Inlet	.006 in.
Exhaust	.007 in.

*Assumes .0005 in. "stretch" of eye of rod and cap due to interference fit of bearing shells.

Valve Spring Free Length—	
Inner	1½ in.
Outer	1 11/16 in.
(Renew when reduced by 1/16 in.)	
Valve Timing with .020 in. clearance. See Page 9.	
Camshaft Bearing Internal Diameters—	
Timing Side	.8135/.8125 in.
Driving Side	.750 in. (after assembly)
Camshaft Bearing Diameters—	
Timing Side	.8115/.8110 in.
Driving Side	.7490/.7485 in.
Cam Lift—	
Exhaust	.360 in.
Inlet	.360 in.
Valve Lift (approx.)—	
Exhaust	.350 in.
Inlet	.350 in.
Timing Sprocket	12 Teeth
Camshaft Sprockets	24 Teeth
Timing Chain—Type ...	Single No. 110038 endless
Length	66 Pitches
Width	.225 in.
Pitch	.375 in.
Roller	.250 in.
Contact Breaker	Half Engine Speed
Points	.015 in.
Timing—Advanced ...	.355 in. before T.D.C. (32°)
Engine Sprocket	29 Teeth
Clutch Sprocket	56 Teeth
Final Drive Sprocket...	20 Teeth
Primary Chain—Type ...	Duplex No. 114038 endless
Length	92 Pitches
Width	.628 in.
Pitch	.375 in.
Roller	.250 in.
Feed Oil Pump—Speed	1/6 Engine Speed
Piston Diameter ...	.37500/.37475 in.
Stroke length ...	.5 in.

Sparking Plug—Lodge 2HLN. Champion N4 KLG FE 80, or Autolite AG2. For high speed running over long distances, use Lodge 3HLN, Champion N3, KLG FE.100, or Autolite AG 901.

Diameter	14 mm.
Reach	¾ in.
Gap...	.018/.022 in.

Engine Specification

1. Engine
The engine is an even-firing vertical twin-cylinder, having separate cylinders and heads and fully enclosed overhead valve gear. The oil is carried in a sump at the bottom of the crankcase and is pressure fed to big ends and valve rockers. A massive one-piece high-strength spheroidal graphite cast iron crankshaft is used.

2. Cylinder Heads
The cylinder heads are die-cast from light aluminium alloy with ample finning to ensure adequate cooling. The exhaust pipe inserts are cast-in and the valve inserts are of austenitic iron and are shrunk in so that they are replaceable. The large capacity induction ports are streamlined and blended to the valve seatings.

3. Cylinders
The separate cast-iron cylinders have a nominal bore of 71 mm, the stroke being 93 mm. The cubic capacity of the engine is 736 c.c. The cylinder heads are located on the cylinders by hollow dowels and the joint between head and barrel is made by a split, triangular section steel ring which seats on a chamfer at the top end of the cylinder barrel and stands about .005 in. proud of the joint face. The push rod tunnels are sealed by washers of special heat and oil resistant rubber bonded to metal and fitting in recesses in the cylinder head.

4. Pistons
The pistons are made of low expansion aluminium alloy, heat treated and form ground taper and oval. Each piston carries two taper faced compression rings and a special dual oil control ring.
One compression plate, .022 in. thick, is fitted below each cylinder barrel when the compression ratio is 8.5 to 1. With the plates removed the ratio is raised to 9 to 1.

5. Connecting Rods
The connecting rods are produced from stampings of Hiduminium RR56 light alloy. The little end bearings are of alloy direct on to the gudgeon pin. In case of wear after long service the little end can be bored out and fitted with a bush, but this is rarely necessary.
The big end bearings consist of white-metalled steel liners which are renewable. The detachable bearing caps are bolted to the connecting rods by means of high tensile socket screws, the heads of which are drilled for wiring.

6. Crankcase
The combined crankcase and oil tank is die-cast from light alloy in two halves, being split vertically.

7. Crankshaft and Flywheel
The crankshaft is cast in one piece, integral with the massive central flywheel, from high quality spheroidal graphitic cast iron. The total weight is approximately 24 lbs., and all crankshafts are dynamically balanced.
The main journals are ground, and the big end journals are ground and hand lapped.

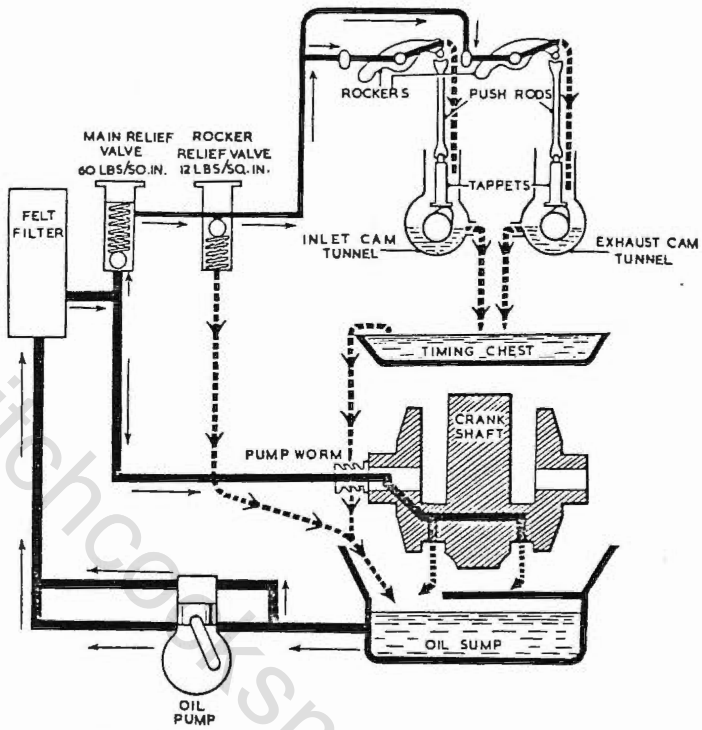
8. Main Bearings
Heavy duty bearings are provided for the crankshaft, the driving side being ball and the timing side roller.

9. Camshafts
The camshafts are machined from drop forged steel stampings with the cams and bearings hardened and ground.
The camshafts are located in the crankcase and run in bronze bushes in the left hand case and in detachable aluminium housings which are bolted to the timing side crankcase. This enables the camshafts to be changed, if so desired for tuning purposes, without the necessity of dismantling the crankcase.

10. Valves
The inlet valves are machined from stampings of special Silicon-Chrome Valve Steel and the exhaust valves are of High-Nickel-Chromium-Tungsten Valve Steel with the stems Stellite-tipped.

11. Valve Gear
The valves are operated from the camshaft by means of large, flat-based, guided tappets, tubular alloy push rods with induction hardened steel ends and overhead rockers. Two compression springs are fitted to each valve secured by Bullock Type split collets locking in high strength aluminium collars. The springs are specially designed to give a variable rate on compression.

12. Timing Drive
The camshafts are driven by an endless chain from the timing sprocket on the crankshaft and the tightness of the chain can be adjusted by means of the chain tensioner in the timing chest.
An extension of the front camshaft drives the contact breaker housed in the timing cover.
A tachometer gearbox is mounted on the left hand crankcase and is driven by the front camshaft.



LUBRICATION SYSTEM. Diagrammatic Arrangement
Fig. 2

13. Ignition and Lighting System

This model is fitted with the Lucas capacitor system which has been developed to enable machines to be run with or without a battery. The rider, therefore, has the choice of running with normal battery operation or running without battery if desired, (e.g., competing in trials or other competitive events), and for emergency in case of battery failure.

Before running the machine with the battery disconnected it is essential that the battery negative lead be taped up to prevent it from shorting to earth (frame of machine). Otherwise, the capacitor will be ruined.

Machines can readily be started without the battery and run as normal with full use of **standard** lighting. When stationary, however, parking lights will not work unless the battery is connected.

The system incorporates an alternator and 12 volt battery coil ignition equipment with a zener diode charging regulator mounted on an efficient heat sink and a spring mounted high-capacity electrolytic capacitor.

Twin contact breakers with an automatic timing advance mechanism mounted on the end of the front camshaft, are housed in the timing cover.

14. Carburettors

Twin Amal Concentric carburettors with a bore of 30 mm are fitted as standard.

15. Lubrication System

Oil is carried in a sump cast integral with the crankcase, ensuring the full rate of circulation immediately the engine is started and rapid heating of the oil in cold weather.

The positively driven double acting piston type oil pump running at $\frac{1}{6}$ engine speed, at the rear of the timing cover pumps oil to the bearings under pressure. A gauze strainer, attached to the sump drain plug, protects the pump from foreign matter, and oil after leaving the pump, passes through a large capacity felt filter removable from the top of the crankcase. Pressure to the big ends is kept at 60 lbs./sq. in. by a relief valve situated in the top of the crankcase. This is the right hand of the two screws behind the right hand cylinder barrel.

The capacity of the pump is sufficient to ensure that there is always more oil available than required by the big ends and oil passing through the main relief valve is fed through external pipes to the overhead rocker gear. A secondary relief valve (the left hand screw behind the cylinder barrel) is set at 10 to 15 lbs./sq. in. and passes surplus oil back into the sump.

The oil from the rocker bearings is squirted through a small hole in each rocker on to the top ends of the push rods. It then flows down the push rod tunnels into the cam tunnels, where it lubricates the cams and tappets and overflows into the timing chest, where it lubricates the timing chains and then drains to the sump.

A small circular magnet is fitted over the fixing stud inside the oil filter for the purpose of collecting any ferrous particles which may be suspended in the oil.

16. Breather

The engine is ventilated to atmosphere by a long, large diameter plastic pipe extending to the rear of the machine and connected to a union screwed into the top of the crankcase.

17. Gearbox

The gearbox is bolted on to the back of the crankcase and has four speeds, which are foot controlled, and a patented neutral finder. All gears are in constant mesh, changes being affected by robust dog clutches. (See Subsection 64).

The standard gear ratios with 20T gearbox sprocket are as follows:—

Bottom Gear	12.40
Second Gear	8.19
Third Gear	6.05
Top Gear	4.44

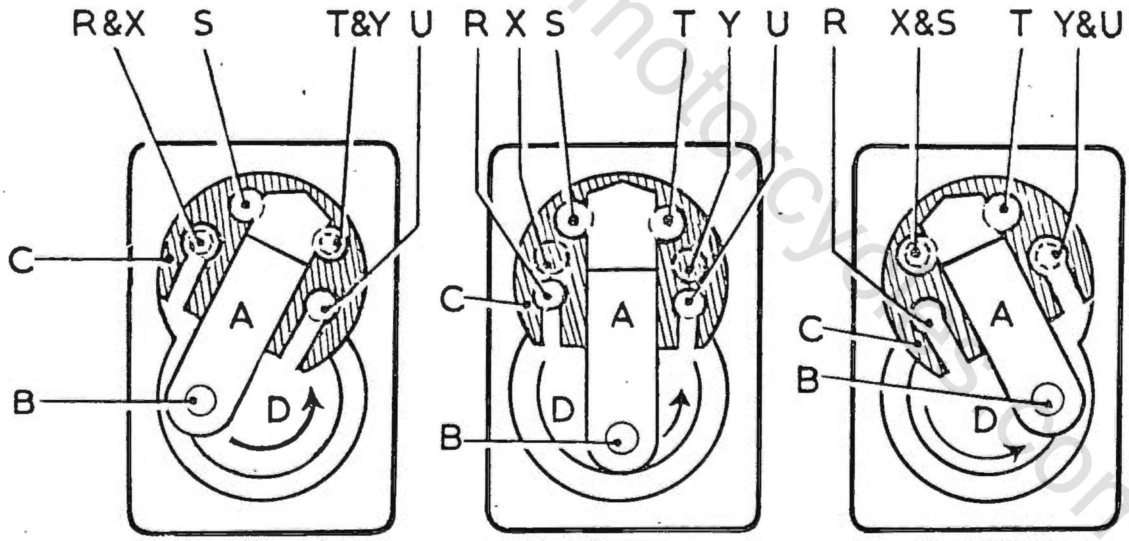
18. Clutch

The clutch has six pressure plates and five friction plates, including the sprocket which is lined on both sides with a bonded cork based friction material.

A description of the operating mechanism is given in Subsection 63.

Oil Pump Diagram

Fig. 3



POSITION 1 POSITION 2 POSITION 3

The ports in the housing are connected as follows:—
X — delivery to big ends. Y — suction from oil tank.

Position 1. The plunger A is being drawn out of the cylinder hole in the disc C by the action of the peg B on the shaft D. The port T in the disc C registers with the suction port Y in the housing, so that oil is drawn into the cylinder from the oil tank. At the same time port R in the disc registers with the delivery port X in the housing and oil below the disc is forced through X to the big ends.

Position 2. The disc is in the central position where the individual ports can be clearly seen.

Position 3. The plunger A is being pushed into the cylinder hole in the disc C. The port S in the disc now registers with the delivery port X in the housing, so that oil is forced out of the cylinder to the big ends. At the same time the suction port U in the disc registers with the suction port Y in the housing and oil is drawn into the housing below the disc from the oil tank.

Service operations with Engine in Frame

19. Removal of the Timing Cover

Before attempting to remove the timing cover it is first necessary to dismantle the contact breaker. Remove the oval cover retained by three screws and the contact breaker assembly will be revealed. Undo the hexagon nut and slotted headed screw retaining the contact breaker plate, pull the plate away from its recess, and leave suspended on the wiring harness. Remove the contact breaker centre screw and replace by the special extractor pin W.49622 included in the tool kit. Tightening this screw will force the unit from the taper on the end of the camshaft.

Place a tray under the engine to catch the oil which will escape when the timing cover is removed. Unscrew the timing cover fixing screws and draw off the cover, tapping it lightly if necessary.

Inspect both oil seals, particularly the crankshaft seal which is subjected to a high pressure. Any sign of a split in the rubber or of a fault in the bonding of the rubber to the casing means the seal must be replaced. Before the crankshaft seal can be changed, it is necessary to dismantle the oil pump as described in Sub-section 38. The new seal must be fitted carefully and a special tool Part No. W50011 is available for this purpose. Make certain the seal enters squarely into the housing and is fitted the right way round. The garter spring on the crankshaft seal faces into the recess and on the camshaft seal faces towards the engine.

In refitting the cover, make sure that the gasket is fitted the correct way round and that it is correctly located with no oil ways obstructed. Also see that the thrust washer is on the chain tensioner sprocket spindle.

Careful assembly of the timing cover is necessary to avoid damage to the oil seals. A special thimble Part No. W49994, fitted over the end of the exhaust camshaft, will ensure that the shaft enters the seal without causing damage to the sealing lip. Two studs can be screwed into the timing cover holes in the crankcase to act as temporary dowels to ensure that the seals line up with the shafts before entry.

The refitting of the cover will be facilitated if the engine is turned gently forwards while the cover is being put into place. This will help the engagement of the pump worm with the pump spindle and prevent damage to the gears.

Before refitting the contact breaker auto-advance unit, clean out the taper hole and also the mating taper on the end of the camshaft. If these are not clean and dry the unit may turn on the taper when the centre screw is tightened up. Assemble and time the ignition as described in Subsection 23.

To verify that the oil pump is working after replacing the timing cover, start the engine and slacken off the hexagon headed nut at the top of the finned oil cleaner cap.

20. Valve Timing

The camshaft sprockets are keyed to the camshafts so that the valve timing can only be incorrect if the timing chain is incorrectly fitted.

The correct setting is obtained with the marks stamped on the camshaft sprockets facing each other inwards on the centre line and the mark on the crankshaft sprocket pointing vertically downwards. (See Fig. 5). If it is necessary to remove the camshafts and sprockets see Subsections 22 and 41.

Remember that the camshaft sprocket nuts and the timing sprocket fixing bolt all have **Left-Hand Threads.** While tightening the camshaft nuts the sprockets should be held.

The correct valve timing at .020 in. tappet clearance is as follows:—

Exhaust opens 73° Before B.D.C.
Exhaust closes 33° After T.D.C.
Inlet opens 33° Before T.D.C.
Inlet closes 73° After B.D.C.

When checking opening and closing points do not expect precise agreement with the figures quoted. The figures obtained when checking will depend largely on the method used to decide when the valve opens or closes also, if using a dial gauge, whether this is reading the movement of the tappet or spring collar. It must be remembered, too, that the precise timing of each valve depends on the accurate position of *four* keyways and on whether the timing chain is new or worn. The figures in the table are intended as a guide to enable a check to be made that the timing marks are correctly lined up. If opening and closing points on the same shaft are early or late by about 30° the sprocket is fitted one tooth wrong.

21. Tappet Adjustment

The tappet clearance is adjusted by means of a screw in the outer end of the rocker. Access to the adjusting screws is obtained by removing the covers of the rocker boxes.

The correct clearances are:— Inlet .006 in., Exhaust .007 in.

These figures are for a COLD engine.

To adjust the clearance, loosen the locknut beneath the rocker arm, turn the screw and re-tighten the locknut.

The adjustment of each valve should be made with the corresponding valve in the other cylinder fully open. This ensures that the tappet is on the neutral position of the cam.

If the heads of the adjusting screws are worn they should be replaced.

22. Removal of the Camshafts

Remove the timing cover (Subsection 19).

Remove the timing chain (Subsection 39).

Remove the rocker box covers and screw the rocker adjusting screws right back.

Unscrew the three screws holding each of the timing side camshaft bearings. A hole is provided in the camshaft sprockets and this can be aligned with each screw in turn, for access with a hexagon wrench. The screws can be fully undone but will remain captive in the cast aluminium bearing.

Before removing the camshafts it is necessary to prevent the tappets falling through their guides when the shafts are no longer holding them up. If this happens, the push rods will come out of engagement with the rocker arms and make replacement difficult. This can be prevented by placing the motor cycle on its left side. With the machine in this position, rotate the camshaft until the timing marks on the sprockets are pointing at 2 o'clock for the inlet and 1 o'clock for the exhaust when they can be withdrawn upwards complete with sprockets and bearings. If the machine has to be moved before the shafts are replaced, it is essential that something is put into the camshaft tunnels to keep the tappets in place.

If it is necessary to remove the sprockets from the camshafts see Subsection 41.

23. Ignition Timing

The contact breakers are accessible after removing the small oval cover. Owing to the provision of automatic ignition advance, the contact breaker is always fully retarded when the engine is at rest or is being turned over slowly. The advance mechanism is situated behind the contact breaker and gives a range of approximately 12° on the half-speed shaft, corresponding to 24° on the engine shaft.

The optimum ignition timing is 32° advance, (.355 in. before T.D.C.), so that in the fully retarded position the contact points must open when the piston is 8° or .023 in. before T.D.C.

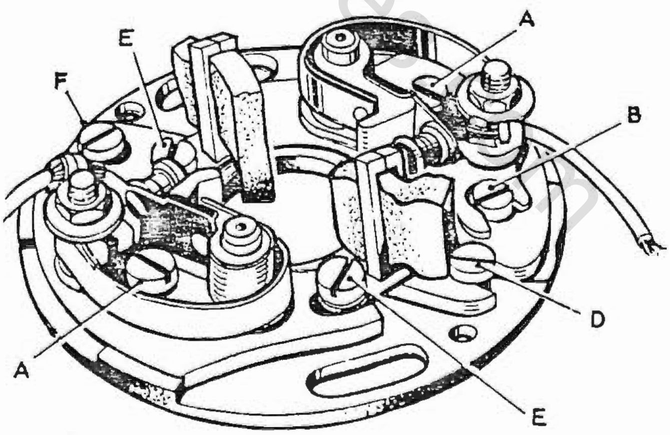
To obtain maximum performance and avoid possible damage to the engine, it is vitally important that the ignition timing is set accurately and also identical on both cylinders. It is easier to obtain the necessary accuracy by timing with the ignition cam in the advanced position and, to hold the cam in this position, a special recessed washer is included in the tool kit.

As a further aid to ignition timing, an indicator has been incorporated to show the correct position of the piston when the points are just beginning to open. Inside the primary chaincase, a line engraved on the alternator rotor lines up with a second line engraved on a fixed plate when the pistons are 32° before T.D.C. These lines are visible after removing the large screwed plug situated towards the front end of the chaincase.

To check the ignition timing, proceed as follows:

Switch off and check the maximum opening of the points, on both sets of contacts; this should be .014 in. to .016 in. The gap must always be checked with the line on face of the cam pointing towards the appropriate contact heel. To adjust the gap, slacken off the slotted screw, marked "A" in Fig. 4, and pivot the small contact plate by turning the eccentric headed screw marked "B" (clockwise to increase the gap). Re-tighten screw "A".

Unscrew and remove the centre screw and washer securing the contact breaker cam centre to the shaft, replace the washer by the special recessed one, Part No. W.49717, included in the tool kit, and refit the centre screw with the recess on the washer pointing towards the engine. Before tightening the centre screw, rotate the cam clock-



CONTACT BREAKER ASSEMBLY
Fig. 4

wise into the advanced position by means of a screwdriver located in the end slot and hold in this position as the screw is tightened. On removing the screwdriver the ignition cam will now stay locked in the advanced position.

Place the machine on the centre stand and remove both sparking plugs. Switch on the ignition, engage top gear and turn the engine by rotating the back wheel forward until the top set of contacts are closed. Continue to rotate the wheel until the ammeter needle flicks to zero, indicating that the points have opened.

Remove the screwed plug, at the front end of the primary chaincase, and the timing marks, now visible through the hole in the chaincase, should be in line.

If the timing is incorrect, adjust by slackening the two screws marked "C" in Fig. 4 and rotating the top contact breaker plate by turning the eccentric headed screw marked "D" (anti-clockwise to advance) Re-tighten screws "C" and again go through the procedure of rotating the back wheel and checking the alignment of the timing marks.

When the timing is correct for the top set of points, carry out a similar check for the bottom set and make any necessary adjustment using screws "E" and "F".

When satisfied that both contact sets are adjusted correctly, remove the centre screw, replace the original plain washer, and re-tighten the screw. Check that the cam is moving freely on the centre.

If the engine has been dismantled or the timing has slipped it will first be necessary to re-time the contact breaker cam centre before making any adjustments on the contact breaker plate. To do this, first unscrew and remove the centre screw securing the contact breaker cam centre to the shaft. Screw the extractor, provided in the tool kit, into the centre of the cam and tighten. A light tap on the head of the extractor will free the cam centre from the driving shaft. Remove the extractor and refit the cam centre loosely on to the shaft with the correct centre screw and washer. Loosen the two screws which secure the circular contact breaker back plate and set the plate central in its slots. Tighten the screws.

Rotate the top and bottom contact breaker plates into their extreme clockwise positions by means of screws "C", "D", "E", and "F", as previously described. With the machine on the centre stand and both sparking plugs removed, engage top gear and turn the engine by rotating the back wheel forward until the timing side (R.H.) piston is on T.D.C. of the compression stroke (both valves closed).

Switch on the ignition and rotate the cam centre in a clockwise direction until the top set of contacts are closed. Continue turning until the ammeter needle flicks to zero. Give the cam centre a sharp tap endways to secure it on the shaft and lock up with the centre screw. The cam centre is now locked in a position where correct timing can be obtained by close adjustment of the small separate contact breaker plates and to do this, follow the procedure given previously for checking the ignition timing. After the correct timing has been obtained, check that the cam is moving freely on the centre.

If a Timing Light is available, this can be used on the timing marks, visible through the hole in the chaincase. The engine must be run at 3,000 r.p.m. to ensure that the ignition is in the fully advanced position, and, if the timing is correct, the two marks will appear to be in line. Make this test on both cylinders.

Occasionally apply two drops of clean engine oil to the rear end of the felt pads bearing against the contact breaker cam and apply a smear of grease to the moving contact pivot post.

24. Primary Chain Adjustment

The tension of the primary chain can be checked through the inspection cover in the primary chain case and, should it require adjustment, access to the adjuster is gained by removing the chain case cover, which is held in position by a single nut. Before removing the nut, place a tray under the engine to catch the oil from the chaincase.

Beneath the bottom run of the chain is a curved slipper on which the chain rests and which may be raised or lowered by turning the adjusting screw after having first slackened the locknut.

A rubber button is fitted to the end of the adjusting screw to prevent the transmission of chain noise to the chaincase and this is held against the chaincase by a hairpin spring, which prevents it from bouncing.

Do not adjust the chain to be dead tight but rotate the engine slowly and, while doing so, test the tension of the top run of the chain by pressing it up and down with the fingers. Adjust the tension so that there is ¼ in. up and down movement at the tightest spot.

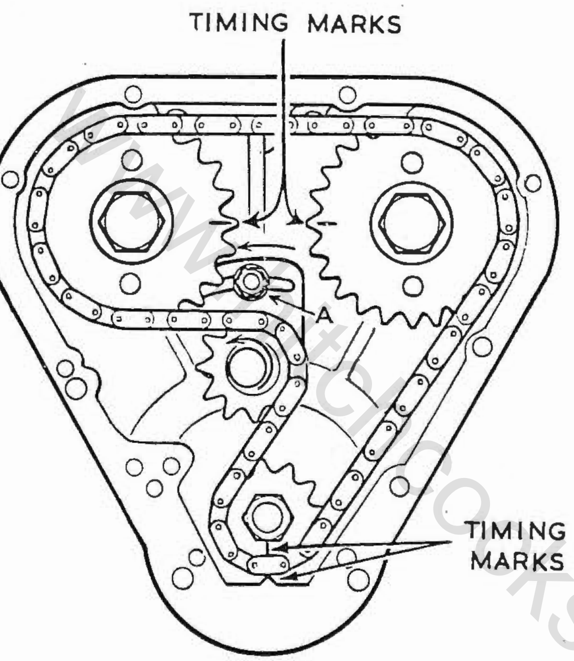
Re-tighten the locknut on the adjusting screw, replace the chain cover and replenish with oil to the height of the level plug.

25. Timing Chain Adjustment

Before adjusting the tension of the timing chain, turn the engine until the chain is in its tightest position, checking the chain between all sprockets.

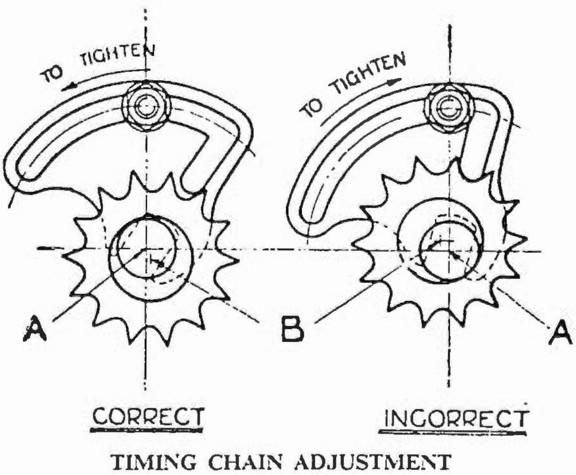
Adjust the tension so that there is ¼ in. movement of the chain.

The tension of the timing chain is altered by moving the quadrant after slackening the nut A which secures it (see Fig. 6). This rotates the eccentric spindle on which the chain tensioner jockey sprocket is mounted. Tightening of the chain is effected by moving the quadrant to the left.



TIMING CHAIN ADJUSTMENT SHOWING TIMING MARKS

Fig. 5



TIMING CHAIN ADJUSTMENT

Fig. 6

It is imperative that the quadrant is fitted the right way round and that the eccentric spindle is fitted correctly in the quadrant fork. If the chain tightens when the quadrant is moved to the right, the tensioner has been wrongly assembled and may cause damage to the quadrant (see Fig. 6).

In making the adjustment, care must be taken to see that any backlash in the quadrant is taken up in the "tightening" direction, i.e. do not make the chain too tight and then move the quadrant back slightly, but tighten the chain progressively until the correct tension is obtained and then lock the quadrant. If the chain becomes too tight during adjustment, slacken it right back and make the adjustment again.

If the chain is too slack it may give rise to a loud noise which can be mistaken for a faulty bearing. If it is too tight the result will be a high pitched howl. If such noises are heard, therefore, first check the adjustment of the timing chain.

26. Removal of the Petrol Tank

The petrol tank is rubber mounted front and rear. The front attachment is by means of a horizontal stud passing through a rubber sleeve housed in a lug across the frame immediately behind the steering head. The rear fixing is a rubber lined metal clip secured by two ¼ in. diameter bolts and nuts.

To remove the tank, first disconnect the petrol pipes, then remove the nut from one end of the front attachment stud and knock out the stud. Then unscrew the nuts and bolts securing the rear end of the tank and lift it away, taking care not to damage the paintwork on top at the front end where it may come into contact with the handlebar clamp.

27. Removal and Refitting of the Cylinder Head

First remove the petrol tank and petrol pipe. (Subsection 26).

Remove head steady brackets.

Disconnect the oil pipes and plug leads.

Remove the exhaust pipes and carburettors.

Remove the rocker box covers.

Turn the engine until both valves in one head are closed.

Remove the five cylinder head nuts from the head, hit it smartly with a hide mallet beneath the exhaust and inlet ports (not the fins) and lift it off.

Turn the engine through one revolution and repeat with the other head.

When replacing the heads, see that the dowels are in position in the cylinder barrels and that the push rods are the right way up (shallow cups upwards).

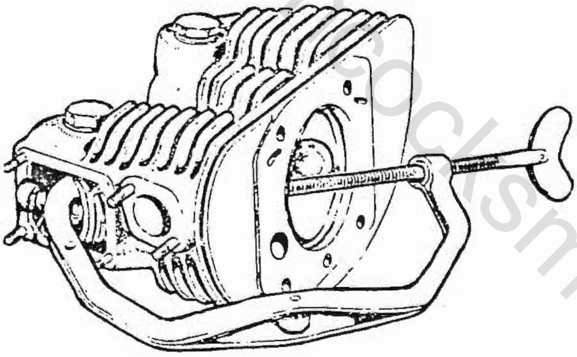
See that the taper section "Cross" sealing ring and its seatings are perfectly clean and that the rubber seals for the push rod tunnels are in good condition and correctly fitted. With the head upside down on the bench drop the seal with the metal side downwards into the recess. A little jointing compound should be applied to both sides of the "Cross" sealing ring and the rubber push rod tunnel seals.

Lower the cylinder heads over the push rods making sure that the rockers locate in the cups.

Fit the head nuts *and washers* and tighten down lightly. Do not overtighten the nuts—20 lbs. ft. is the recommended figure. Tighten each nut a little at a time in turn. Begin with the two inside nuts and the one by the spark plug, leaving the final tightening of the corners to the last.

28. Removal of the Valves

Having removed the cylinder head, remove the rocker-box covers, each held by four nuts, and swing the rocker clear of the valve. Using a suitable valve spring compressing tool, compress the valve springs and remove the split collets from the end of the valve stem. Slacken back the compressing tool and release the springs. Withdraw the valve and place its springs, top spring collar (and bottom collar if it is loose) and split collets together in order that they may be reassembled with the valve from which they were removed.



REMOVAL OF VALVES
Fig. 7

Deal similarly with the other valves in the heads.

If the valve will not slide easily through the valve guide, remove any slight burrs on the end of the valve stem with a carborundum stone. If the burrs are not removed and the valve is forced out, the guide may be damaged.

29. Removal of the Rockers

To remove the rocker, first take off the cylinder head. Remove the hexagon plug on the inner side and the rocker spindle may be drawn out by means of a bolt screwed into the rocker spindle, which is tapped $\frac{5}{16}$ in. B.S.F.

On reassembling make sure that the spring washers are fitted on the sides of the rockers nearest the centre of the engine and the plain thrust washers on the outer sides.

30. Removal of the Valve Guides

To remove the valve guides from the heads two special tools are required which can easily be made.

The first is a piece of tube with an internal bore of not less than $\frac{7}{8}$in.

The second is a mandrel about 4 in. long made from $\frac{9}{16}$ in. diameter bar with the end turned down to about $\frac{5}{16}$ in. diameter for $\frac{1}{2}$ in.

Support the cylinder head on the tube which fits over the collar of the valve guide. Using the mandrel force the guide out of the head with a hand press or by using a hammer.

To fit a new guide, support the head at the correct angle and use a hand press and the same mandrel. If a hand press is not available and the guide is replaced by a hammer, use a piece of tube of $\frac{9}{16}$ in. internal diameter to prevent damage to the bore of the guide. If a valve guide is removed for any reason, an oversize one should be fitted in order to maintain the interference. It is necessary to re-cut the valve seat and grind in the valve after a guide has been replaced. (See Subsection 35).

A worn exhaust valve guide may give rise to slight smoking from the exhaust pipe due to oil passing down the valve stem on to the hot valve head. This may also be caused or increased by faulty operation of the breather.

31. Removal of the Sparking Plugs

Care must be taken when removing and replacing the sparking plugs not to damage the threads in the cylinder heads.

If the threads do become damaged, they can be tapped out to a larger size and steel wire inserts fitted.

Special tools are available for tapping and inserting the steel wire inserts. The latter tool consists of a piece of $\frac{7}{16}$ in. diameter tube or rod with a slot cut in the end.

The insert is placed over the tool with the tag engaging in the slot and it is screwed into the plug hole in the cylinder head from the outside until the last coil is 1 to $1\frac{1}{2}$ threads below the top face. A reverse twist of the tool will then break off the tag.

If the cylinder head has been removed, the fitting of the insert will be facilitated if the tool is put through the hole from the inside and the insert screwed back from the outside.

If the cylinder head has not been removed, care must be taken not to drop the end of the tag into the cylinder and in such a case it is better to break off the tag with a pair of long-nosed pliers.

32. Removal of the Cylinders

When the cylinder heads have been removed the cylinders can be lifted clear of the studs. This should be done with the pistons at top dead centre.

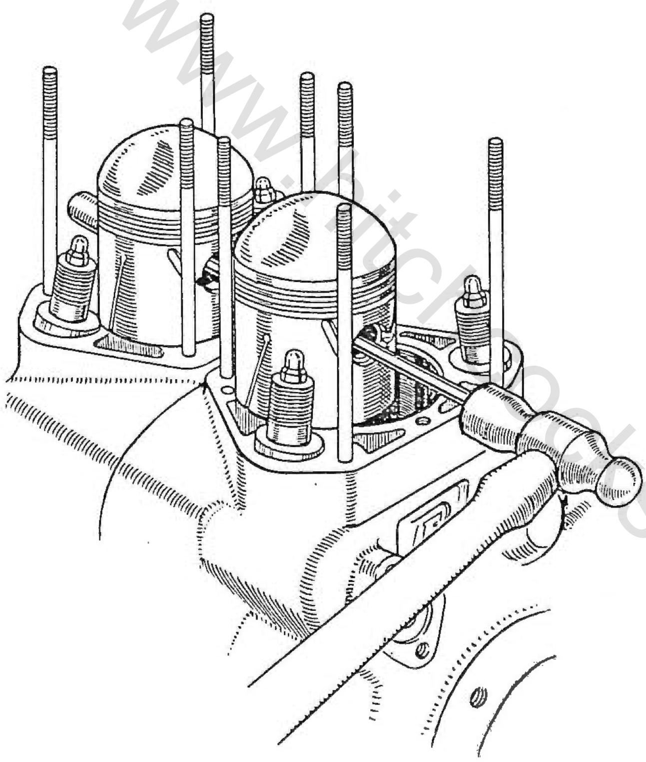
It is advisable to put a clean cloth over the mouth of the crankcase to prevent anything, such as a piece of broken piston ring, from falling in.

When replacing the cylinders, clean off the joint faces and fit new paper joints, two to each cylinder, one each side of the compression plate.

33. Removal of Pistons

Remove the cylinder heads and cylinders.

With a tang of a file remove the two outer circlips retaining the gudgeon pins. Remove the long central cylinder studs which come opposite the gudgeon pins.



REMOVAL OF PISTONS
Fig. 8

Use Special Tool No. E.5477/T to extract the gudgeon pin or using a rod about $\frac{1}{4}$ in. in diameter insert this right through one gudgeon pin and drive the other pin out of its piston, supporting the connecting rod substantially meanwhile to prevent distortion.

Having lifted the first piston away, the other one may be readily removed in the same manner. Mark the pistons and gudgeon pins so that they go back into the same pistons the same way round and so that the pistons go back into the same barrels the same way round.

Take care not to drop the gudgeon pin circlip into the crankcase. A clean cloth should be put over the mouths of the crankcase to prevent this.

34. Decarbonising

Having removed the cylinder heads as described in Subsection 27, scrape away all carbon, bearing in mind that you are dealing with aluminium which is easily damaged. Scrape gently and avoid scoring the combustion chamber or the valve seats which are of austenitic iron shrunk into the head. Be careful while performing this work not to injure the joint faces which bed down on to the head gaskets.

Do not, in any circumstances, use caustic soda or potash for the removal of carbon from aluminium alloy.

Scrape away all carbon from the valve heads and beneath the heads, being very careful not to cause any damage to the valve faces.

If the piston rings are removed the grooves should be cleaned out and new rings fitted. For cleaning the grooves, a piece of discarded ring thrust into a wooden handle and filed to a chisel point is a useful tool.

If the piston ring gaps exceed $\frac{1}{16}$ in. when the rings are in position in the barrel, new rings should be fitted. The correct gap for new rings is .015—.020 in. The gap should be measured in the least worn part of the cylinder, which will be found to be the extreme top or bottom of the bore.

While the cylinders and pistons are not in position on the engine, cover the crankcase with a clean cloth to prevent the ingress of dust and dirt of all kinds. Do not, of course, attempt to scrape the carbon from the pistons when the mouths of the crankcase are open.

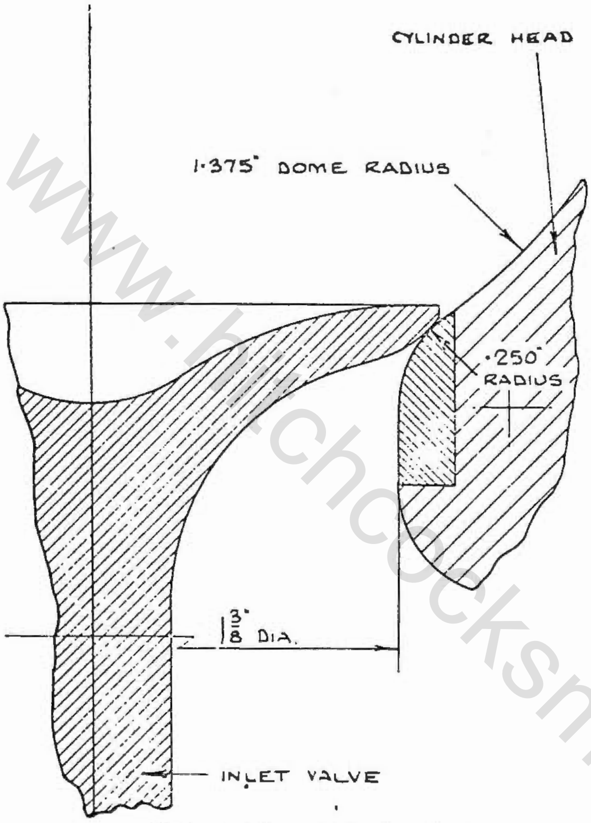
35. Grinding-in Valves

To grind a valve, smear the seating with a little grinding-in compound, place a light, short coil spring over the valve stem and beneath the head, insert the valve into its appropriate guide, press it on to the seat using a tool with a suction cup and with a backwards and forwards rotary motion, grind it on to its seat. Alternatively, a tool which pulls on the valve stem can be used. Frequently lift the valve and move it round so that an even and true seating is obtained. If no light spring is available, the lifting will have to be done by hand. Continue grinding until a bright ring is visible on both valve and seating.

The faces and seats of the exhaust valves are cut at 45 degrees but the profiles of the inlet valves are of a special streamlined design which eliminates pockets and sharp edges and allows a smooth flow of gas without eddies.

If the inlet valves or their seats are pitted and require re-cutting, care must be taken to reproduce the correct profile as shown in Fig. 9.

The cylinder heads should preferably be returned to the Works for the inlet valve seats to be re-cut but, if this is not possible, a special tool consisting of an arbor No. T.2053 and cutter No. T.2054 is available. Great care must be exercised in using this tool as it is located off the valve guides and these may be damaged if suitable apparatus is not employed.



INLET VALVE SEAT PROFILE
Fig. 9

The inlet valve faces and seats can be cut at 45 degrees in cases of emergency but this may have a deleterious effect on the performance of the engine.

36. Reassembly after Decarbonising

Before building up the engine, see that all parts are scrupulously clean and place them conveniently to hand on a clean sheet of brown paper.

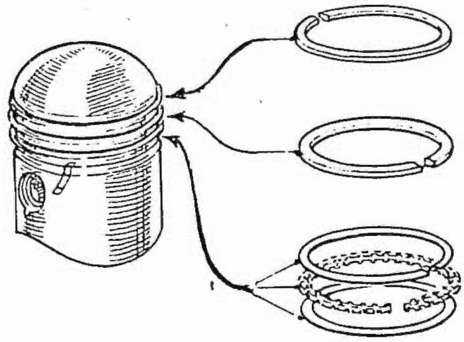
Check the piston ring gaps to find out whether excessive wear has taken place (see Subsection 34).

It is advisable to fit new gaskets to the cylinder base and cylinder head. Two paper gaskets are fitted to the base of each cylinder, one each side of the compression plate.

Smear clean oil over the pistons, having replaced the rings if these have been removed, lower the piston over the connecting rod and insert the gudgeon pin from the outer side. Fit the circlip and then fit the second piston in a similar manner.

Oil the cylinder bores and lower the barrels over the pistons and seat them gently on their gaskets.

Drop the push rods down their tunnels on to the tappet heads, shallow cups upwards.



CORRECT ASSEMBLY OF APEX OIL CONTROL RINGS
Fig. 10

Replace the cylinder heads as described in Subsection 27.

After the engine has been assembled, run it for a brief period at a speed which will ensure that the ignition has been advanced by the automatic advance device. If it is run too slowly "blueing" of the exhaust pipes may take place.

After the engine has been run for some time and has become thoroughly hot, go over all the cylinder head and other nuts to ensure that they are tight.

37. Cleaning the oil Filters

The oil filter is located at the top of the crankcase and is in the feed circuit to the big ends. (See Fig. 11).

The filter element is removed by unscrewing the nut holding the end cap in position. A small circular magnet supported on a short distance piece is also fitted over the fixing stud inside the filter for the purpose of collecting any ferrous particles which may be suspended in the oil. When reassembling the filter after cleaning, take care that no grit or other foreign matter is sticking to it. After replacing or renewing the felt filter, fill the filter housing with oil, level with the top of the finned cap, before fitting the hexagon sleeve nut.

The felt element should be taken out and washed in petrol after the first 500 miles and after every subsequent 2,000 miles. Fit a new element every 5,000 miles.

38. Overhaul of Oil Pump

Remove the timing cover as described in Subsection 19.

Remove the pump end plate followed by the pump disc, spring and plunger.

The spindle can be pulled out from the pump housing after undoing the nut on the forward end. This nut has a LEFT HAND thread. A hole is provided in the spindle and timing cover through which a $\frac{3}{16}$ in. dia. tommy bar can be fitted to prevent the spindle turning whilst the nut is undone.

The bar must be pushed through the spindle and right to the bottom of the hole in the cover or the spindle boss may fracture.

Check the fit of the plunger in the pump disc which should have a minimum of clearance but should be able to be moved in and out by hand.

If, when fitting a new disc or plunger, the plunger is found to be too tight a fit, carefully lap with metal polish until it is just free. If the pump disc is not seating properly or if a new pump disc is being fitted, it should be lapped to the seating with Special Tool No. E.5425, using Carborundum 360 Fine Paste or liquid metal polish until an even grey surface is obtained.

Wash all passages, etc., thoroughly with petrol after lapping to remove all traces of grinding paste.

Check the pump disc spring for fatigue by assembling in the timing cover and placing the pump cover in position. If the spring is correct, the pump cover should be held ¼ in. off the timing cover by the pump spring.

The pump spindle must be a good fit in the timing cover and should be renewed if the clearance is such that oil can escape from the pump. Check the gear teeth for excessive wear.

Reassemble the oil pump, replacing the paper cover gasket if necessary. Before fitting the cover fill the pump chamber with clean oil.

Having assembled the pump lay the timing cover flat and fill the oil ports by means of an oilcan. Turn the pump spindle with a screwdriver in a clockwise direction looking on the front and it can then be seen whether the pump is operating correctly.

Refit the timing cover as described in Subsection 19 and time the ignition as described in Subsection 23.

39. Removal of the Timing Chain

Remove the timing cover (Subsection 19).

Loosen the chain tensioner locknut and stud.

Lift the adjusting plate clear of the chain tensioner spindle.

Remove the chain tensioner spindle and sprocket.

Lift the chain off the sprockets.

40. Removal of Pump Worm and Timing Sprocket

Remove the timing chain (Subsection 39).

Unscrew the oil pump worm by means of the hexagon head behind it. This is a **Left-Hand Thread.**

Withdraw the timing sprocket.

41. Removal of the Camshaft and Sprockets

Remove the camshaft together with sprocket as described in Subsection 22.

Hold the timing side cam between soft vice jaws and unscrew the sprocket nut (L.H. thread). The sprockets can now be extracted using the special extractor Part No. 49907. The special plug must be used in the end of the exhaust camshaft to protect the contact breaker driving taper.

When assembling the sprockets great care must be taken to prevent the key from tipping in the keyway on the shaft otherwise it will be wedged against the end of the bearing causing damage. The sprocket must be fitted with the timing mark facing outwards. The sprocket nut should be tightened to 50 ft. lbs. torque.

42. Removal of the Engine and Clutch Sprockets

The primary chain is endless so that it is necessary to remove both the engine and clutch sprocket simultaneously.

The alternator stator is removed by undoing the three fixing nuts, after which the stator can be pulled off the three studs on which it is located.

Remove the central hexagon nut and washer securing the alternator rotor, which can then be drawn off, taking care not to lose the key.

Unscrew the engine sprocket nut, using Special Tool No. 49908. The engine sprocket is mounted on splines and can then be removed with the clutch sprocket.

To remove the clutch sprocket, unscrew the three pressure plate pins and remove the pressure plate assembly, the centre retaining plate and the assembly of driving and driven clutch plates. The clutch sprocket can then be withdrawn from the centre after the removal of the large circlip which secures it.

43. Removal of the Tappets and Guides

It is only necessary to remove the tappets and guides if they have become worn.

Remove the cylinder heads and barrels. (Subsections 27 and 32).

Extract the tappet guides, using Special Tool No. 49925, having heated the case first.

The guides are made from Nickel Chrome Alloy Iron and if a guide should break while removing it, it can be withdrawn with a pair of pliers if the crankcase is heated locally with a blowlamp. Otherwise it is necessary to dismantle the crankcase and drive the tappet and guide out from underneath using a heavy bar in the cam tunnel.

The guide should have an interference of .0015 to .0025 in. in the crankcase and can be driven in with a bronze drift, care being taken when the guide is nearly home to avoid breaking the collar.

If a tappet guide is taken out it should be replaced by an oversize one.

44. Crankcase Breather

The crankcase breather is in the form of a long plastic tube attached by a hose clip to an adaptor on the top of the case.

There are no moving parts and nothing to go wrong. Check that the plastic tube is not pinched anywhere causing a restriction.

45. Removal of the Clutch

Remove the engine sprocket and clutch sprocket together as described in Subsection 42.

To remove the clutch hub, hold the clutch with Special Tool No. 49919 and remove the centre retaining nut and washer with a box spanner.

The hub can then be withdrawn from the shaft with Special Tool No. 49909.

46. Removal of the Final Drive Sprocket

Remove the clutch as described in Subsection 45.

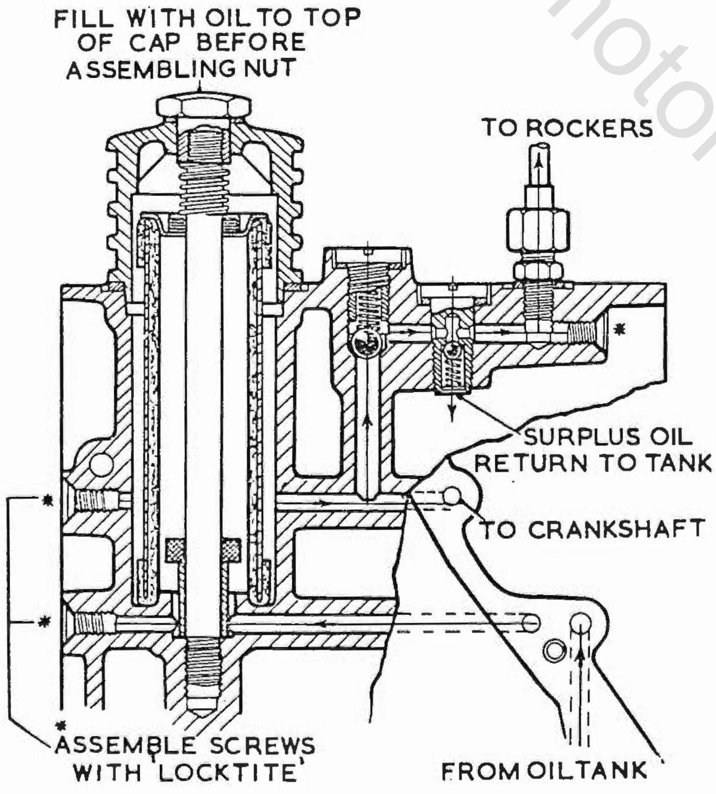
Remove the primary chain tensioner.

Remove the rear half of the primary chain case by taking out three socket screws and the centre stud.

Remove the splined collar from the gearbox mainshaft using special extractor No. 49926.

Remove the grub screw locking the final drive sprocket nut.

Hold the sprocket and remove the nut (**Right-Hand Thread**). The sprocket can then be withdrawn.



OIL RELEASE VALVES AND OIL FILTER
Fig. 11

47. Oil Seal Behind Engine Sprocket

This consists of a neoprene oil seal, with a garter spring, backed up by one steel washer. The correct order of assembly is as follows:—

(1) Press the oil seal W43382 into the chain case from the front with the garter spring facing the inside of the case. The seal should be pressed in till its outer face is flush with the inner surface of its housing in the back half of the chain case.

(2) Into the recess thus formed at the back of the chaincase fit the washer W34069.

(3) Fit the back half of the chain case to the engine and tighten the three socket screws. Engines numbered 1B1001 to 1B2001 require C.E.1 threaded screws Part No. 38027, engines numbered 1B2002 and later require B.S.F. threaded screws Part No. 49918. Tightening the screws should result in the oil seal being pushed in to the chain case so that its face stands slightly proud of the inner surface of its housing.

(4) Fit the engine sprocket, taking great care not to damage the lip of the seal when pushing the sprocket through it.

48. Oil Pipe Unions

The oil feed to the rocker gear is through pipes from a union at the back of the crankcase below the cylinder base to unions on the cylinder heads.

The tapped holes into which the unions screw into the aluminium cylinder heads are fitted with steel wire inserts to prevent the threads in the aluminium from stripping.

The method of fitting the thread inserts is the same as that used for the sparking plug inserts described in Subsection 31.

49. Oil Feed Relief Valves

There are two pressure relief valves in the oiling system, both are located at the top of the crankcase, behind the right hand cylinder barrel. (See Fig. 11).

The right hand screw holds a $\frac{5}{16}$ dia. ball and spring in position, forming the main relief valve holding a pressure of 60 lbs./sq. in. in the oil supply line to the big-ends. It is important that the correct washer is used under the head of the screw, a thinner washer or no washer at all will give a higher pressure and a thicker washer will give a lower pressure than intended. Too high a pressure in this part of the system could cause damage to the crankshaft seal in the timing cover and leakage at this point will reduce the amount of oil passing the main release valve. This could cause oil starvation at the rockers and lead to excessive wear of cams and tappets and poor lubrication of camshaft bearings. If the pressure in the main system is too low, the amount of oil reaching the big-ends will be reduced.

The second screw forms a pressure relief valve for the oil supply to the overhead rockers. The unit is pre-set at the Works to release at 10-15 lbs./sq. in. and cannot be adjusted.

50. Fitting the Alternator

The alternator consists of two parts, the stator and the rotor.

The stator is mounted on to the primary chaincase with three studs and distance pieces.

The rotor, which contains the permanent magnets, is mounted on the end of the crankshaft and is located by a key and secured by a stud, nut and washer.

The radial air gap between the rotor and the poles of the stator should be .020 in. in all positions and care must be taken when refitting to see that it is not less than .010 in. at any point.

Fit the rotor first, making sure that it is located concentrically on the end of the crankshaft. Attention must be given to the seating of the key because a badly-fitting key may cause the rotor to run unevenly. Finally secure the rotor with the appropriate nut and washer.

Place the three distance pieces over the three chaincase studs. The stator can then be fitted, with the coil connections facing outwards.

Replace the nuts and shakeproof washers only fingertight, and insert six strips (preferably of non-magnetic material) .015 in. thick and about $\frac{1}{8}$ in. wide between the rotor and each pole piece.

Tighten the stator nuts and withdraw the strips.

Check the air gap with narrow feelers and, if less than .010 in. at any point, remove the stator and set the three studs carefully until the correct gap is obtained.

An alternative, and more satisfactory, method of assembling the alternator requires the use of Special Tool No. T2055/19.

This is a gauge .015 in. greater in radius than the rotor and fits over the adaptor on the end of the crankshaft in the rotor's place.

The stator is then put in position on the studs in the chaincase and the nuts tightened up.

Remove the gauge and fit the rotor, then check the air gap.

Service operations with Engine Removed

51. Removal of the Engine Gearbox Unit from the Frame

Remove battery cover and disconnect the battery leads.

Remove the petrol tank (Subsection 26).

Remove the cylinder head steady plates.

Remove the exhaust pipes.

Loosen the rectifier bracket and swing the rectifier clear.

Disconnect the contact breaker leads and alternator leads.

Remove the sparking plug caps.

Loosen the breather tube clip and disconnect the tube from the adaptor.

Remove fixed portion of rear chainguard and remove rear chain.

Remove air intake tubes from carburettors.

Remove screws holding mixing chamber tops to carburettors and withdraw slides.

Disconnect the clutch cable.

Disconnect the tachometer drive cable.

Remove the footrest bar.

Slacken off the nuts holding the prop stand cross bar to the frame.

Remove the bottom rear engine bolt and the bolt securing the gearbox bracket to the frame. Loosen the nuts on the chainstay pivot bolt.

Support the engine on a suitable box or wood block.

Raise the centre stand and remove the spring.

Loosen the bottom gearbox nuts and swing the lower engine plates down.

Remove the front engine plates, and stand.

Lift the engine out of the frame.

52. Removal of the Gearbox

Remove the engine sprocket and clutch (Subsections 42 and 45).

Remove the rear half of the primary chaincase by removing three socket screws and the centre stud.

The gearbox and gearbox bracket can now be withdrawn from the back of the crankcase after unscrewing the four nuts which secure them.

53. Dismantling the Crankcase

Drain the oil tank by removing the drain plug.

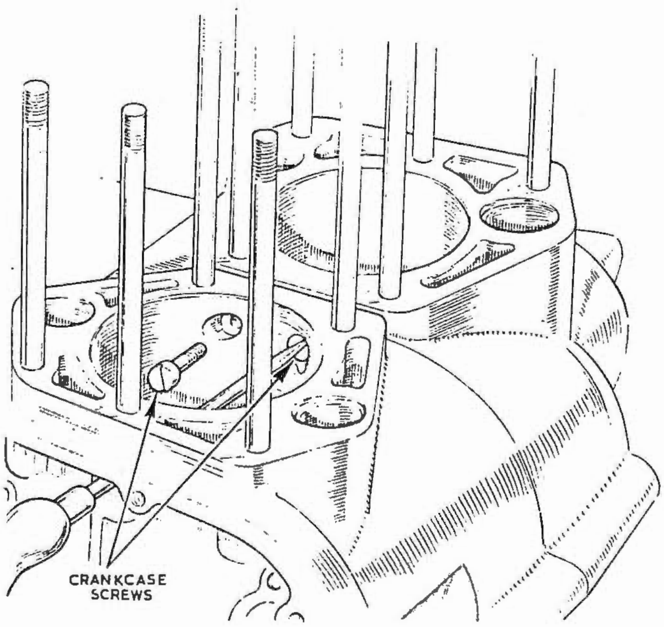
Having removed the engine from the frame as described in Subsection 51, dismantle the heads, barrels, pistons, timing gear and camshafts, as described in Subsections 19, 22, 27, 32, 33, 39, and 40.

Remove the gearbox as described in Subsection 52.

Remove the two screws holding the crankcases together at the top. Holes are provided in the timing-side case to provide access for the screwdriver (See Fig. 12).

Remove three nuts in the timing chest, two loose studs through the rear of the crankcase and four screws through the bottom of the oil tank. (The other studs have already been removed to take the engine out of the frame).

Turn the crankshaft until the connecting rods are at bottom dead centre and the two halves of the crankcase can then be separated, tapping the crankcase with a soft mallet.



REMOVAL OF SCREWS IN CRANKCASE
Fig. 12

The inner race of the roller bearings on the timing side will remain on the crankshaft bringing with it the cage and rollers and leaving the outer race fixed to the crankcase.

The inner race of the ball bearing on the driving side is a tight fit on the shaft and can be removed with Special Tool No. W49910. If this is not available, the shaft can be driven out with a hide mallet or a soft metal drift.

To avoid damage to the ball bearing the case should be heated to about 100°C. before doing this.

54. Main Bearings

To remove the ball bearing from the driving side crankcase, heat the crankcase to about 100 degrees C. by immersion in hot water or in an oven after which the bearing can be driven out using a drift **which applies pressure to the outside race only.**

When refitting a new ball bearing, heat the crankcase in the same way and use the same drift taking great care to keep the bearing square with the bore.

To remove the outer roller race from the timing side crankcase, first heat the crankcase then drive the race out using a small punch through the three holes provided.

The inner race and rollers can be withdrawn from the crankshaft using a claw type extractor.

When refitting the inner race drive it on to the shaft until the shaft projects $\frac{1}{16}$ in. from the face of the bearing.

55. Fitting the Connecting Rods

To remove the connecting rods from the crankshaft, unscrew the socket screws in the connecting rods, having first removed the security wires through the heads.

If the big end bearing caps are removed to examine the condition of the bearings, *make sure that the caps are refitted the same way round on the same rods and that the rods themselves are refitted the same way round on the same crank pins.*

In refitting the connecting rods, the socket screws should be tightened with a torque wrench set at 275 in. lb. (23 ft. lb.)

No cotter pins or other locking devices are fitted. If the socket screws are correctly tightened they will never come loose. If they are *not* adequately tightened they are liable to fatigue failures. Use only genuine big end screws, Part No. 47876 These have a very high fatigue strength due to the use of a special steel and the fact that the threads are rolled *after* heat treatment.

Wire the heads using .024" diameter stainless steel wire.

If it is necessary to replace the big ends, a service crankshaft can be supplied with connecting rods fitted.

56. Reassembly of Crankcase

If the main bearings have been removed fit the replacement ball bearing in the driving side crankcase and the outer roller race in the timing side as described in Subsection 54. The outer race should be pressed home and then secured by making four equally spaced centre punch marks in the case so as to spread the aluminium over the radiused edge of the race.

Assembly of the two halves of the crankcase on to the crankshaft is easier if the crankcase is warmed while the crankshaft is cold. First fit the crankshaft assembly into the drive side crankcase, pulling the shaft right through the ball race and fitting the engine sprocket and nut. The nut must be tightened right home before the timing side crankcase is fitted otherwise the roller bearing inner race may be inadvertently moved along the shaft through the crankshaft entering too far into the timing side case. This can also happen, or a roller can be dislodged, if the rollers tilt out of the inner race and make assembly difficult. Wrapping a piece of string round the rollers will keep them in place and ensure their easy entry into the outer race. The string must be long enough to be easily pulled free after assembly.

Before assembly make sure that all parts are scrupulously clean, put clean oil on bearings, remove all traces of old jointing compound and any protruding pieces of metal from the joint face by means of a scraper and put fresh jointing compound on the face between the two halves of the crankcase. Do not forget the distance piece W34062 between the driving side ball bearing and the crank web.

Bolt the two halves of the crankcase together before the jointing compound has set. Do not forget the two screws between the cylinder barrels (see Fig. 12).

57. Crankshaft Plugs

The oil passage through the big ends is sealed by two screwed aluminium plugs locked by a centre punch.

If the crankcase is taken out of the engine for any reason, the plugs should be removed and the oil passage cleared of sludge.

Gearbox and Clutch

58. Description of the Clutch

The clutch is built into the clutch sprocket and is mounted on the gearbox mainshaft which projects through into the primary chaincase.

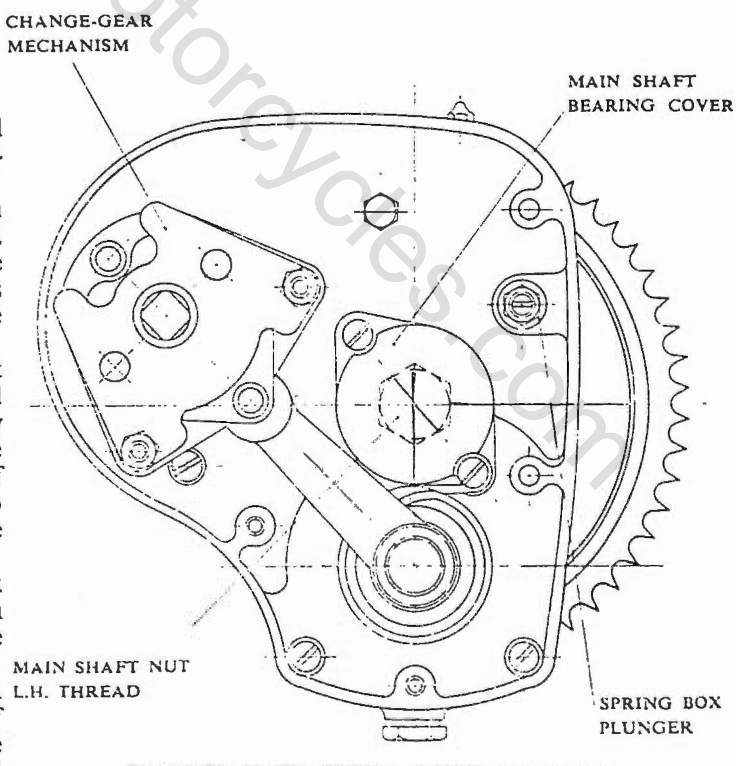
There are six driven plates which are plain and five driving plates, giving ten friction surfaces.

The driven plates comprise the clutch centre back plate, two dished and two flat steel plates on splines on the clutch centre drum, and the clutch front plate (see Fig. 14).

The driving plates include the clutch sprocket itself, which has a ring of friction material bonded to it and is located on the clutch centre drum by a ring of low friction material. There are four loose friction plates, having bonded-on segments of "J.17" synthetic cork based material, splined to the clutch outer drum, which is riveted to the clutch sprocket.

Pressure is applied to the clutch plates by six springs fitted between the outside of the clutch front plate and the inside of a star-shaped pressure plate.

The clutch operating mechanism consists of a lever mounted on the inside of the outer cover of the gearbox and operated by the control cable and handlebar lever. When the control is operated the clutch front plate is caused to move to the left,



GEARBOX WITH OUTER COVER REMOVED
Fig. 13

against the pressure of the springs, by means of a pad pushed by a rod passing through the gearbox mainshaft and operated by the lever in the outer cover through an adjusting screw and ball.

The clutch centre drum drives the mainshaft through a cush drive with six rubber blocks.

59. Description of the Gearbox

The operation of the gearbox is shown diagrammatically in Fig. 15.

The clutch sprocket A is mounted on the end of the mainshaft B which passes through the mainshaft sleeve C on the end of which is the final drive sprocket D.

At the other end of the mainshaft B is a pinion E which engages with a pinion F on the layshaft G. At the other end of the layshaft G is a pinion H engaging with a pinion J which runs free on the mainshaft sleeve C.

The mainshaft sleeve C has splines on which slides a double pinion KL. This double pinion KL engages with two pinions M and N which are free to rotate or slide on the layshaft G.

The double pinion KL has dogs at each end which can engage with dogs on the pinion E or on the pinion J.

The pinions M and N have internal dogs which can engage or slide over projecting dogs P and Q on the layshaft G.

The double pinion KL and the pinions M and N all slide together and are moved by the operator fork R and are located by a spring plunger S which engages with a notched plate which is part of the operator arm R.

The kickstart lever is connected to the pinion F on the layshaft by a ratchet mechanism which automatically disengages when the lever is released.

60. Removal of the Gearbox

This is described in Subsection 52.

The gearbox can, however, be completely dismantled with the engine in the frame except for the removal of the inside operator and the bearings in the gearbox shell.

61. To Dismantle the Gearbox

First remove the kickstart crank, the change-gear lever and the neutral finder and pointer.

Remove four screws and the gearbox outer cover can then be detached.

Remove the change-gear mechanism, by taking off the two nuts securing it.

Remove the mainshaft bearing cover which is attached by two screws.

Remove four cheese-headed screws and one hexagon bolt.

Remove the spring box locating plunger nut and washer.

Remove the mainshaft nut **(left-hand thread).**

The gearbox inner cover can then be removed.

The mainshaft can be drawn straight out if the clutch has been removed, which, however, should be done before taking off the gearbox inner cover. (See Subsection 45). The top gear pinion and dog will come away with the mainshaft.

The layshaft can then be removed and the 2nd and 3rd gears drawn off the final drive sleeve together with the operator fork.

To take out the final drive sleeve, the final drive sprocket must be removed and this is preferably done before removing the inner cover. (See Subsection 46).

62. Removal of the Ball Races

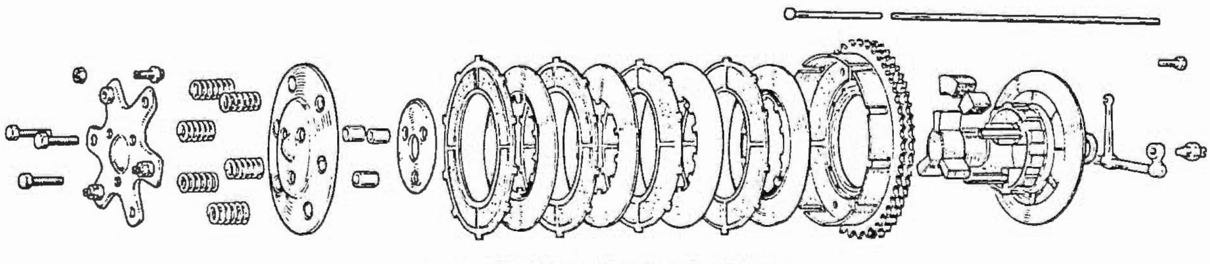
The mainshaft ball bearings can be removed by using a stepped drift $1\frac{7}{16}$—$1\frac{11}{64}$ in. diameter for the bearing in the box and $\frac{13}{16}$—$\frac{39}{64}$ in. diameter for the bearing in the cover.

When refitting the bearings stepped drifts of $2\frac{5}{16}$—$1\frac{11}{64}$ in. diameter and $1\frac{11}{16}$—$\frac{39}{64}$ in. diameter must be used for the bearings in the box and cover respectively.

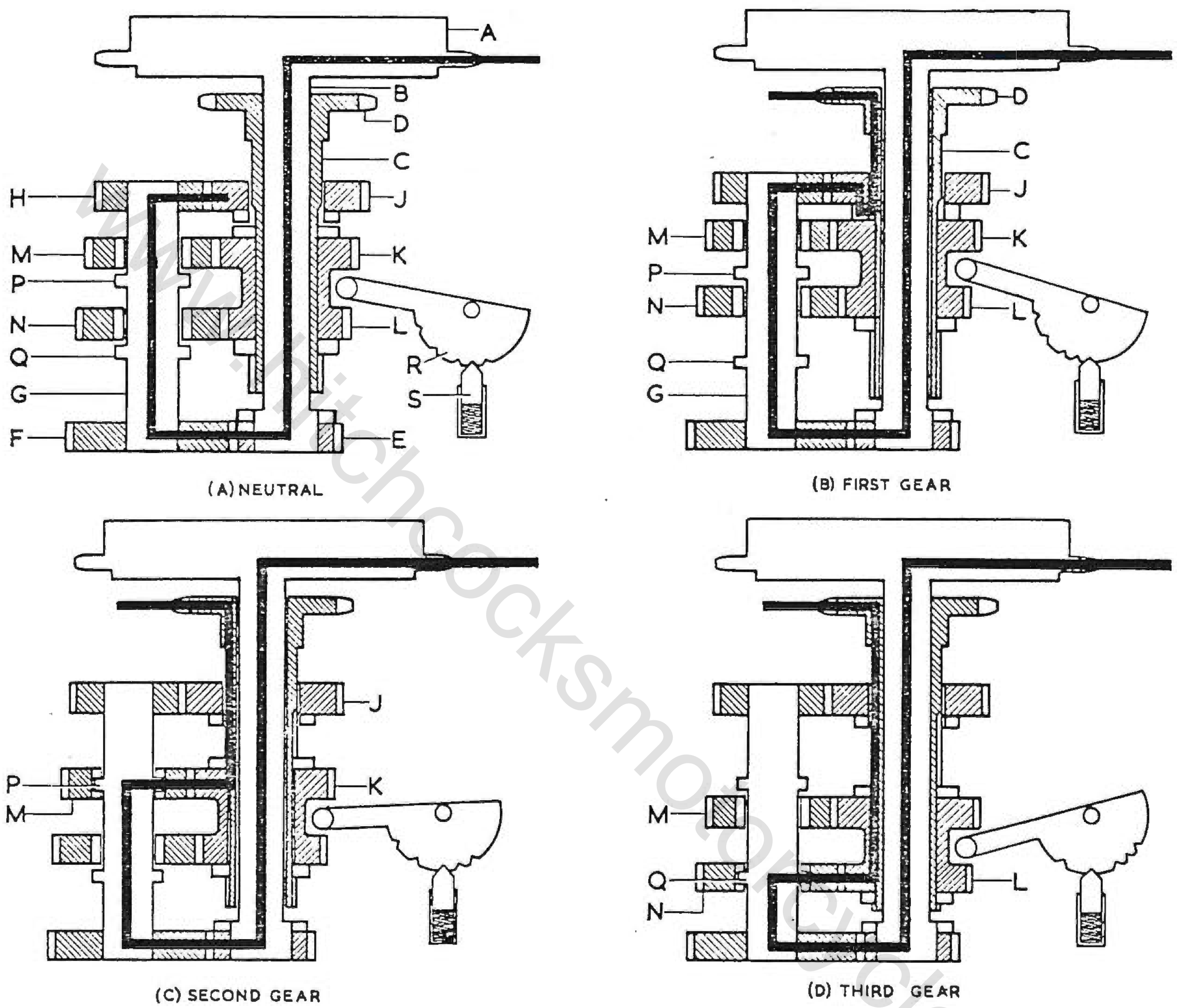
Note the oil seal in the recess behind the larger mainshaft bearing.

63. Change-Gear Mechanism

If the two nuts securing the change-gear ratchet mechanism are slackened the adjuster plate



EXPLODED VIEW OF CLUTCH
Fig. 14



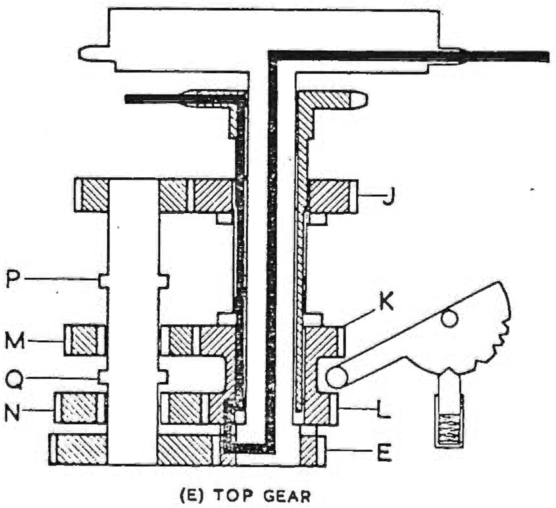


Fig. 14A—Neutral. None of the dogs is engaged so that the mainshaft B and pinions E, F, H, J are rotating but the mainshaft sleeve C and the final drive sprocket are stationary.

Fig. 14B—Bottom Gear. The sliding pinions K, L, M, N have moved over so that the dogs on K engage with the dogs on the pinion J. This causes the double pinion KL, the mainshaft sleeve C and the sprocket D to rotate with the pinion J which is being driven from the mainshaft through the layshaft G. The dogs P and Q are not engaged.

Fig. 14C—Second Gear. The sliding pinions have moved so that the dogs on J are disengaged but the dogs P on the layshaft engage with the pinion M. The drive from the mainshaft and layshaft then passes through pinions M and K to the splines on the mainshaft sleeve and the pinion J is free on the sleeve.

Fig. 14D—Third Gear. The sliding pinions have moved further over so that the dogs Q on the layshaft engage with the pinion N which drives the pinion L and thus the mainshaft sleeve, the pinion M being free on the layshaft.

Fig. 14E—Top Gear. The sliding pinions have now moved right over so that both sets of dogs P and Q on the layshaft have disengaged but the dogs on the double pinion KL have engaged with those on the pinion E and the mainshaft and sleeve rotate together giving a one to one drive through the gearbox from the clutch sprocket to the output sprocket, the pinions M, N, J being free to rotate.

OPERATION OF GEARS
Fig. 15

can be set in the correct position. In this position the movement of the gear lever necessary to engage the ratchet teeth will be approximately the same in each direction.

If the plate is incorrectly adjusted, it may be found that, after moving from top to third or from bottom to second gear, the outer ratchets do not engage the teeth on the inner ratchets correctly.

If, when fitting new parts, it is found that the gears do not engage properly, ascertain whether a little more movement is required or whether there is too much movement so that the gear slips right through second or third gear into neutral. If more movement is required, this can be obtained by filing the adjuster plate very slightly at the points of contact with the pegs on the ratchet ring.

If too much movement is already present, a new adjuster plate giving less movement must be fitted.

64. Reassembling the Gearbox

The procedure is the reverse of that given in Subsection 61, but the following points should be noted:—

If the mainshaft top gear pinion and dog have been removed, make sure that the dog is replaced the right way round or third and top gears can be engaged simultaneously.

Make sure that the trunnions on the operator fork engage with the slots in the inside operator.

See that the mainshaft is pushed right home. It may tighten in the felt washer inside the final drive shaft nut.

The layshaft top gear and kickstarter pinion should be assembled on the layshaft and the kickstarter shaft and ratchet assembled on to it before fitting the end cover. Do not forget the washer on the layshaft between the kickstarter pinion and the kickstarter shaft.

The joint between the gearbox and the inner cover should be made with gold size, shellac or a similar jointing compound.

Make sure that all parts are clean before commencing assembly. In normal climates the recesses in the gearbox should be packed with soft grease and the box should be filled up to the correct level with engine oil. (See Subsection 68). **On no account must heavy yellow grease be used.**

65. Dismantling and Reassembling the Clutch

The method of removing the clutch is described in Subsection 42.

When reassembling the clutch, the following sequence must be adhered to, after first securing the clutch sprocket with the large circlip.

Fit the cush rubbers, retaining plate and three distance tubes, and follow with the pressure plate assembly as follows:—

Plain dished plate (dish projecting outwards).
Friction plate (with bonded facings).
Plain flat plate.
Friction plate (with bonded facings).
Plain flat plate.
Friction plate (with bonded facings).
Plain dished plate (dish projecting inwards).
Friction plate (with bonded facings).
Front plate.
Pressure plate and springs.

When reassembling the pressure and front plates, see that the three distance pieces are fitted over the pins securing the pressure plate to the clutch centre drum. These must pass through the holes in the front plate into the three recesses in the clutch centre retaining plate. Note that three strong (13g) and three weak (14g) springs are used. These *must* be fitted alternately and, the 14g springs *must* be fitted behind the adjusting screws. The three pressure plate pins must be locked up tight.

If the clutch lifts unevenly adjust one or, if necessary, two of the adjusting screws in the pressure plate. These screws can also be used to increase the spring pressure when wear has taken place on the friction surfaces but care must be taken not to screw them in too far. This could reduce the lift of the clutch by causing some of the springs to become coil bound, thus causing clutch drag.

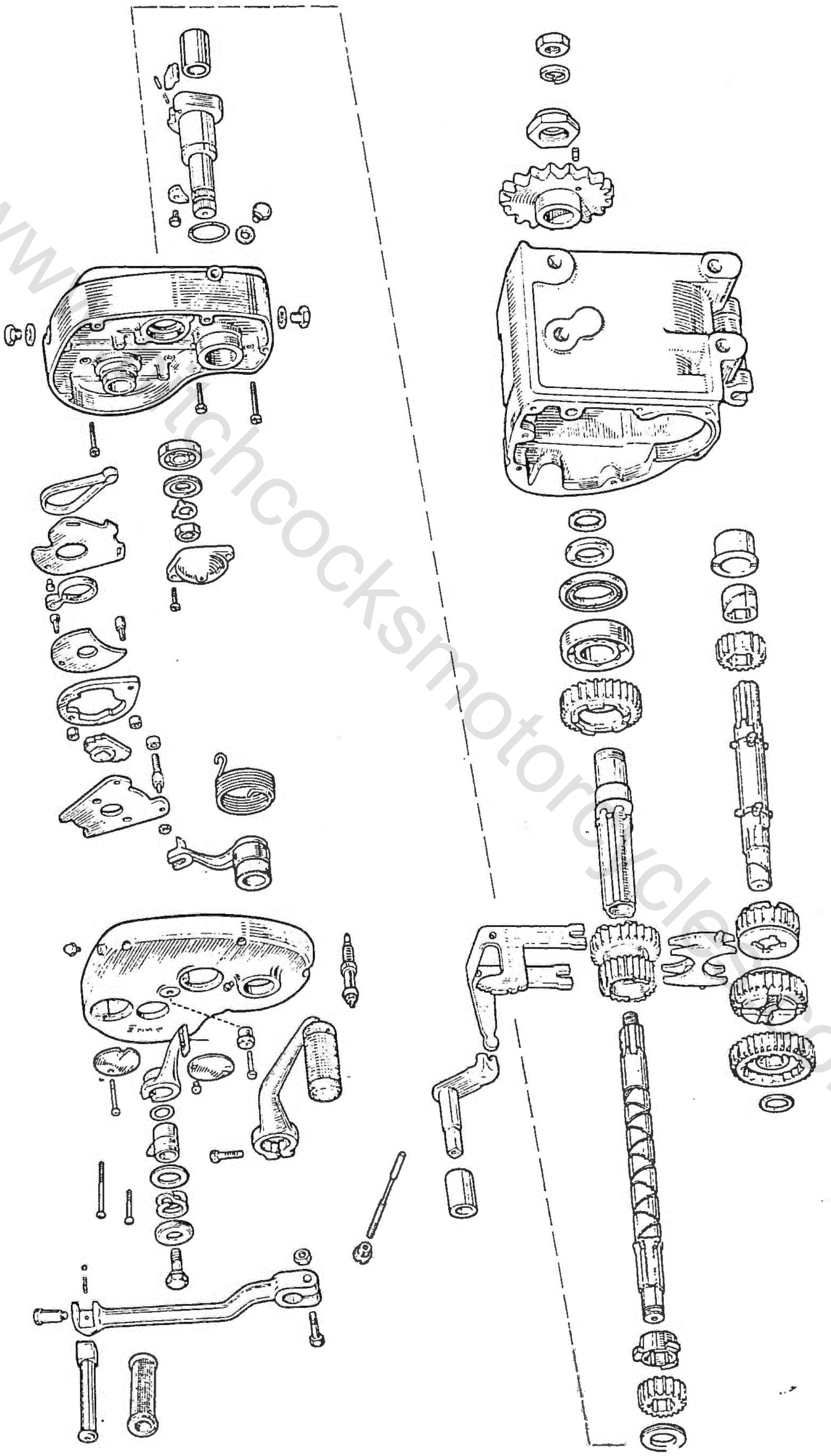
66. Adjustment of Clutch Control

It is essential that there is about $\frac{1}{32}$ in. free movement in the clutch cable, to ensure that all the spring pressure is exerted on the plates.

There are three points of adjustment for the clutch control. The first is in the clutch operating lever in the gearbox and is accessible after removing the lower inspection cover in the front cover of the gearbox (see Fig. 17). The clutch cable should be slacked right off or, preferably, disconnected when making this adjustment. Slacken the locknut and adjust the centre screw in or out until it is as nearly as possible in line with the clutch push rod. Tighten the locknut and check that no part of the lever is hard against the inside of the gear box front cover or either of the inspection covers.

The second and third adjustments are in the outer casing of the clutch control cable. There is an adjustable sleeve with a locknut forming the abutment for the outer casing at the gearbox end and also a finger-operated sleeve and locknut at the handlebar end.

To adjust the control cable, having first set the adjuster in the gearbox clutch operating lever correctly, couple up the control cable, screw the adjusting sleeve at the handlebar end of the casing in as far as possible then unscrew it two turns.



EXPLODED VIEW OF GEARBOX
Fig. 16

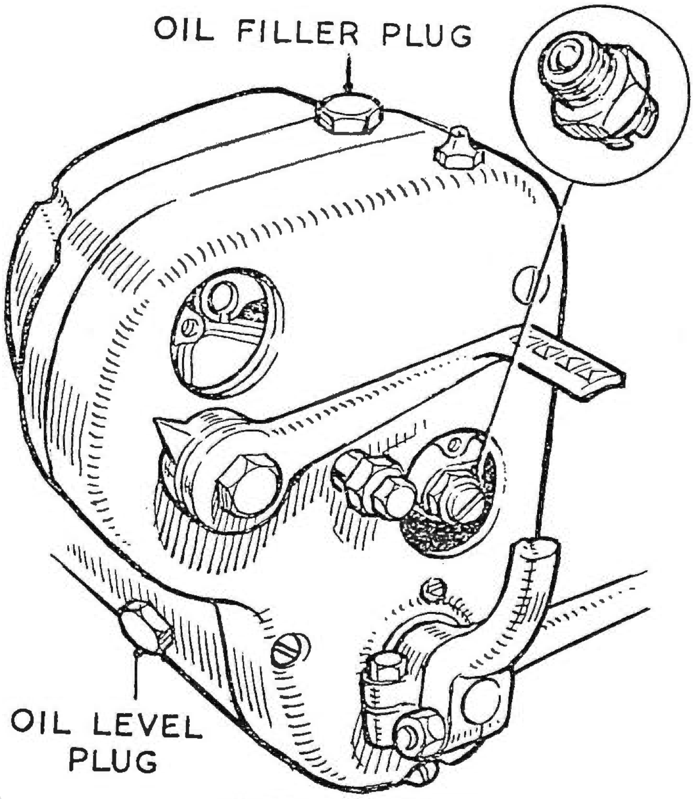
Now adjust the sleeve at the gearbox end of the casing until there is $\frac{1}{32}$ in. to $\frac{1}{16}$ in. slack in the control. If the control is adjusted in this manner the finger adjustment at the handlebar end can be used to take up any slack which may appear temporarily as the result of the friction material swelling due to heat if the clutch has to be slipped a great deal in traffic. This adjustment can also be used to give more clearance temporarily if this is necessary as a result of wear of the friction linings. This, however, should be corrected finally by adjusting the centre screw in the gearbox clutch operating lever.

67. Adjustment of the Neutral Finder

The neutral finder is adjusted by means of an eccentric stop secured to the front of the gearbox cover by a bolt which limits the travel of the operating pedal. Slacken the bolt and turn the eccentric until the correct movement of the pedal is obtained.

68. Gearbox Oil Level

The gearbox is filled with oil by removing a plug in the top and the correct level can be checked by removing a second plug lower down on the left-hand side looking at the cover. (See Fig. 17).



CLUTCH ADJUSTMENT
Fig. 17

Recommended Lubricants

	B.P.	CASTROL	DUCKHAMS	ESSO	MOBIL	REGENT or Caltex/Texaco	SHELL
Engine Below 20°F	Energol SAE 20W	Castrolite	Q.20/50	Extra 20W/30	Arctic or Mobiloil Super (10W/50)	Havoline 20/20W	X-100 20/20W
Engine 20°F-50°F (British Winter)	Energol SAE 30	Castrolite or XL	Q.20/50	Extra 20W/30	A or Mobiloil Super (10W/50)	Havoline 30	X-100 30
Engine 50°F-90°F (British Summer) Gearbox top up Rear Chain	Energol SAE 40	XXL	Q.20/50	Extra 40/50	AF or BB or Mobiloil Super (10W/50)	Havoline 40	X-100 40
Engine Above 90°F	Energol SAE 50	Grand Prix	Q.20/50	Extra 40/50	BB or D or Mobiloil Super (10W/50)	Havoline 50	X-100 50
Front Fork	Energol SAE 20W	Castrolite	Q.20/50	Extra 20W/30	Arctic	Havoline 20/20W	X-100 20/20W
Grease Gun Wheel hubs (Re pack)	Energrease L2	Castrolease LM	LB.10	Esso Multipurpose grease H	Mobilgrease MP	Marfak Multipurpose 2	Retinax A

MULTIGRADE OILS—Several of the above suppliers offer "Multigrade "oils. Those rated at S.A.E. 10W/30 are approved for use at ambient temperatures up to 50°F. Oils rated at S.A.E. 20W/40, 20/50 and 10W/50 are approved for use at all ambient temperatures.

Amal Concentric Carburettor

750 Series I & II

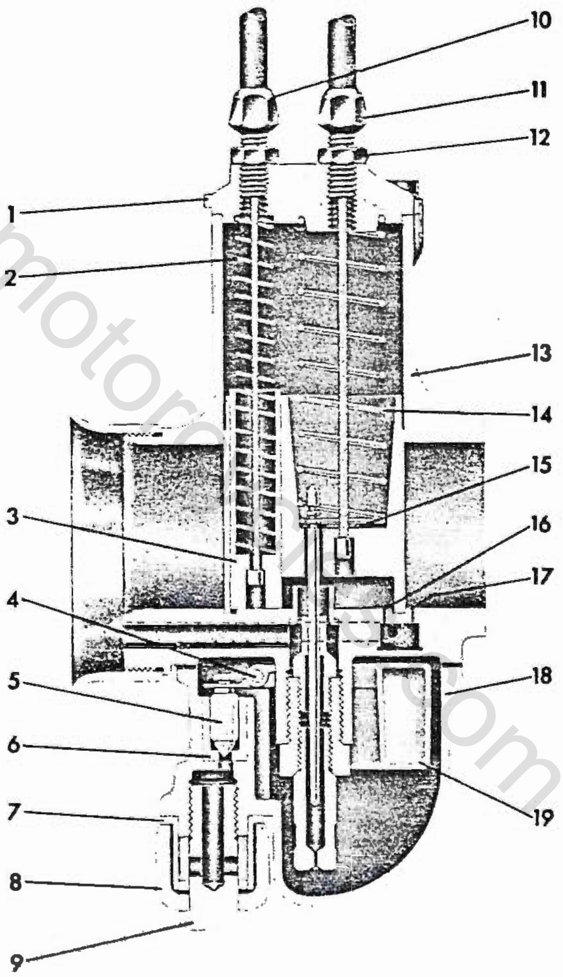
69. General Description

Two of the well-known AMAL Concentric carburettors are fitted direct on to the inlet ports. A sectioned view of the carburettor is shown in Figs. 18 & 19 and an "exploded" view in Fig. 22. Each carburettor is self contained with its own float chamber fed from a tap in the fuel tank. The float chambers are connected together by a short flexible tube joining the two banjos and both fuel taps must always be turned on to ensure an ample supply of fuel at high revs. Each float chamber contains a plastic float operating on a kemetal fuel needle with a powerful lever action which ensures a positive cut-off unless there is dirt on the seating.

The supply of air to the engine is controlled by a throttle slide which carries a taper needle operating in the needle jet. The needle is secured to the throttle slide by a spring clip fitting in one of three grooves and the mixture strength throughout a large proportion of the throttle range is controlled by the position of this needle in the slide and by the size of the jet in which it works. There is, however, a restricting or main jet at the bottom of the needle jet and the size of this controls the mixture strength at the largest throttle openings. At very small throttle openings petrol and air are fed to the engine through a separate pilot system, which has an outlet at the engine side of the throttle. The air supply to this pilot system is controlled by the pilot air screw and the slow running of the engine can be adjusted by means of this screw and a stop which holds the throttle open a very small amount. The throttle slide is cut away at the back and the shape of this cut-away controls the mixture at throttle openings slightly wider than that required for slow running. There is a compensating system to prevent undue enriching of the mixture with increasing engine speed, this system consisting of a primary choke surrounding the upper end of the needle jet through which air is drawn in increasing quantities as the depression in the main choke increases. This air supply and the supply to the pilot system are taken from two separate ducts in the main air intake to the carburettor so that all the air passing to the engine can be filtered by fitting an air cleaner to the main carburettor air intake.

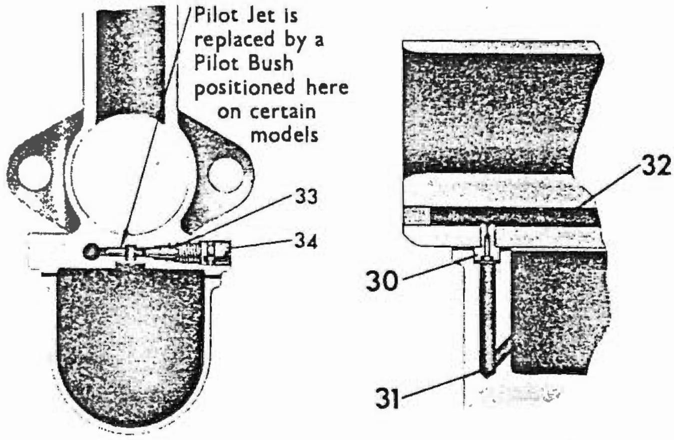
Two small cross holes in the needle jet, at a level just below the static level in the float chamber, permit petrol to flow into the primary choke when the engine is not running or when it is running at very low speeds, thus forming a well of petrol which will be drawn into the engine on starting or accelerating from low speeds. At moderately high engine speeds the level of petrol in the float chamber falls slightly and in consequence no more fuel flows through the cross holes in the needle jet so that the petrol well remains empty until the engine slows down or stops.

A handlebar controlled air slide is provided to enrich the mixture temporarily when required.

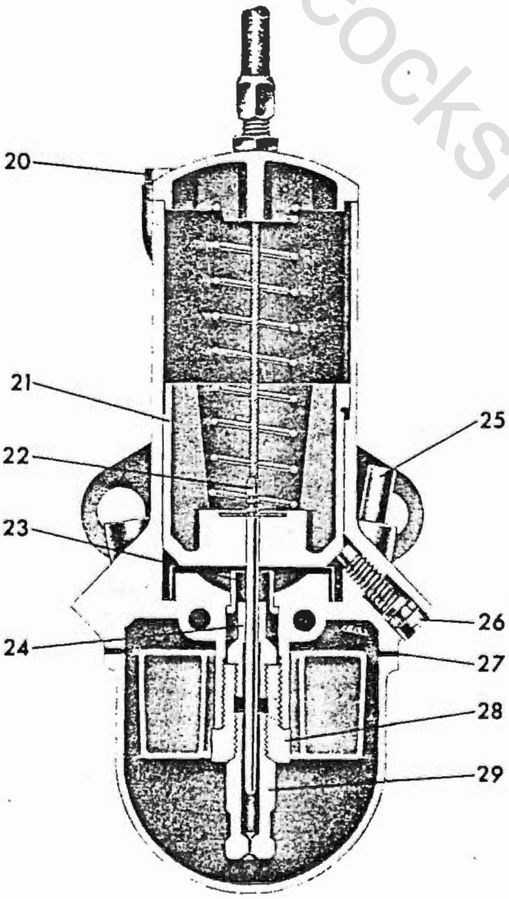


SECTION THROUGH MIXING CHAMBER, SHOWING AIR VALVE AND THROTTLE CLOSED
Fig. 18

1 Mixing Chamber Top.
2 Air Valve Spring.
3 Air Valve.
4 Float Spindle.
5 Float Needle.
6 Needle Seating.
7 Filter Gauze.
8 Banjo.
9 Banjo Bolt.
10 Cable Adjuster (Air).
11 Cable Adjuster (Throttle).
12 Cable Adjuster Locknuts.
13 Carburettor Body.
14 Throttle Valve Spring.
15 Jet Needle Clip.
16 Pilot By-pass.
17 Pilot Outlet.
18 Float Chamber Body.
19 Float.
20 Mixing Chamber Top Screws.
21 Throttle Valve.
22 Jet Needle.
23 Choke Tube.
24 Needle Jet.
25 Tickler.
26 Throttle Adjusting Screw.
27 Float Chamber Washer.
28 Jet Holder.
29 Main Jet.
30 Pilot Jet.
31 Pilot Jet Feed Passages.
32 Feed Passage from Pilot Jet.
33 Pilot Air Feed Passage.
34 Pilot Air Adjusting Screw.



SECTION SHOWING PILOT JET AND PILOT JET FEED PASSAGES
Fig. 20



SECTION THROUGH FLOAT CHAMBER
Fig. 19

70. Tuning the Carburettors

The throttle opening at which each tuning point is most effective is shown in Fig. 21. It should be remembered, however, that a change of setting at any point will have some effect on the setting required at other points; for instance, a change of main jet will have some effect on the mixture strength at half throttle which, however, is mainly controlled by the needle position. Similarly an alteration to the throttle cut-away may affect both the needle position required and the adjustment of the pilot air screw. For this reason it is necessary to tune the carburettor in a definite sequence, which is as follows:

First—Main Jet. The size should be chosen which gives maximum speed at full throttle with the air control wide open. If two different sizes of jet give the same speed the larger should be chosen for safety as it is dangerous to run with too weak a mixture at full throttle.

Second—The pilot air screw should be set to give good idling. On Series I and early Series II machines the pilot jet is detachable.

Third—The throttle valve should be selected with the largest amount of cut-away which will prevent spitting or misfiring when opening the throttle slowly from the idling position.

Fourth—The lowest position of the taper needle should be found consistent with good acceleration with the air slide wide open.

Fifth—The pilot air screw should be checked to improve the idling if possible. When setting the adjustment of the pilot air screw this should be done in conjunction with the throttle stop. Note that the correct setting of the air screw is the one which gives the fastest idling speed for a given position of the throttle stop. If the idling speed is then undesirably fast it can be slowed down by unscrewing the throttle stop a fraction of a turn.

It will be noted that of the four points at which adjustments are normally made, i.e., pilot air screw, throttle cut-away, needle position and main jet size, the first and third do not require changing of any parts of the carburettor. Assuming that the carburettor has the standard setting to suit the particular type of engine any small adjustments occasioned by atmospheric conditions, changes in quality of fuel, etc., can usually be covered by adjustment of the pilot air screw and raising or lowering the taper needle one notch. If, however, the machine is used at very high altitudes or with a very restricted air cleaner a smaller main jet will be necessary. The following table gives the reduction in main jet size required at different altitudes:

Altitude, ft.	Reduction, %
3,000	5
6,000	9
9,000	13
12,000	17

When using alcohol fuels the following new components are necessary. A metallic double feed banjo, banjo bolt washer 13/163, needle jet 622/100, jet needle 928/099, filter gauze 376/093B and banjo washer 14/175 are required for each carburettor. The main jets must be increased for straight alcohol by approximately 150%. The final setting must be a question of trial and error according to the nature of fuel used. When using alcohol fuels it is advisable to err on the rich side to avoid engine overheating.

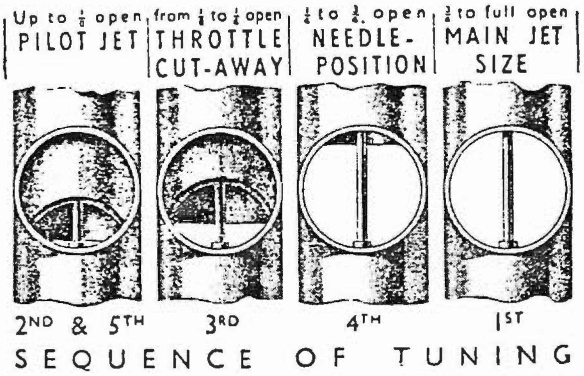
If the engine is run on fuel containing a small proportion of alcohol added to the petrol, a rough and ready guide is that the main jet should be increased by 1% for every 1% of alcohol in the fuel. In most cases alcohol blends available from petrol pumps do not contain sufficient alcohol to require any alteration to the carburettor setting.

The range of adjustment of the taper needle and the pilot air screw are determined by the size of the needle jet and of the pilot outlet respectively. Standard needle jets have a bore at the smallest point of .1065 in. and are marked 106. Alternative needle jets. 1055 in., .1075 in., .109 in. and .113 in. bore are availableand are marked 105, 107, 109 and 113 respectively.

The standard pilot outlet bore is .025 in. but in some cases larger size pilot outlets are used. Since the pilot outlet is actually drilled in the body of the carburettor it is necessary to have a carburettor with the correct size pilot outlet if the best results are to be obtained.

The accompanying table shows the standard settings for Amal Concentric Carburettors used on Royal Enfield "Interceptor" Series I & II motor cycles.

These may be taken as correct for all normal conditions and for practical purposes carburettor



PHASES OF AMAL CONCENTRIC CARBURETTOR THROTTLE OPENINGS
SEQUENCE OF TUNING
Fig. 21

tuning consists only of setting the pilot air screw and throtle stop.

71. Tuning Sequence with Two Carburettors

When setting the slow running on machines fitted with two carburettors the following procedure is recommended:—

(1) See that both throttle slides are open the same amount for any given position of the twist grip. This is most easily checked by looking into the air intakes while slowly opening and closing the throttles with the air slides wide open. Make sure that the highest point of the cut-away on the throttle valve reaches the top of the bore simultaneously in both carburettors. If necessary adjust one or both mid-cable adjusters in the throttle cables.

(2) Repeat this procedure for the air slides.

(3) Start the engine and let it run at a fast idle till thoroughly warm. Open the air slides fully and remove the H.T. lead and waterproof plug cap from the right-hand sparking plug, opening the throttle if necessary to keep the engine running on one cylinder.

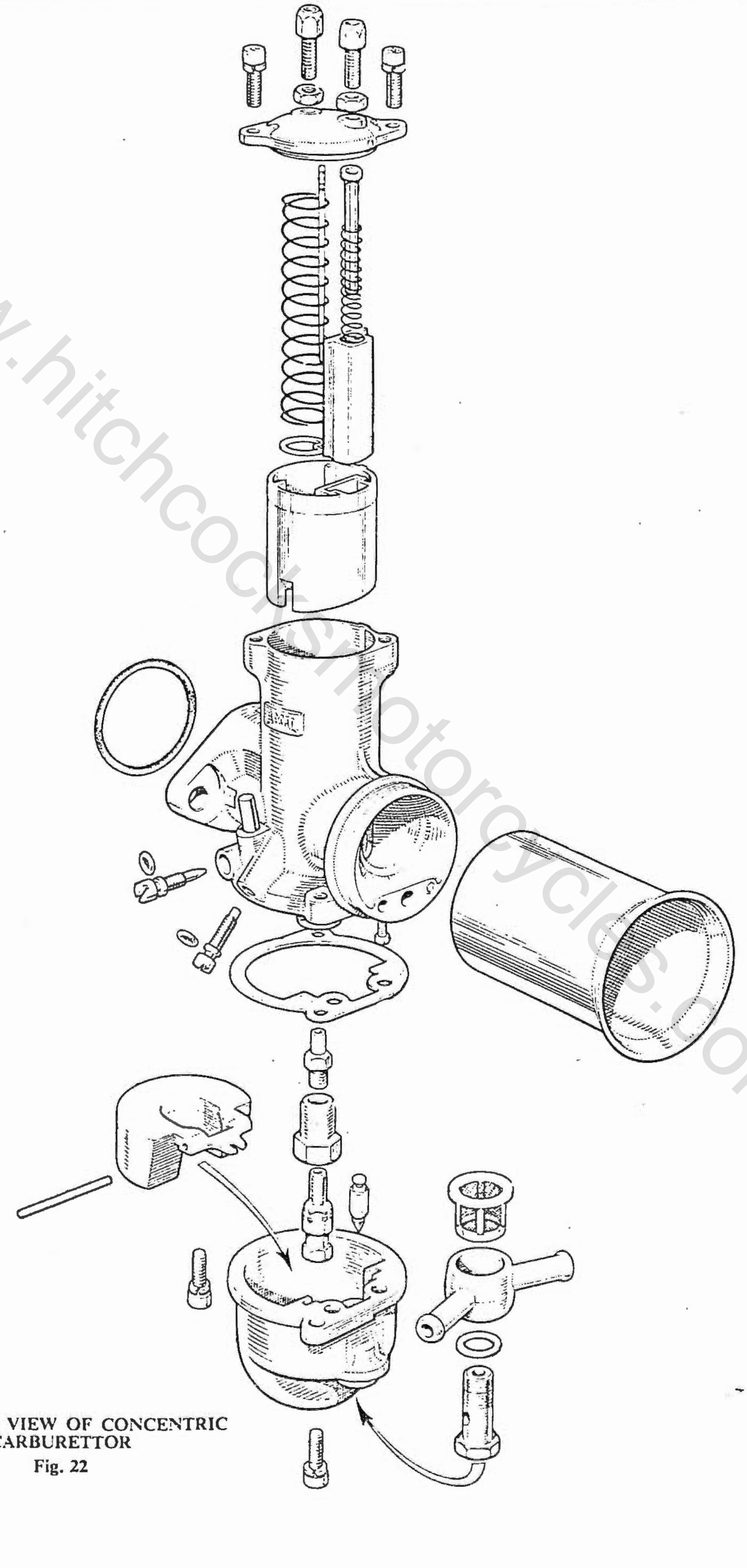
(4) Adjust the throttle stop on the left-hand carburettor to hold the throttle just wide enough open to keep the engine running with the twist grip shut.

(5) Adjust the pilot air screw on the left-hand carburettor to give the maximum speed for this throttle position.

(6) Slow down the engine as far as possible by adjusting the throttle stop and reset the pilot air screw if necessary to give the maximum speed for the new throttle position. Repeat till the engine is running as fast as possible on the smallest possible throttle opening.

(7) Replace the right-hand plug cap and lead and remove the left-hand ones.

(8) Repeat (4), (5) and (6) on the right-hand carburettor.



EXPLODED VIEW OF CONCENTRIC CARBURETTOR
Fig. 22

(9) Replace the left-hand plug cap and lead. The engine should now be running steadily at a fast idle.

(10) Slow the engine down by unscrewing each throttle stop equally. If running becomes lumpy adjust each pilot air screw an equal amount. If necessary, slow engine down further by unscrewing each throttle stop equally but do not try to get *too* slow an idle with a hot engine otherwise it will be liable to stop when only partly warmed up.

72. Dismantling Carburettor

The construction of the carburettor is clearly shown in Fig. 22.

If the float chamber floods, first make sure that there is no dirt on the fuel needle seating. Owing to the use of a Kemetal needle and the leverage ratio between float and needle, flooding is very unlikely with this type of carburettor unless dirt is present or, of course, the float is punctured.

73. Causes of High Petrol Consumption

If the petrol consumption is excessive first look for leaks either from the carburettor, petrol pipes, petrol taps or tank. If coloured petrol is in use this will readily indicate the presence of any small leaks which otherwise might pass unnoticed. If the petrol system is free from leaks, carefully set the pilot adjusting screw as described in Subsections 70 and 71 to give the correct mixture when idling. Running with the pilot adjusting screw too far in is a common cause of excessive petrol consumption. If the consumption is still heavy try the effect of lowering the taper needle in the throttle slide by one notch. Do not fit a smaller main jet as this will not affect consumption except when driving on nearly full throttle and may make the mixture too weak at large throttle openings, thus causing overheating. Remember that faults in other parts of the machine can have a marked effect on petrol consumption. Examples of this are binding brakes, chains too tight or out of line and, in particular, under-inflated tyres.

Settings for AMAL Concentric Carburettors on Royal Enfield "Interceptor" 750 Series I and II Motor Cycles

Carburettor Type No.	Choke Bore m.m.	Main Jet c.c.	Needle Jet in.	Needle Position	Throttle Valve	Pilot Jet	Remarks
L/H L930/4 R/H R930/3	30	220	.107	2	3	25 c.c.	Series I & early Series II engines.
L/H L930/33 R/H R930/32	30	220	.107	2	3½	622/107	Pilot jets are not removable.

Notes: Needle positions:—No. 1=clip in top groove. No. 3=clip in bottom groove.
L930/4 and R930/3 carburettors fitted to Series II engines have different throttle needles, needle jets and jet holders from the carburettors fitted on Series I engines, and these three items are only interchangeable as sets.

Electrical System

74. Introduction

The electrical system is supplied from an alternating current generator contained in the primary chaincase and driven from the crankshaft. The generator output is then converted into direct current by a silicon diode rectifier. The direct current is supplied to a 12 volt 8 ampere/hour battery with a Zener diode in circuit to regulate the battery current.

The current is then supplied to the ignition system which is controlled by a double contact breaker driven direct from the exhaust camshaft. The contact breaker feeds two ignition coils, one for each cylinder.

Current from the alternator is also stored in a high capacity electrolytic capacitor which ensures that the engine can be started and run with a discharged battery or without a battery in the circuit.

The routine maintenance needed by the various components is set out in the following sections. All electrical components and connections including the earthing points to the frame of the machine must be clean and tight.

BATTERY INSPECTION AND MAINTENANCE

75. General

The battery containers are moulded in translucent polystyrene through which the acid level can be seen. The battery top is so designed that when the cover is in position, the special anti-spill filler plugs are sealed in a common venting chamber. Gas from the filler plugs leaves this chamber through a vent pipe union at the side of the top. The vent at the other side of the top is sealed off. Polythene tubing is attached to the vent pipe union to lead corrosive fumes away from parts of the machine which may otherwise suffer damage.

To prepare a dry-charged battery for service, first discard the vent hole sealing tape and then pour into each cell pure dilute sulphuric acid of appropriate specific gravity to THE COLOURED LINE. (See table). Give the battery an initial charge of 1 ampere for 2—3 hours and allow the battery to stand for at least one hour for the electrolyte to settle down, thereafter maintain the acid level at the coloured line by adding distilled water.

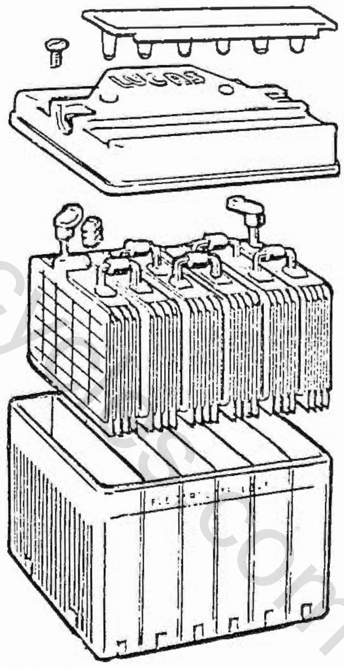
76. Routine Maintenance

Every week examine the level of the electrolyte in each cell. Lift off the battery cover so that the coloured filling line can be seen. Add distilled water until the electrolyte level reaches this line.

Note—On no account should batteries be topped up to the separator guard but only to the coloured line.

With this type of battery, the acid can only be reached by a miniature hydrometer, which would indicate the state of charge.

Great care should be taken when carrying out these operations not to spill any acid or allow a naked flame near the electrolyte. The mixture of oxygen and hydrogen given off by a battery on charge, and to a lesser extent when standing idle, can be dangerously explosive.



EXPLODED VIEW OF BATTERY PUZ5A
Fig. 23

The readings obtained from the battery electrolyte should be compared with those given in table. If a battery is suspected to be faulty it is advisable to have it checked by a Lucas Service Centre or Agent.

77. Technical Data

Specific gravity of electrolyte for filling the battery.

U.K. and Climates normally below 90°F (32.2°C)		Tropical Climates over 90°F (32.2°C)	
Filling	Fully charged	Filling	Fully charged
1.260	1.280/1.300	1.210	1.220/1.240

Every 1.000 miles (1.500 k.m.) or monthly, or more regularly in hot climates the battery should be cleaned as follows. Remove the battery manifold (cell cover) and clean the battery top. Examine the terminals: if they are corroded scrape them clean and smear them with a film of petroleum jelly, such as vaseline. Check that the vent holes are clear.

Maximum permissible electrolyte temperature during charge

Climates normally Below 80°F (27°C)	Climates between 80-100°F (27-38°C)	Climates frequently above 100°F (38°C)
100°F (38°C)	110°F (43°C)	120°F (49°C)

Notes

The specific gravity of the electrolyte varies with the temperature. For convenience in comparing specific gravities, they are always corrected to 60°F., which is adopted as a reference temperature. The method of correction is as follows:

For every 5°F. below 60°F. deduct .020 from the observed reading to obtain the true specific gravity at 60°F. For every 5°F. above 60°F., add .020 to the observed reading to obtain the true specific gravity at 60°F.

The temperature must be indicated by a thermometer having its bulb actually immersed in the electrolyte and not the ambient temperature. To take a temperature reading tilt the battery sideways and then insert into the electrolyte.

It is extremely important that the battery is correctly connected into the circuit to avoid damage to the electrical equipment. All machines use a positive (+ve) earth system. Refer to Fig. 24 which shows the correct method of connecting the battery.

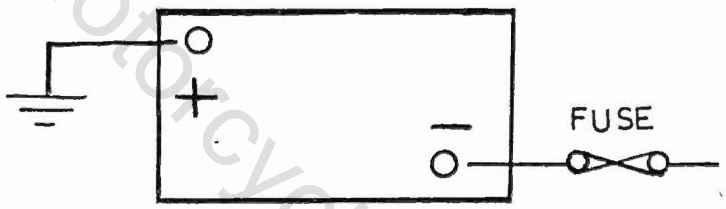


Fig. 24

COIL IGNITION SYSTEM

78. Description

The coil ignition system comprises two ignition coils and a contact breaker fitted in the timing cover and driven by the exhaust camshaft. The ignition coils are mounted to the rear of the vertical partition behind the battery. To gain access to the coils it is first necessary to remove the rear mudguard carrier assembly (Subsection 114) the coil cover can now be removed after undoing the two fixing bolts. It may first be necessary to slacken off the two bolts clamping the top of the partition to the frame. The cover must first be moved to the left to clear the frame before lifting off. Apart from cleaning the coils, in between the terminals and checking the low tension and high tension connections, the coils will not require any other attention. Testing the ignition coils is amply covered in Subsection 81 below whilst testing the contact breaker is described in Subsection 83. The 6CA type of contact breaker is used, with the two capacitors mounted on a separate bracket in the same compartment. Access to the capacitors is gained by removing the contact breaker cover and detaching them from the supporting bracket.

The best method of approach to a faulty ignition system, is that of first checking the low tension circuit for continuity as shown in Subsection 79, and then following the procedure laid out in Subsection 80 to locate the fault(s).

Failure to locate a fault in the low tension circuit indicates that the high tension circuit or sparking plugs are faulty, and the procedure detailed in Subsection 84 must be followed. Before commencing any of the following tests, however, the contact breaker and sparking plugs must be cleaned and adjusted to eliminate this possible source of fault.

79. Checking the Low Tension Circuit for Continuity

To check whether there is a fault in the low tension circuit and to locate its position, the following tests should be carried out:

Remove the white lead which connects the "SW" terminals of the left and right ignition coils. Then, with the wiring harness white lead connected to the SW terminal of the left ignition coil only, turn the ignition switch to the "IGN" position. Slowly crank the engine and at the same time observe the ammeter needle, which should fluctuate between zero and a slight discharge, as the contacts open and close respectively.

Disconnect the wiring harness white lead from the left ignition coil and connect it to the SW terminal of the right ignition coil and then repeat the test. If the ammeter needle does not fluctuate in the described way then a fault in the low tension circuit is indicated.

First, examine the contact breaker contacts for pitting, piling or presence of oxidation, oil or dirt etc. Clean and ensure that the gap is set correctly to .014 in.–.016 in. (.35–.40 m.m.) as described in Subsection 23.

80. Fault Finding in the Low Tension Circuit

To trace a fault in the low tension wiring, turn the ignition switch to "IGN" position and then crank the engine until both sets of contacts are opened, or alternatively, place a piece of insulating material between both sets of contacts whilst the following test is carried out.

Disconnect the Zener Diode. To do this remove the white lead from the Diode centre terminal.

For this test, it is assumed that the wiring is fully connected as shown in the appropriate wiring diagram. With the aid of a D.C. voltmeter and 2 test-prods (Voltmeter 0–15 volts) make a point to check along the low tension circuit starting at the battery and working right through to the ignition coils, stage by stage, in the following manner, referring to the wiring diagram.

(1) First, establish that the battery is earthed correctly by connecting the volt meter across the battery negative terminal and the machine frame earth. No voltage reading indicates that the red earthing lead is faulty (or the fuse has blown, in —ve lead). Also, a low reading would indicate a poor battery earth connection.

(2) Connect the voltmeter between the left ignition coil SW terminal and earth and then the right ignition coil SW terminal and earth. No voltage reading indicates a breakdown between the battery and the coil SW terminal, or that the switch connections or ammeter connections are faulty.

(3) Connect the voltmeter between both of the ammeter terminals in turn and earth. No reading on the "feed" side indicates that either the ammeter is faulty or there is a bad connection along the brown and blue lead from the battery, and a reading on the "battery" side only indicates a faulty ammeter.

(4) Connect the voltmeter between ignition switch input terminal and earth. No reading indicates that the brown and white lead has faulty connections. Check for voltage at the brown/white lead connections at rectifier and ammeter.

(5) Connect the voltmeter across ignition switch output terminal and earth. No reading indicates that the ignition switch is faulty and should be replaced. Battery voltage reading at this point but not at the ignition coil SW terminals indicates that the white lead has become "open circuit" or become disconnected.

(6) Disconnect the black/white, and black/yellow leads from the C.B. terminals of each ignition coil. Connect the voltmeter across the CB terminal of the left coil and earth and then the CB terminal of the right coil and earth. No reading on the voltmeter in either case indicates that the coilprimary winding is faulty and a replacement ignition coil should be fitted.

(7) With both sets of contacts open reconnect the ignition coil leads and then connect the voltmeter across both sets of contacts in turn. No reading in either case indicates that there is a faulty connection or the internal insulation has broken down in one of the capacitors.

If a capacitor is suspected then a substitution should be made and a re-test carried out.

(8) Finally, reconnect the Zener Diode white lead and then connect the volt meter between the Zener Diode centre terminal and earth (with ignition "ON"). The volt meter should read battery volts. If it does not the Zener Diode is faulty and a substitution should be made. Refer to Subsection 101 for the correct procedure for testing a Zener Diode on the machine. Ignition coil check procedure is given in Subsection 81.

81. Ignition Coils

The ignition coils consist of primary and secondary windings wound concentrically about a laminated soft iron core, the secondary winding being next to the core. The primary winding usually consists of some 300 turns of enamel covered wire and the secondary some 17,000–26,000 turns of much finer wire—also enamel covered. Each layer is paper insulated from the next in both primary and secondary windings.

To test the ignition coil on the machine, first ensure that the low tension circuit is in order as described in Subsection 79 then disconnect the high tension leads from the left and right sparking plugs. Turn the ignition switch to the "IGN" position and crank the engine until the contacts (those with the black/yellow lead from the ignition coil) for the right cylinder are closed. Flick the contact breaker lever open a number of times whilst the high tension lead from the right ignition coil is held about $\frac{3}{16}$ in. away from the cylinder head. If the ignition coil is in good condition a strong spark should be obtained. If no spark occurs this indicates the ignition coil to be faulty.

Repeat this test for the left high tension lead and coil by cranking the engine until the contacts with the black/white lead from the left ignition coil are closed.

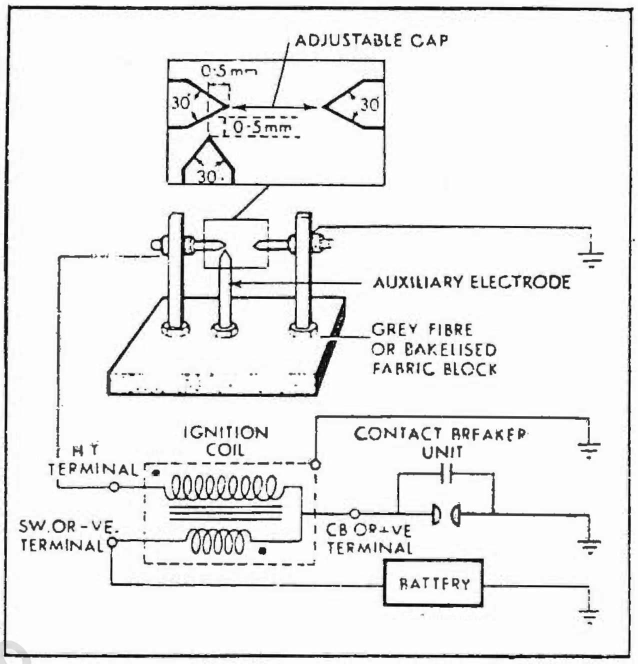
Before a fault can be attributed to an ignition coil it must be ascertained that the high tension cables are not cracked or showing signs of deterioration, as this may often be the cause of mis-firing etc. It should also be checked that the ignition points are actually making good electrical contact when closed and that the moving contact is insulated from earth (ground) when open. It is advisable to remove the ignition coils and test them by the method described below.

82. Bench Testing an Ignition Coil

Connect the ignition coil into the circuit shown in Fig. 25 and set the adjustable gap to 9 mm. for the MA12 Type and 8 mm. for the 17M12 Type.

With the contact breaker running at 600 r.p.m. for a single lobe cam and the coil in good condition, not more than 5% missing should occur at the spark gap over a period of 15 seconds. The primary winding can be checked for short-circuit coils by connecting an ohmeter across the low tension terminals. The reading obtained should be within the figures quoted below (at 20°C.)

Coil	Primary Resistance	
	Min.	Max.
MA12	3.0 ohms.	3.4 ohms.
17M12	3.3 ohms.	3.8 ohms.



IGNITION COIL TEST RIG
Fig. 25

83. Contact Breaker

Faults occurring at the contact breaker are in the main due to, incorrect adjustment of the contacts or the efficiency being impaired by piling, pitting or oxidation of the contacts due to oil etc. Therefore, always ensure that the points are clean and that the gap is adjusted to the correct working clearance.

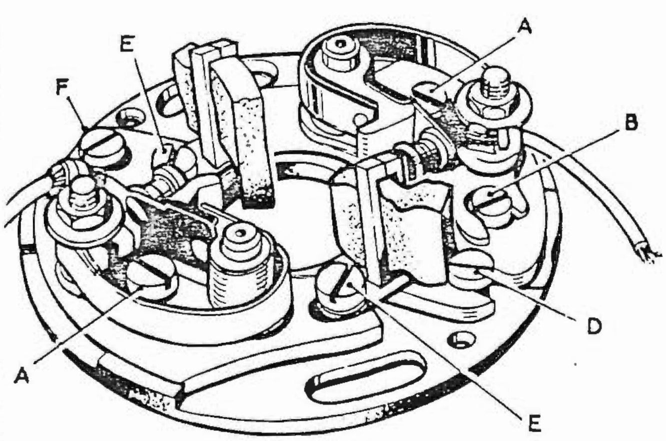
To test for a faulty capacitor, first turn the ignition switch to "IGN" position and then take voltage readings across each set of contacts with the contacts open. No reading indicates that the capacitor internal insulation has broken down. Should the fault be due to a capacitor having a reduction in capacity, indicated by excessive arcing when in use, and overheating of the contact faces, a check should be made by substitution.

Particular attention is called to the periodic lubrication procedure for the contact breaker. When lubricating the parts ensure that no oil or grease gets onto the contacts.

Note—Under no circumstances should the shaft and action plate and the cam shaft be lubricated.

If it is felt that the contacts require surface grinding then the complete contact breaker unit should be removed and the moving contacts disconnected by unscrewing the securing nuts from the capacitor terminals. Grinding is best achieved by using a fine carborundum stone or very fine emery cloth, afterwards wiping away any trace of dirt or metal dust with a clean petrol (gasoline) moistened cloth. The contact faces should be slightly domed to ensure point contact. There is no need to remove the pitting from the fixed contact. When re-fitting the moving contacts do not forget to refit the insulating shields to the capacitor terminals. Apply two drops of clean engine oil to the rear end of the C.B. cam. felt pads. Also apply a smear of grease to the moving contact pivot post.

Key
A—Cable Eyelet
B—Fixed Contact Securing Screw
C—Fixed Contact Eccentric Adjustment Screw
D—Angular Adjustment Plate Fixing Screw
E—Angular Adjustment Plate Eccentric Screw



CONTACT BREAKER—TYPE 6CA
Fig. 26

84. Checking the High Tension Circuit

If ignition failure or mis-firing occurs, and the fault is not in the low tension circuit, then check the ignition coils as described in Subsection 81. If the coils prove satisfactory, ensure that the high tension cables are not the cause of the fault.

If a good spark is available at the high tension cable, then the sparking plug suppressor cap or the sparking plug itself may be the cause of the fault. Clean the sparking plug and adjust the electrodes to the required setting, and then re-test the engine for running performance. If the fault recurs then it is likely the suppressor caps are faulty and these should be renewed.

CAPACITOR IGNITION (MODEL 2MC)

85. General

The Lucas motor cycle capacitor system has been developed to enable machines to be run with or without a battery. The rider therefore has the choice of running with normal battery operation or running without battery if desired (e.g. competing in trials or other competitive events) and for emergency operation in case of battery failure.

Machines can readily be started without the battery and run as normal with full use of standard lighting. When stationary, however, parking lights will not work unless the battery is connected. The capacitor system also has the advantage of being much less critical with regard to alternator timing.

The system utilises the standard 12 volt battery-coil ignition equipment with the Zener diode charging regulator mounted on an efficient heat sink, plus a spring mounted high capacity electrolytic capacitor (Model 2MC), of a special shock-resistant type.

The energy pulses from the alternator are stored by the capacitor to ensure that sufficient current flows through the ignition coil at the moment of contact opening, thus producing an adequate spark for starting. When running, the capacitor also helps to reduce the D.C. voltage ripple.

Also with this system alternator timing is much less critical. Provided the centres of the rotor and stator poles are roughly in line in the fully retarded position satisfactory starting will be obtained. Furthermore any auto-advance angle and speed characteristics may be used and perfect running ignition performance achieved.

86. Identification of Capacitor Terminals

The 2MC capacitor is an electrolytic (polarised) type and care must be taken to see that the correct wiring connections are made when fitting. Spare Lucar connectors are supplied to assist in connecting up. Looking at the terminal end of the unit it will be seen that there are two sizes of Lucar connector. The small $\frac{3}{16}$ in. Lucar is the *positive* (earth) terminal the rivet of which is marked with a spot of red paint. The double $\frac{1}{4}$ in. Lucar forms the *negative* terminal.

CAPACITOR AND SPRING
Fig. 27

The illustration shows the spring and capacitor. The capacitor should be positioned with its terminals pointing downwards. When fitting the spring to the capacitor, insert the capacitor at the widest end of the spring and push it down until the small coil locates in the groove on the capacitor body.

87. Storage Life of Model 2MC Capacitor

The life of the 2MC is very much affected by storage in high temperatures. The higher the temperature the shorter its shelf life. At normal temperature i.e. 20°C. (68°F.) it will have a shelf life of about 18 months. At 40°C. (86°F.) about 9 to 12 months. Therefore, storing in a cool place will maintain their efficiency.

88. Testing

The efficiency of a stored capacitor can be determined fairly accurately with the aid of a voltmeter (scale 0–12 volts) connected to the terminals of a charged capacitor and the instantaneous reading on the meter noted. The procedure is as follows:—

(1) Connect the capacitor to a 12 volt supply and leave connected for 5 *minutes*. Observe carefully the polarity of connections, otherwise the capacitor may be ruined.

(2) When charging time has been completed, disconnect the supply leads and allow the charged capacitor to stand for at least 5 *minutes*.

(3) Then connect the voltmeter leads to the capacitor and note the instantaneous reading. This should not be less than 8.0 volts for a serviceable unit.

If a voltmeter is not available a rough check can be made by following the procedures in (1) and (2) and using a single strand of copper wire instead of the voltmeter to short-circuit the capacitor terminals. A good spark will be obtained from a serviceable capacitor at the instant the terminals are shorted together.

89. Wiring and Installation

The capacitor is fitted into the spring and is mounted with its terminals downwards. The capacitor negative terminal *and* Zener diode is connected to the rectifier centre (D.C.) terminal (brown/white), and the positive terminal must be connected to the centre bolt earthing terminal (see capacitor ignition terminal on diagram).

90. Service Notes

Before running a 2MC equipped machine with the battery disconnected it is essential that the *battery negative lead be insulated* to prevent it from re-connecting and shorting to earth (frame of machine). Otherwise, the capacitor will be ruined. This can be done by removing the fuse from its holder and replacing it with a length of $\frac{1}{4}$ in. dia. dowel rod or other insulating medium.

A faulty capacitor may not be apparent when used with a battery system. To prevent any inconvenience arising, periodically check that the capacitor is serviceable by disconnecting the battery to see if the machine will continue to run in the normal manner, with full lighting also available.

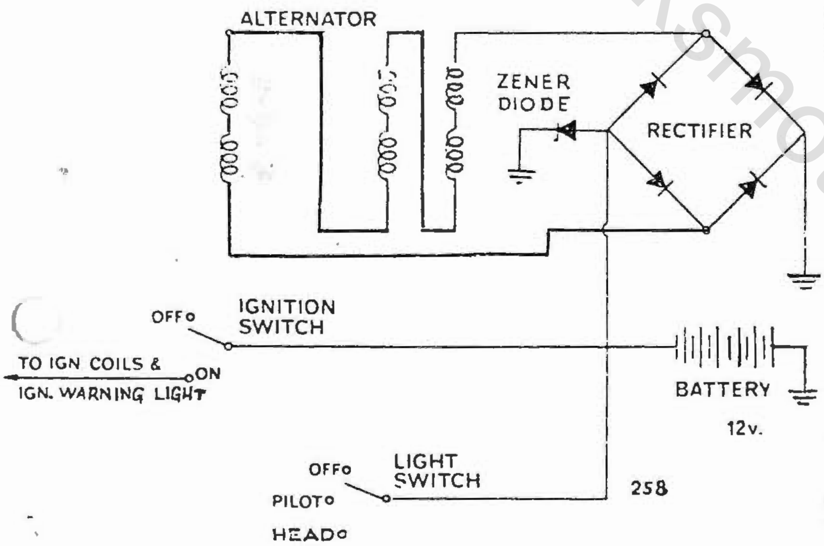
CHARGING SYSTEM

91. Description

The charging current is supplied by the two lead alternator, but due to the characteristics of alternating current the battery cannot be charged direct from the alternator. To convert the alternating current to direct current a full wave bridge rectifier is connected into the circuit. The alternator gives full output, all the alternator coils being permanently connected across the rectifier.

Excessive charge is absorbed by the Zener Diode which is connected across the battery. Always ensure that the ignition switch is in the "OFF" position whilst the machine is not in use, to prevent overheating of the ignition coils, and discharging the battery.

To locate a fault in the charging circuit, first test the alternator as described in Subsection 93. If the alternator is satisfactory, the fault must lie in the charging circuit, hence the rectifier must be checked as given in Subsection 94 and then the wiring and connections as shown in Subsection 97.



SCHEMATIC DIAGRAM OF 12 VOLT CHARGING CIRCUIT WITH SINGLE CHARGE RATE, ZENER DIODES

Fig. 28

92. Checking the D.C. Input to Battery

For this test the battery must be in good condition and a good state of charge, therefore before conducting the test ensure that the battery is up to the required standard, or alternatively fit a good replacement battery.

Disconnect the Zener Diode battery connection.

Connect D.C. ammeter (0–15 amp.) in series between the battery main lead (brown/blue) and battery negative terminal and then start the engine and run it at approximately 3,000 r.p.m.

Note—Ensure that the ammeter is well insulated from the surrounding earth points otherwise a short circuit may occur.

With the Zener Diode disconnected the minimum reading on the ammeter should be 8 amperes.

Caution—Do not run machine for more than 15 seconds under these conditions.

Reduce engine speed and reconnect the Zener Diode. Increase engine speed to 3,000 r.p.m. and note reduction of input to the battery. No reduction of input to the battery will indicate faulty Zener Diode or associated wiring—see Zener Diode test, Subsection 101. If the reading is lower than quoted, then the alternator must be tested as described in Subsection 93 below.

93. Checking the Alternator Output

Disconnect the two alternator output cables coming from the engine and run the engine at 3,000 r.p.m.

Connect an A.C. voltmeter (0–15 volts) with 1 ohm load resistor in parallel with the two alternator leads. The minimum reading on the voltmeter should be 9 volts.

A suitable 1 ohm load resistor can be made from a piece of nichrome wire as shown in Subsection 98.

From the results obtained, the following deductions can be made:—

(1) If the reading is equal to or higher than quoted then the alternator is satisfactory.

(2) A low reading indicates that some turns of the coils are short circuited, or that the rotor has become partially demagnetised. If the latter case applies, check that this has not been caused by a faulty rectifier or that the battery is of incorrect polarity, and only then fit a new rotor.

(3) A zero reading indicates that a coil has become disconnected, is open circuit, or is earthed.

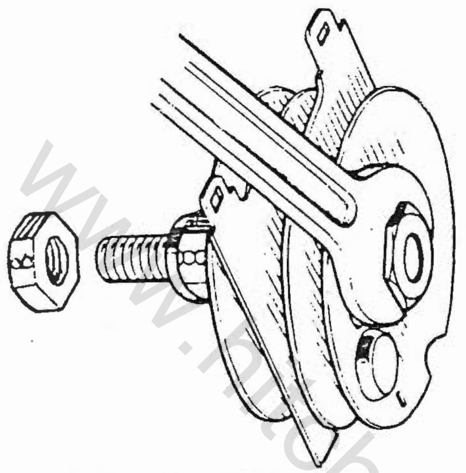
(4) A reading obtained between any one lead and earth indicates that coil windings or connections have become earthed.

94. Rectifier Maintenance and Testing

The silicon bridge rectifier requires no maintenance beyond checking that the connections are clean and tight, and that the nut securing the rectifier to the frame is tight. It should always be kept clean and dry to ensure good cooling, and spilt oil washed off immediately with hot water.

Note—The nuts clamping the rectifier plates together must not be disturbed or slackened in any way.

When tightening the rectifier securing nut, hold the spanners as shown in Fig. 29, for if the plates are twisted, the internal connections will be broken. Note that the circles marked on the fixing bolt and nut indicate that the thread form is $\frac{1}{4}$ in. U.N.F.



REFITTING THE RECTIFIER
Fig. 29

95. Testing the Rectifier

For test purposes disregard the end earth (ground) terminal.

To test the rectifier, first disconnect the brown/white lead from the rectifier centre terminal and insulate the end of the lead to prevent any possibility of a short circuit occurring, and then connect a D.C. voltmeter (with 1 ohm load resistor in parallel) between the rectifier centre terminal and earth.

Note—Voltmeter positive terminal to frame earth (ground) and negative terminal to centre terminal on rectifier.

With the engine running at approximately 3,000 r.p.m. observe the voltmeter reading. The reading obtained should be at least 7.5V minimum.

(1) If the reading is equal to or slightly greater than that quoted, then the rectifier elements in the forward direction are satisfactory.

(2) If the reading is excessively higher than the figures given, then check the rectifier earthing bolt connection. If the connection is good then a replacement rectifier should be fitted.

(3) If the reading is lower than the figure quoted or zero readings are obtained, then the rectifier or the charging circuit wiring is faulty and the rectifier should be disconnected and bench tested so that the fault can be located.

Note that all of the above conclusions assume that the alternator A.C. output figures were satisfactory. Any fault at the alternator will, of course, reflect on the rectifier test results. Similarly any fault in the charging circuit wiring may indicate that the rectifier is faulty. The best method of locating a fault is to disconnect the rectifier and bench-test it as shown below:

96. Bench Testing the Rectifier

For this test the rectifier should be disconnected and removed. Before removing the rectifier, disconnect the leads from the battery terminals to avoid the possibility of a short circuit occurring.

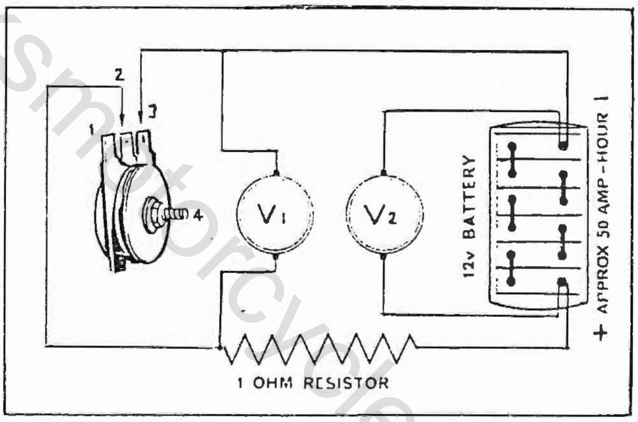
Connect the rectifier to a 12 volt battery and 1 ohm load resistor, and then connect the D.C. voltmeter in the V2 position, as shown in Fig. 30. Note the battery voltage (should be 12V) and then connect the voltmeter in V1 position whilst the following tests are conducted.

A voltmeter in position V1 will measure the volt drop across the rectifier plate. In position V2 it will measure the supply voltage to check that it is the recommended 12 volts on load.

Test 1. With the test leads, make the following connectings but keep the testing time as short as possible to avoid overheating the rectifier cell: (a) 1 and 2, (b) 1 and 4, (c) 3 and 4, (d) 3 and 2. Each reading should not be greater than 2.5 volts with the battery polarity as shown.

Test 2. Reverse the leads or battery polarity and repeat Test 1. The readings obtained should not be more than 1.5 volts below battery voltage (V2) (i.e. 10.5 volts minimum).

If the readings obtained are not within the figures given, then the rectifier internal connections are shorting or aged and the rectifier should be renewed.



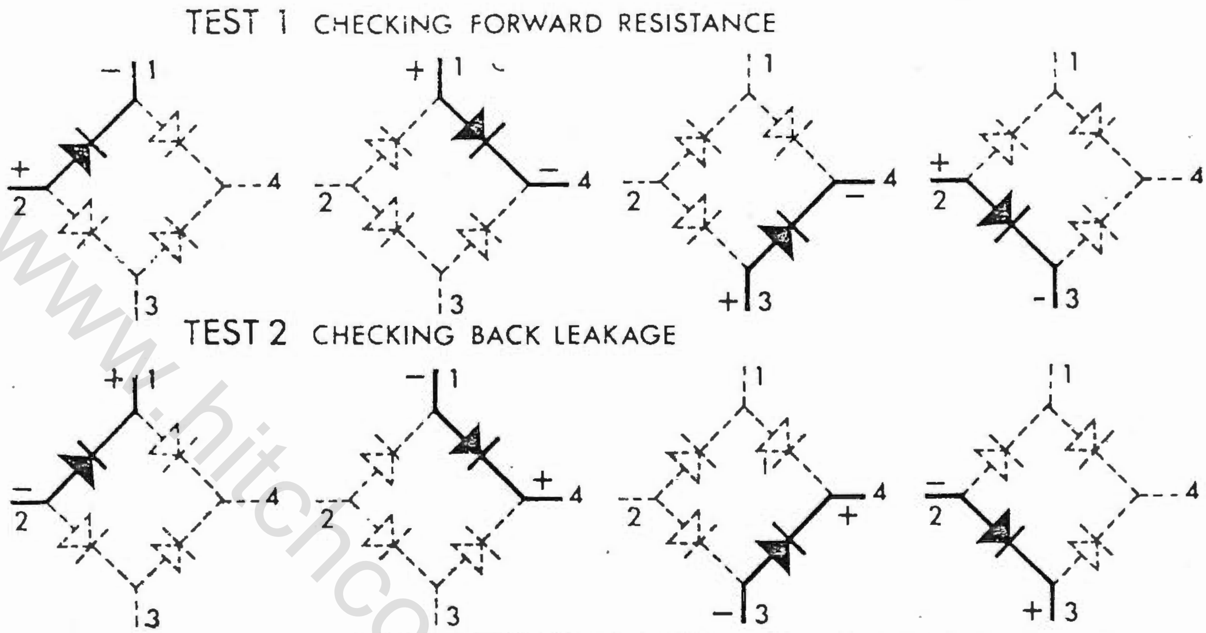
BENCH TESTING THE RECTIFIER
Fig. 30

97. Checking the Charging Circuit for Continuity

First check that there is voltage at the battery and that it is correctly connected into the circuit +ve earth (ground). Ensure that the fuse has not blown in the negative line.

(1) First, check that there is voltage at the rectifier centre terminal by connecting a D.C. voltmeter, with 1 ohm load resistor in parallel, between the rectifier centre terminal (not the end terminal on latest rectifiers) and earth (remember (+ve) positive earth (ground)). The voltmeter should read battery volts. If it does not, disconnect the alternator leads (green/white and green/yellow) at the snap connectors.

(*a*) Fit a jumper lead across the brown/white and green/yellow connections at the rectifier, and check the voltage at the snap connector. This test will indicate whether the harness alternator lead is open circuit.



RECTIFIER TEST SEQUENCE FOR CHECKING FORWARD RESISTANCE AND BACK LEAKAGE
Fig. 31

(*b*) Repeat this test at the rectifier for the white/green lead.

(2) If no voltage is present at the rectifier central terminal (brown/white), check the voltage at the ammeter terminal. If satisfactory, it indicates that the brown/white wire is open circuit. If not, the ammeter is open circuit.

(3) If no voltage is present at either ammeter terminal, then the brown/blue wire from the battery (—ve) is open circuit, or the fuse has blown.

98. Constructing a One-ohm Load Resistor

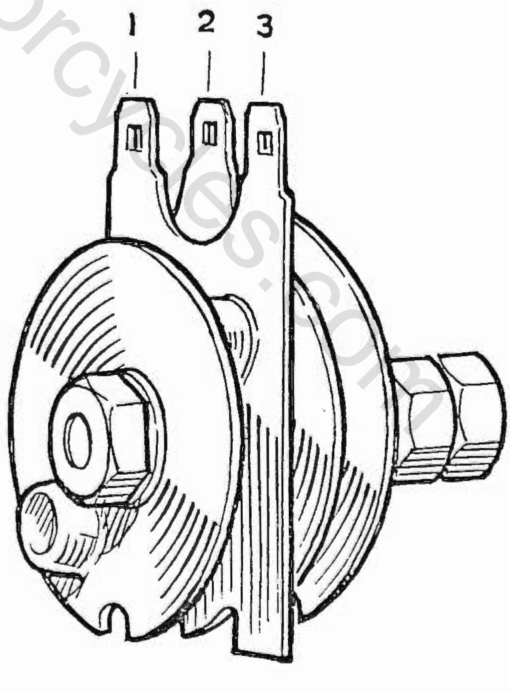
The resistor used in the following tests must be accurate and constructed so that it will not overheat otherwise the correct values of current or voltage will not be obtained.

A suitable resistor can be made from 4 yards ($3\frac{3}{4}$ metres) of 18 S.W.G. (.048 in. (i.e. 1.2 m.m.) dia.) NICHROME wire by bending it into two equal parts and calibrating it as follows:—

(1) Fix a heavy gauge flexible lead to the folded end of the wire and connect this lead to the positive terminal of a 6 volt battery.

(2) Connect a D.C. voltmeter (0–10V) across the battery terminals and an ammeter (0–10 amp) between the battery negative terminal and the free ends of the wire resistance, using a crocodile clip to make the connection.

(3) Move the clip along the wires, making contact with both wires until the ammeter reading is numerically equal to the number of volts shown in the voltmeter. The resistance is then 1 ohm. Cut the wire at this point, twist the two ends together and wind the wire on an asbestos former approximately 2 inches (5 cm.) dia. so that each turn does not contact the one next to it.



RECTIFIER—SHOWING TERMINAL CONNECTIONS FOR BENCH TESTS 1 AND 2
Fig. 32

ZENER DIODE

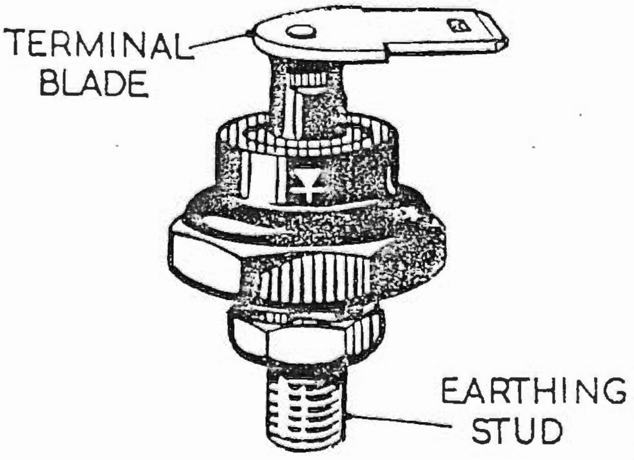
99. Description

The Zener Diode output regulating system uses all the coils of the 6-coil alternator connected permanently across the rectifier, provides automatic control of the charging current. It will only operate successfully on a 12 volt system where it is connected in parallel with the battery as shown in the wiring diagram. The Diode may be connected through the ignition switch or direct to the centre terminal of the rectifier.

Assuming the battery is in a low state of charge its terminal voltage (the same voltage is across the Diode) will also be low, therefore the maximum charging current will flow into the battery from the alternator. At first none of the current is by-passed by the Diode because of it being non-conducting due to the low battery terminal volts. However, as the battery is quickly restored to a full state of charge, the system voltage rises until at 13.5 volts the Zener Diode becomes partially conducting, thereby providing an alternative path for a small part of the charging current. Small increases in battery voltage result in large increases in Zener conductivity until, at approximately 15 volts about 5 amperes of the alternator output is by-passing the battery. The battery will continue to receive only a portion of the alternator output as long as the system voltage is relatively high.

Depression of the system voltage, due to the use of headlamp or other lighting equipment, causes the Zener Diode current to decrease and the balance to be diverted and consumed by the component in use.

If the electrical loading is sufficient to cause the system voltage to fall to 13.5 volts, the Zener Diode will revert to a high resistance state of non-conductivity and the full generated output will go to meet the demands of the battery.



ZENER DIODE
Fig. 33

100. Maintenance

The Zener Diode is mounted on an aluminium heat sink. Providing the Diode and the heat sink are kept clean, and provided with an adequate airflow, to ensure maximum efficiency, and provided a firm flat "metal to metal" contact is maintained between the base of the Diode and the surface of the heat sink, to ensure adequate heat flow, no maintenance will be necessary.

101. Test Procedure

(Procedure for testing on the Machine)

The test procedure given below can be used when it is required to check the performance of the Zener Diode type ZD715 whilst it is in position on the machine.

Good quality moving coil meters should be used when testing. The voltmeter should have a scale 0–18, and the ammeter 0–5 amps min. The test procedure is as follows:—

(1) Disconnect the cable from the Zener Diode and connect ammeter (in series) between the Diode Lucar terminal and cable previously disconnected. The ammeter red or positive lead must connect to the Diode Lucar terminal.

(2) Connect voltmeter across Zener Diode and heat sink. The red or positive lead must connect to the heat sink which is earthed to the frame of the machine by its fixing bolts and a separate earth lead. The black lead connects to the Zener Lucar terminal.

(3) Start the engine, ensure that all lights are off, and gradually increase engine speed while at the same time observing both meters:—

(*a*) the series connected ammeter must indicate zero amps, up to 12.75 volts, which will be indicated on the shunt connected voltmeter as engine speed is slowly increased.

(*b*) increase engine speed still further, until Zener current indicated on ammeter is 2.0 amp. At this value the Zener voltage should be 13.5 volts to 15.3 volts.

TEST CONCLUSIONS:—

If the ammeter in test (*a*) registers any current at all before the voltmeter indicates 13.0 volts, then a replacement Zener Diode must be fitted.

If test (*a*) is satisfactory but in test (*b*) a higher voltage than that stated is registered on the voltmeter, before the ammeter indicates 2.0 amp., then a replacement Zener Diode must be fitted.

102. Zener Diode Location

The Zener Diode is mounted in front of the right hand rear suspension unit. The aluminium heat sink is finned to assist cooling and is secured to the frame by a bracket and bolt. See Fig. 37.

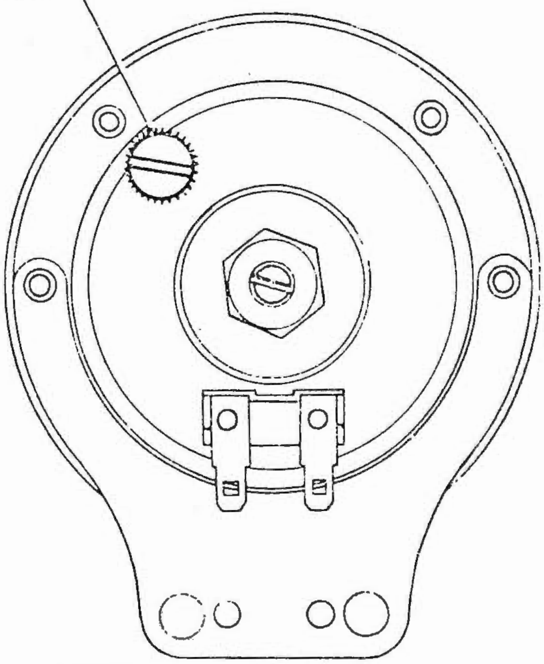
To remove Diode only, disconnect the brown/white double "Lucar" connector from the Diode. Unscrew the nut which secures the Diode (see Fig. 33). When refitting, the Diode nut must be tightened with extreme care. The correct torque is 24–28 lbs. in. To remove the finned heat sink, remove the front bolt from the retaining bracket. A double red earth (ground) wire is attached at this point.
NOTE—The earth wire must NOT be placed between the Zener body and heat sink as this could cause a heat build up possibly resulting in a Zener Diode failure.

HORN

103. Description
The 6H horn is of a high frequency single note type and is operated by direct current from the battery. The method of operation is that of a magnetically operated armature, which impacts on the cone face, and causes the tone disc of the horn to vibrate. The magnetic circuit is made self interrupting by contacts which can be adjusted externally.

If the horn fails to work, check the mounting bolts etc., and horn connection wiring. Check the battery for state of charge. A low supply voltage at the horn will adversely effect horn performance. If the above checks are made, and the fault is not remedied, then adjust the horn as follows.

104. Horn Adjustment
When adjusting and testing the horn, do not depress the horn push for more than a fraction of a second or the circuit wiring may be overloaded.



HORN ADJUSTMENT SCREW
Fig. 34

A small serrated adjustment screw situated near the terminals (see Fig. 34), is provided to take up wear in the internal moving parts of the horn. To adjust, turn this crew anticlockwise until the horn just fails to sound, and then turn it back (clockwise) about one quarter to half a turn.

LAMP UNITS

105. Description
The headlamp is of sealed beam unit type and access is gained to the bulb and bulb holder by withdrawing the rim and beam unit assembly. To do so slacken the screw at the top of the headlamp and prise off the rim and beam unit assembly.

The bulb can be removed by first pressing the cylindrical cap inwards and turning it anticlockwise. The cap can then be withdrawn and the bulb is free to be removed.

When fitting a new bulb, note that it locates by means of a cutaway and projection arrangement. Also note that the cap can only be replaced one way, the tabs being staggered to prevent incorrect reassembly. Check the replacement bulb voltage and wattage specification and type before fitting. Focusing with this type of beam unit is unnecessary and there is no provision for such.

106. Beam Adjustments
The beam must in all cases be adjusted as specified by local lighting regulations. In the United Kingdom the Transport Lighting Regulations reads as follows:—

A lighting system must be arranged so that it can give a light which is incapable of dazzling any person standing on the same horizontal plane as the vehicle at a greater distance than twenty-five feet from the lamp, whose eye level is not less than three feet-six inches above that plane.

The headlamp must therefore be set so that the main beam is directed straight ahead and parallel with the road when the motor cycle is fully loaded. To achieve this, place the machine on a level road pointing towards a wall at a distance of twenty-five feet away with a rider and passenger. on the machine, slacken the two pivot bolts at either side of the headlamp and tilt the headlamp until the beam is focused at approximately two feet six inches from the base of the wall. Do not forget that the headlamp should be on "full beam" lighting during this operation.

107. Removing and Refitting the Headlamp

Disconnect the leads from the battery terminals then slacken the light unit securing screw at the top of the headlamp. Prise the top of the light unit free.

Detach the pilot bulbholder from the light unit and disconnect the main bulbholder leads at the snap connector. Disconnect the 4 spade terminals from the lighting switch and the terminals from the ammeter. The red leads for the warning lights should be parted at the snap connectors and then the harness complete with warning light bulbholders can be withdrawn with the grommet from the back of the headlamp shell. Finally remove the pivot bolts to release the shell and collect the spacers.

Refitting is the reversal of the above instruction but reference should be made to the wiring diagram. Finally, set the headlamp main beam as explained previously.

Do not tighten the headlamp pivot bolts over the torque setting of 10 lb. ft. (1.4 kg.M).

108. General

Access to the bulbs in the tail and stop lamp unit is achieved by unscrewing the two slotted screws which secure the lens. The bulb is of the double-filament offset pin type and when a replacement is carried out, ensure that the bulb is fitted correctly.

Check that the two supply leads are connected correctly and check the earth (ground) lead to the bulb holder is in satisfactory condition.

When refitting the lens, do not overtighten the fixing screws or the lens may fracture as a result.

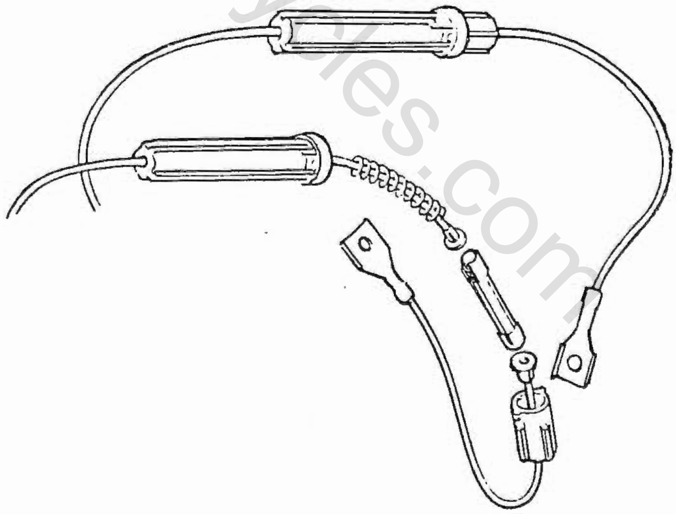
Fuses

109. Description

The fuse is to be found on the brown/blue live lead from the battery negative terminal. It is housed in a quickly detachable shell and is of 35 amp fuse rating.

Before following any fault location procedure always check that the fuse is not the source of the fault. A new fuse-cartridge should be fitted if there is any doubt about the old one.

The fuse rating must not under any circumstances be below 35 amp rating.



EXPLODED VIEW OF FUSEHOLDER ASSEMBLY
Fig. 35

IGNITION AND HEADLAMP SWITCHES AND WARNING LIGHTS

110. Description

The ignition switch incorporates a "barrel" type lock, having individual "Yale" type keys rendering the ignition circuit inoperative when the switch is turned off and the key removed. It is advisable for the owner to note the number stamped on the key to ensure a correct replacement in the event of the key being lost.

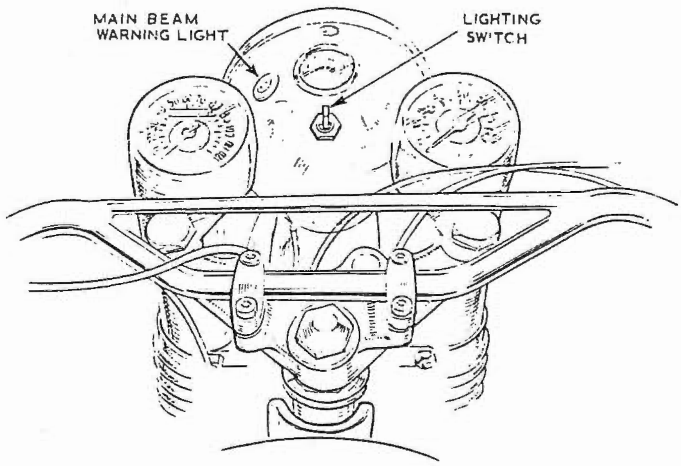
Three Lucar connectors are incorporated in the switch and these should be checked from time to time to ensure good electrical contact. The switch body can be released from the switch panel by removing the large retaining nut and pushing the switch out. The battery leads should be removed before attempting to remove the switch to avoid a short circuit.

The lock is retained in the body of the switch by a spring loaded plunger. This can be depressed with a pointed instrument through a small hole in the side of the switch body and the lock assembly withdrawn after the lock and switch together have been detached from the machine.

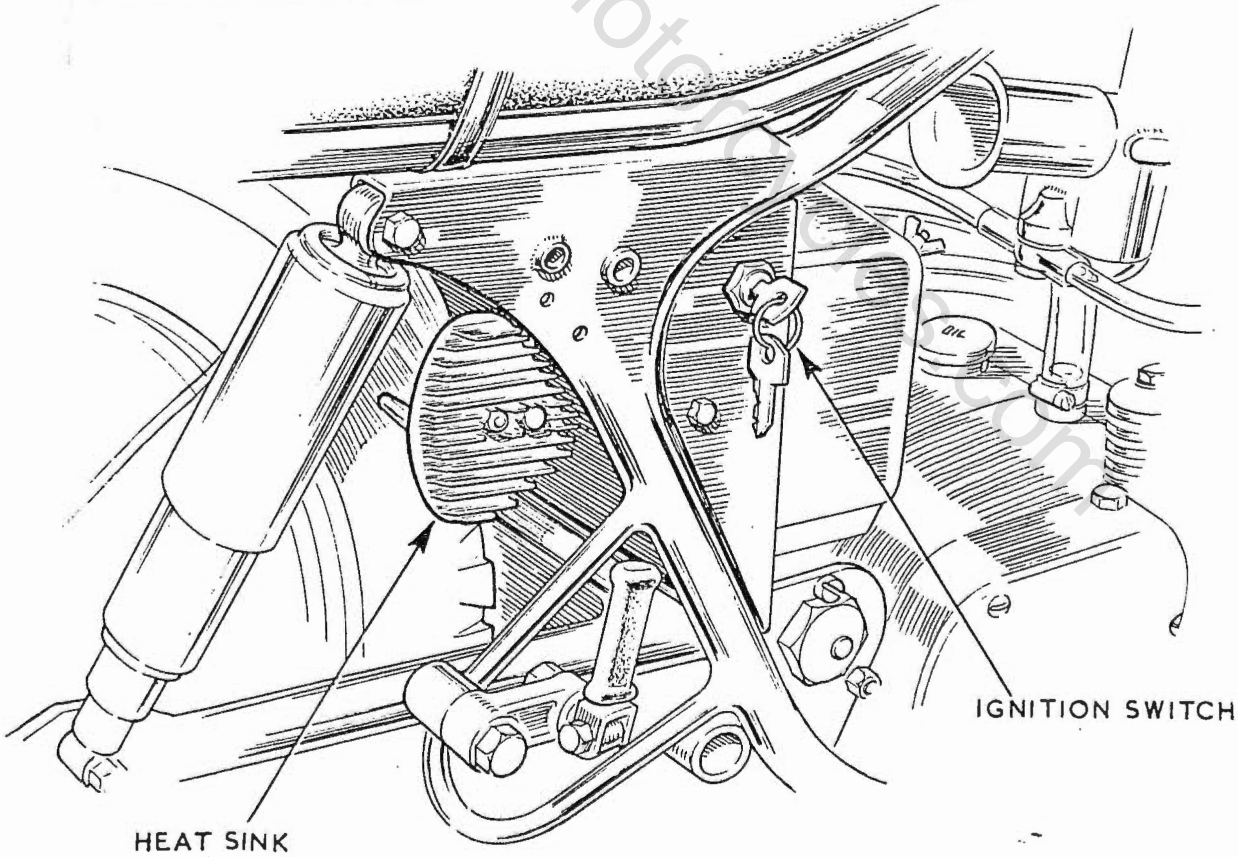
111. General

A headlamp main beam (red) warning light is incorporated in the headlamp shell.

Bulb replacement is simple and only requires extraction by normal hand pressure of the bulb adaptor from its location.



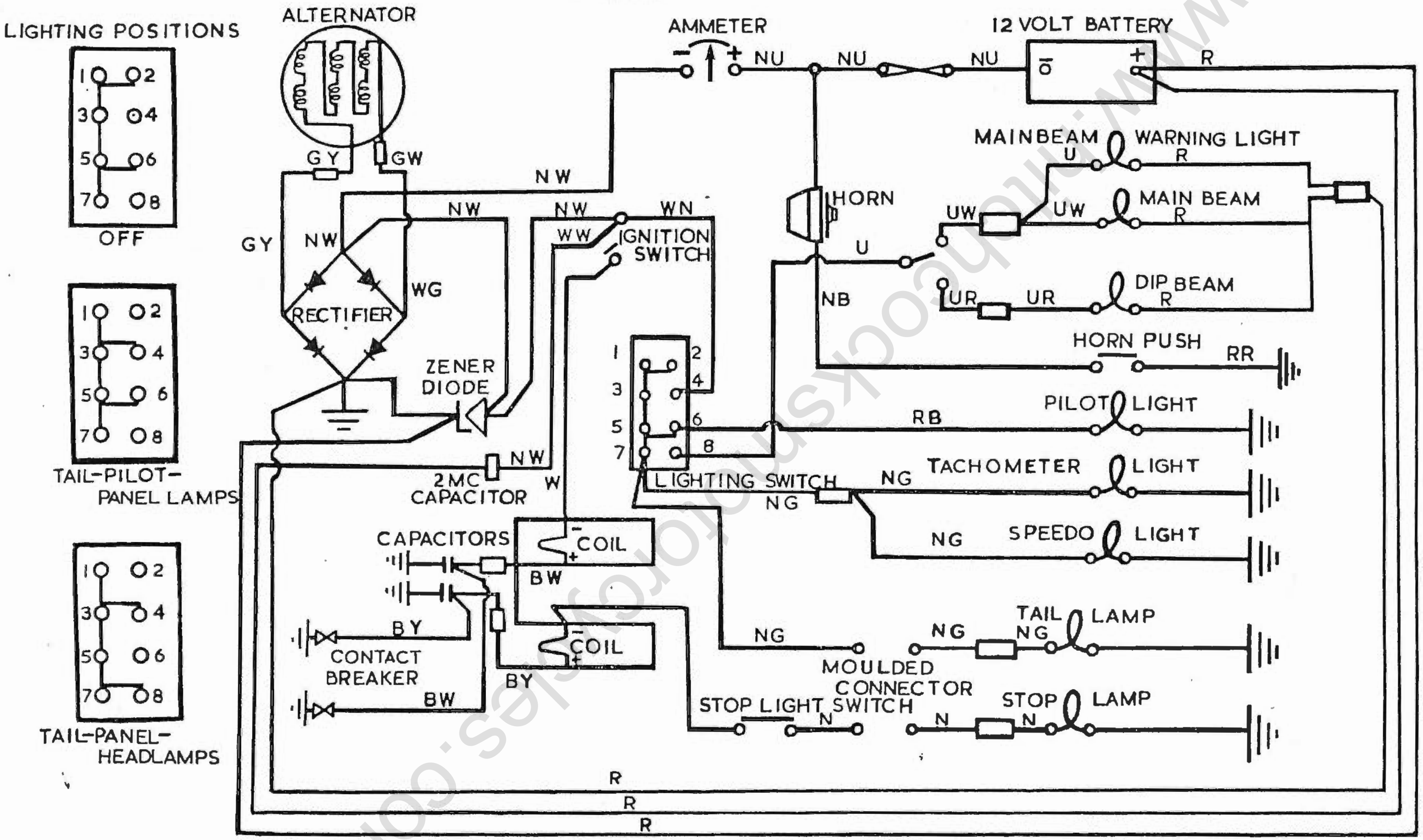
LOCATION OF MAIN BEAM WARNING
Fig. 36



SHOWING THE IGNITION SWITCH FINNED HEATSINK ZENER DIODE LOCATION
Fig. 37

CABLE COLOUR CODE

B	BLACK	K	PINK	Y	YELLOW
U	BLUE	P	PURPLE	D	DARK
N	BROWN	R	RED	L	LIGHT
G	GREEN	S	SLATE	M	MEDIUM
		W	WHITE		



2MC CAPACITOR IGNITION SYSTEM
Fig. 38

Frame

112. Description of Frame

The frame is built throughout of cold drawn weldless steel tubing with brazed or welded joints, liners being fitted where necessary for extra strength. All the main frame members are made of chrome-molybdenum alloy steel tubing which retains its strength and resistance to fatigue after brazing or welding.

The rear wheel is carried in a swinging arm unit which forms the chainstays.

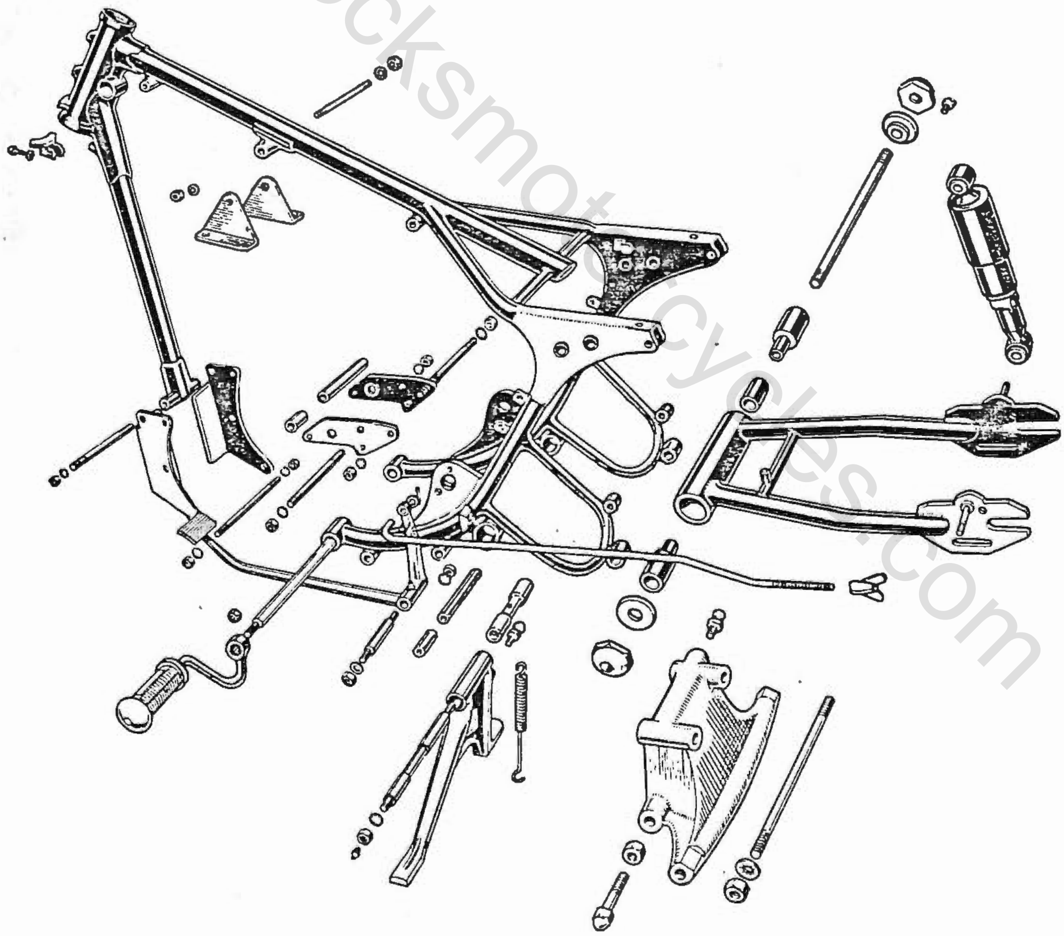
This unit pivots on pre-stressed rubber bushes with inner and outer metal sleeves. The inner sleeves are extended inwards and butt against a short distance piece fitted between them. The outer ends of the inner sleeves project beyond the ends of the rubber bushes and bear against steel thrust washers fitting into recesses in the main frame pivot lugs. A long steel bolt and nuts secure the whole assembly. No greasing is necessary.

113. Steering Head Races

The steering head races, 34085, are the same at the top and bottom of the head lug. They are easily removed by knocking them out with a hammer and drift and new races can be fitted either under a press or by means of a hammer and a wooden drift.

114. Removal of Rear Mudguard Assembly

With the machine on the centre stand, slacken off the two top rear suspension pivot nuts to free them from the recesses in the mudguard carrier plates. The mudguard assembly can now be lifted upwards and backwards sufficiently to gain access to the rear lamp wiring connectors. When these are disconnected and the breather tube straps undone the assembly is free to be removed leaving the breather tube in position in the main frame.



EXPLODED VIEW OF "INTERCEPTOR" FRAME
Fig. 39

When reassembling the unit make certain that the clips at the front of the carrier are located on the cross bar of the frame and that the carrier side plates are fully home on the suspension top pivot pins before tightening the nuts. Do not forget to re-connect the rear lamp wiring harness.

115. Removal of Rear Suspension Unit

Place the machine on the centre stand and remove the dual seat and rear mudguard. (See Subsection 114).

Remove the top pivot pin nut, drive out the pivot pin, then hinge the suspension unit back on the lower pivot pin. After removing the lower nut, the unit may be pushed off the pivot pin welded to the fork end.

116. Servicing Rear Suspension Units

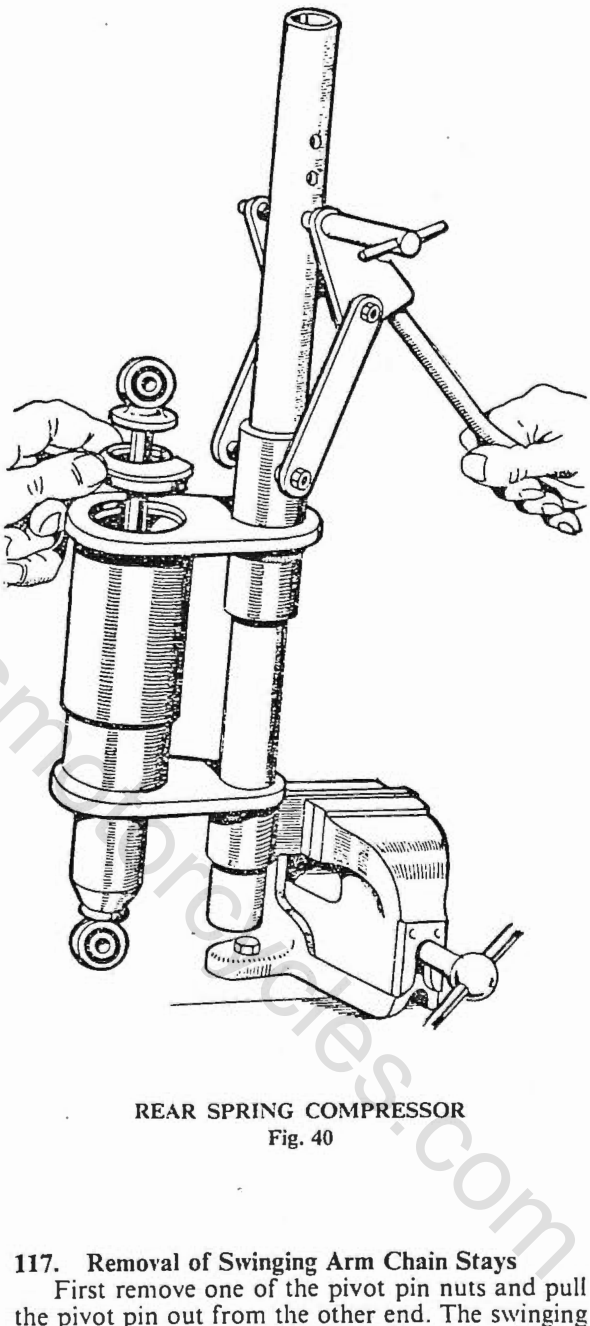
The proprietary units fitted are sealed and servicing of the internal mechanism can be carried out only by the manufacturers.

The rubber bushes in the top and bottom eyes can easily be renewed and the spring can be removed by pushing down on the top spring cover so as to release the split collar above it. After removal of the split collar the top cover and spring can be lifted off. When reassembling, the spring should be greased to prevent rust and squeaking if it should come into contact with either of the covers (when fitted).

The Girling dampers have only one spring but the pre-load can be varied by turning the bottom spring cup by means of a "C" spanner thus raising the rear of the machine and preventing bottoming on the bump stop under heavy loads. The lowest position is suitable for normal solo work, the middle position is for use with a pillion passenger and the top position is suitable for sidecar work. The part number for the spring for these dampers is 64539963, colour code red/orange, rating 132 lb./in.

When replacing a spring the use of a compressor, as shown in Fig. 00, is a great convenience. If one is not available, reduce the spring load as much as possible by setting the dampers to their lowest setting.

When the spring is removed it should be possible to push the plunger up and down *slowly* throughout the length of its stroke but it should resist *sudden* movements, particularly in the direction of the rebound. If it does not, or if there are signs of leakage of the hydraulic fluid, the complete damper unit should be exchanged for a service replacement. When making this test always hold the damper approximately upright so that the hydraulic fluid is at the lower end.



REAR SPRING COMPRESSOR
Fig. 40

117. Removal of Swinging Arm Chain Stays

First remove one of the pivot pin nuts and pull the pivot pin out from the other end. The swinging arm can now be withdrawn from between the pivot plates.

If it is necessary to replace or remove the rubber bushes a press capable of exerting a load of 10/12 tons will be necessary. Support one end of the pivot tube on a piece of tube with a bore just large enough to accept the outside diameter of the outer metal sleeve of the rubber bush ($1\frac{1}{16}$ in.). Press one bush into the pivot tube, thus pushing out the other bush and the distance piece between them.

Do this by means of a mandrel $1\frac{1}{32}$ in. diameter with one end stepped down to $\frac{31}{64}$ in. diameter to locate it in the inner sleeve of the bush.

Note—This procedure will normally scrap one or both the rubber bushes which should not be removed unnecessarily. When fitting replacement bushes do not forget the distance piece between them.

118. Centre Stand

To remove the centre stand unscrew the nut from one end of the stand spindle, knock out the latter and withdraw the stand complete with its bearing sleeve after disconnecting one end of the stand spring.

119. Wheel Alignment

Note that it is not possible to guarantee that the wheels are correctly aligned when the same notch position is used on both adjuster cams. It is therefore not sufficient to count the notches and use the same position on both sides of the machine. The only way to guarantee that the wheels are in line is to check the alignment from front wheel to back using either a straight edge or a piece of taut string. The alignment should be checked on both sides of the machine and if the front and rear tyres are of different section allowance must be made for this.

It is usual to check the alignment of the wheels at a point about six inches above the ground but, if the alignment is checked also towards the top of the wheels, it will be possible to ascertain whether or not the frame is twisted so as to cause one wheel to be leaning while the other is vertical. To do this it is always necessary to remove the mudguards and, unless a straight edge cut away in its centre portion is available, it will be necessary also to remove the cylinders, battery, etc., in order to allow an unbroken straight edge or a piece of taut string to contact the front and rear tyres.

120. Lubrication

The steering head races, and stand pivot bearing should be well greased on assembly. The stand pivot is provided with a grease nipple but no nipples are provided for the steering head as experience has shown that the provision of nipples at this point causes trouble through chafing and cutting of control and lighting cables. If the steering head bearings are well packed they will last for several years or many thousands of miles.

Recommended greases are Shell Retinax A, Castrolease LM, Esso Multipurpose Grease H, Marfak Multipurpose 2, Mobilgrease MP, or Energrease L2.

Front Forks

121. Lubrication

Use one of the grades of oil, S.A.E. 20 as shown in the table of lubricants. The normal oil content is 6$\frac{1}{3}$ fluid ozs. (170.4 cc.) Attention is only necessary at the first 1,000 miles and again at 10,000 miles when the oil should be changed by draining. An exploded drawing of the front forks is shown in Fig. 00 from which it will readily be seen that the fork springs abut against the filler plugs (34), before removing these plugs weight must be taken off the front wheel, by placing the machine on its central stand to avoid the forks collapsing.

122. To Drain the Forks

With the machine on the central stand: Unscrew the two filler plugs (34). Have available a container to catch oil drained, then remove the drain plug screw (7) with its washer, with the container under the fork leg. If the wheel is inclined to one side, draining will be more complete. Deal with the other fork leg in a similar manner.

123. Filling Oil

It will be seen the air space between the fork spring, and the inside of the tube is very close: therefore fresh oil must be filled with extreme care. to avoid losses by spilling. Use a measured container for the correct content of 6$\frac{1}{3}$ ozs. Replace the drain plugs before filling, also firmly tighten the filler plugs after.

124. Steering Head Adjustment

On a new machine the filler plugs (34) should be checked for tightness due to settling down, check as well the steering head bearings at the first 100 miles, and then occasionally, as the mileage increases. Using the machine with movement in these bearings will damage the races. Movement in these bearings can usually be detected when the front brake is applied. To check, raise the front wheel well clear of the ground with a box under the crankcase. Try to raise or lower the front wheel with one hand and use the fingers of the other hand encircling the handle bar lug where it meets the frame, when movement can be felt. To adjust bearings a thin open ended spanner $1\frac{3}{8}$ in. across the flats is needed. First release the tube clamping stud nut (28), unscrew the stem nut (37) slightly. Use the thin spanner on the sleeve nut (30) and manipulate as necessary. The bearing should be devoid of play with free movements. Retighten the column nut. also the clamping stud nuts.

The steering head bearing consists of two deep groove thrust races each containing 19 $\frac{1}{4}$ in. dia. balls. See Subsection 113 for removal of races from frame head lug. Use an old screwdriver, or taper wedge to take off the cone on the fork column.

125. Dismantling the Forks

The forks can be removed as a unit, or the fork legs can be removed individually. To take out one one fork leg remove the front wheel as described elsewhere. Take off the front mudguard with stays. Release nut for pinch bolt (28), and pull top end of rubber gaiter from cover tube. Remove filler cap plug (34), disconnect it from the damper rod, by using two spanners.

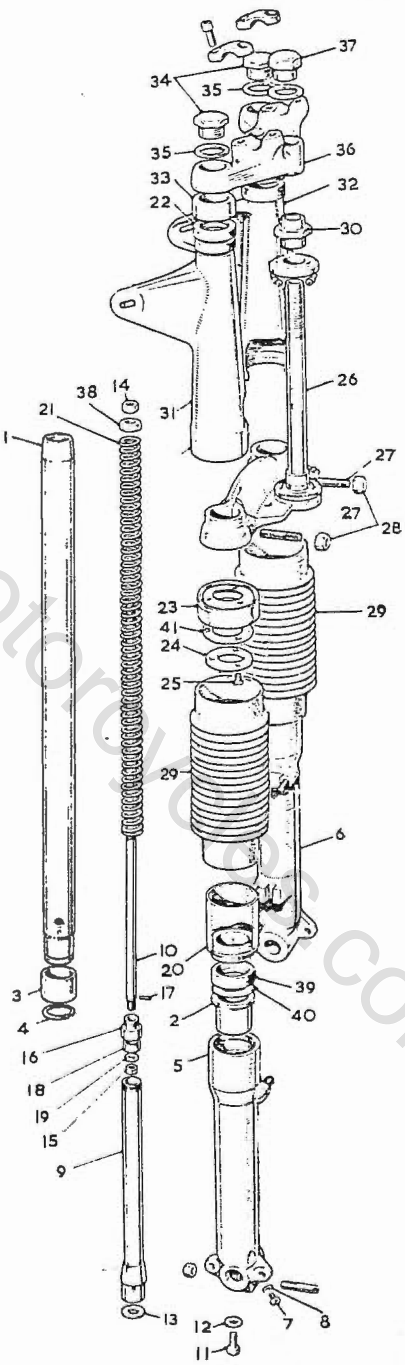
The fork inner tube can now be drawn downwards clear of the handlebar lug and fork crown. If the tube resists removal fit back the filler plug without being connected to the damper rod, screw in a few turns, then give it a few sharp blows with a soft faced mallet to separate the tube from its taper fixing in the handlebar lug.

Front Fork Assembly

1 Fork main tube.
2 Main tube bush.
3 Main tube bottom bush.
4 Main tube bottom bush circlip.
5 Fork end left hand.
6 Fork end right hand.
7 Fork end drain plug.
8 Washer for plug.
9 Oil damper tube.
10 Oil damper rod.
11 Oil damper tube bolt.
12 Washer for bolt.
13 Washer for tube.
14 Nut for rod top.
15 Nut for rod bottom.
16 Damper tube cap.
17 Piston locating peg.
18 Oil damper valve cup.
19 Oil damper valve cup slotted ring.
20 Main tube lock ring with cup.
21 Main spring.
22 Main spring locating bushes.
23 Spring cover tube.
24 Spring top cover tube securing plate.
25 Screws securing plate.
26 Crown lug complete with column.
27 Pinch stud for crown lug.
28 Nut for stud.
29 Rubber gaiter.
30 Fork head race adjuster nut.
31 Top cover left hand.
32 Top cover right hand.
33 Main tube top cover ring.
34 Fork main tube filler and retaining plug.
35 Washer for plug.
36 Fork head clip.
37 Fork crown and column lock nut.
38 Fork spring locating bush.
39 Main fork tube oil seal.
40 Main fork tube oil seal washer.
41 Bottom cover tube seal.

126. To Remove the Forks as a Unit

Follow the instructions given for removing a fork leg, as far as disconnecting the filler plugs from the damper rods. Proceed by taking off the headlamp leaving it suspended by the loom. Separate the control cables from the levers, and remove handlebars. Remove the column nut (37) then



FRONT FORKS
Fig. 41

give the underside of the handlebar lug one or two blows with a mallet until it is clear of the fork tubes. At this stage support the ends of the forks, for after removing the sleeve nut (30) the forks will drop out. Watch for the steel balls for the races, there are 19 in each race (38 in all), if a steering damper is fitted detach the fixed plate from the frame.

127. To Dismantle a Fork Slider

Remove from the fork slider the bolt fixing damper tube (11). Unscrew the bottom cover (23), and take away the fork slider (5).

The damper tube with the fork spring can be extracted from the tube. To dismantle further, take off nut securing fork spring, unscrew the damper tubecap (16) with a tommy bar through the holes in the damper tube, for if this is held in a vice it will distort and become useless. The damper assembly sequence is clearly depicted in Fig. 41.

Note—When removing the oil seal, sealing washer and flanged bush pass them along the fork tube and take off from the top end past the taper end, if the oil seal is to be used again.

128. Assembling the Forks

It will be apparent from the dismantling instructions given that there is nothing complicated in the fork assembly and if the reverse sequence is used, no difficulty should occur with the following precautions.

The fork tube, where the oil seal operates, must have a smooth finish and free from blemish.

The oil seal is fitted from the top of the tube, with the visible spring facing downwards against the flange for the bush.

The damper tube cap also the damper tube fixing bolt must be properly tightened.

Finally tighten the bottom cover (23) when the front wheel has been put back.

Fill 6½ ozs. of S.A.E. 20 oil to each fork leg.

Front Wheel

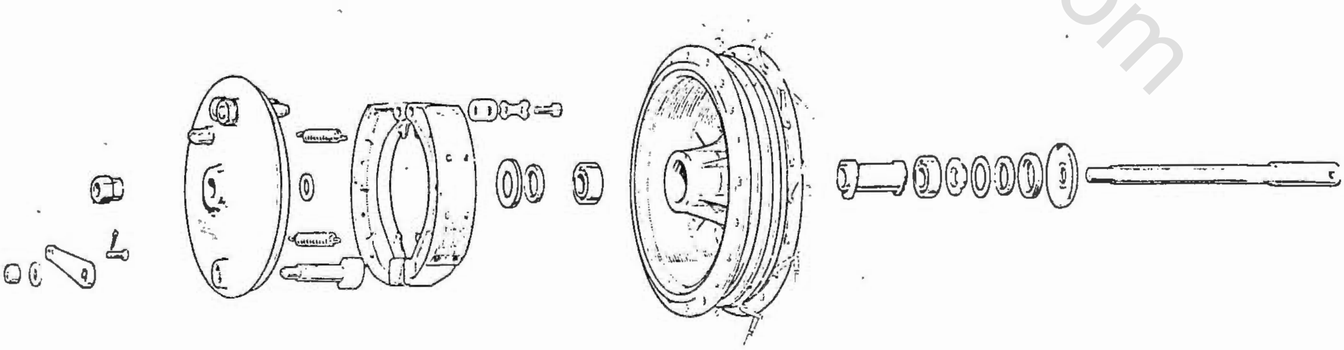
129. To Remove the Front Wheel

With the machine on the central stand: Detach the brake cable from the expander lever. Detach the brake cable adjuster from the brake plate. Detach the right hand spindle nut. Release the pinch stud in left fork slider end. Take the weight of the wheel by the left hand, pull out the wheel spindle. The wheel can be taken out of the forks.

130. To Refit the Wheel

Reverse the procedure described for removal, with the following precautions. Remove traces of rust from the spindle and grease. Exercise care to correctly locate brake plate in the fork slider. Do not tighten unduly the slider pinch bolt, overtightening can cause a fracture.

Note—If the fork motion is stiff after refitting the wheel, slack off the spindle nut and work the forks up and down (the fork tubes will take up alignment), then retighten the spindle nut.



FRONT HUB
Fig. 42

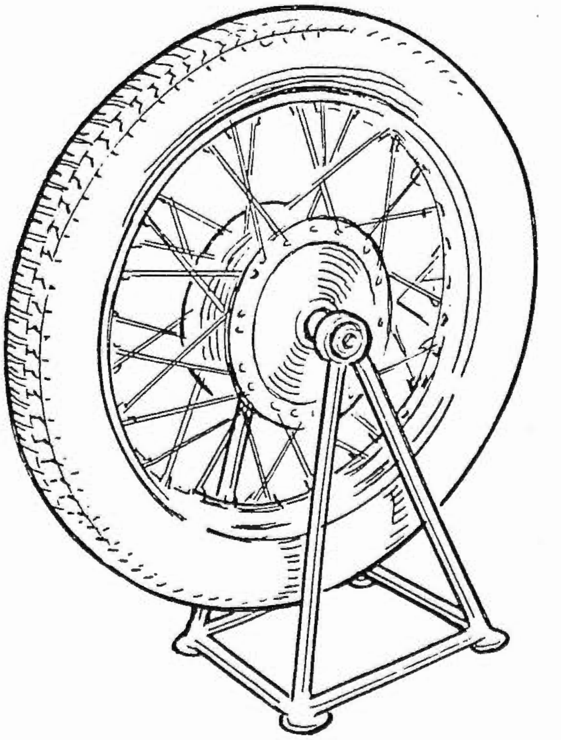
131. To Dismantle the Hub

The wheel hub is packed with grease during initial assembly, and should not need further lubrication for at least 10,000 miles when the hub should be dismantled for cleaning and fresh grease used. To dismantle the hub, with the wheel removed take away the brake plate with brake shoes.

Unscrew bearing lock plate on left side of hub, holes are provided for a peg spanner or use a punch. If the plate resists removal use a little heat which will facilitate removal, take out felt sealing washer and distance piece.

To eject the bearing use a drift through the brake side (the front wheel spindle can be used for this purpose) when a few light blows from a mallet will drive out the bearing until it is clear of the hub, and no more, as the other bearing goes into the hub during this process.

Take out the spindle, or drift, invert the wheel and repeat the process to eject the double bearing which will bring with it the large steel washer, the felt washer, also the thin steel washer.



BALANCING THE ROAD WHEELS
Fig. 43

132. Assembling the Hub

Clean and repack both bearings with fresh grease (see table of lubricants). Press into the left side of the hub the single bearing, fit the distance washer (flat side against the bearing), then the felt washer and secure with the lock plate.

Invert the hub, insert the distance tube (small end first) against the bearing.

Enter the double bearing square with the hub, use the drift through both bearings and drive home until the bearing abuts against the distance tube.

Fit the smallest of the two washers, the felt washer, then the large steel washer.

With a suitable punch peen the hub material, where it joins the washer in three equidistant positions to retain the washer.

133. Brake Adjustment

Clearance between the brake shoes and drum can be reduced by unscrewing the adjusters on the cable and handlebar lever. Continual adjustment causes the expander lever to occupy a position with lost leverage. To restore leverage, take off the cable and reverse the expander lever.

To improve brake efficiency, release the spindle nut a few turns, hold the brake hard on, retighten the spindle nut at the same time. The brake shoes will then centralise.

134. Brake Dismantling and Assembly

Remove brake plate from drum. Remove nut and washer from cam spindle. Remove cam lever.

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

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

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

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

135. Brake Re-assembly

Remove all traces of rust and dirt from the expander cam and pivot pins, apply a slight smear of grease. For ease in working the brake plate can be held in a smooth jaw vice, clamping it by the torque stop. Fit the brake shoes, tie plate and tab washer and set screws. If the tab washer has been used on more than one occasion discard it and use a new one. Fit the shoe springs, by anchoring the end farthest away from the operator, use a length of stout string in the free end of the spring, stretch the spring with one hand and guide the spring onto its anchorage with the other hand. Alternatively use a narrow blade screwdriver. Finally fit the expander lever with its nut and washer.

136. Balancing the Front Wheel

At high speeds, if the tyres are out of balance, the steering can be affected and in extreme cases the front forks can "flap" at maximum speed. As oil seals are used on the wheel spindle, the wheel cannot be accurately balanced until the friction caused by the seals is removed.
The courses open are:

(1) Remove the oil seals.

(2) Obtain two ball races with an internal diameter sufficiently large enough to take the wheel spindle, mount the wheel on two boxes as shown in Fig. 43.

If the wheel is correctly balanced, it should remain stationary in any position in which the wheel is placed. The most likely out of balance position will be where the valve is situated or where a security bolt is fitted. The heaviest part will of course come to rest at 180° or 6 o'clock. To counterbalance, use thin strips of lead twisted round the spoke. Special weights for this purpose are supplied by the tyre makers. When the wheel is in perfect balance, secure the strips of lead with insulating tape which should be painted with jointing compound. The effect of a balanced wheel has to be tried to be appreciated if continued high speeds are permissible.

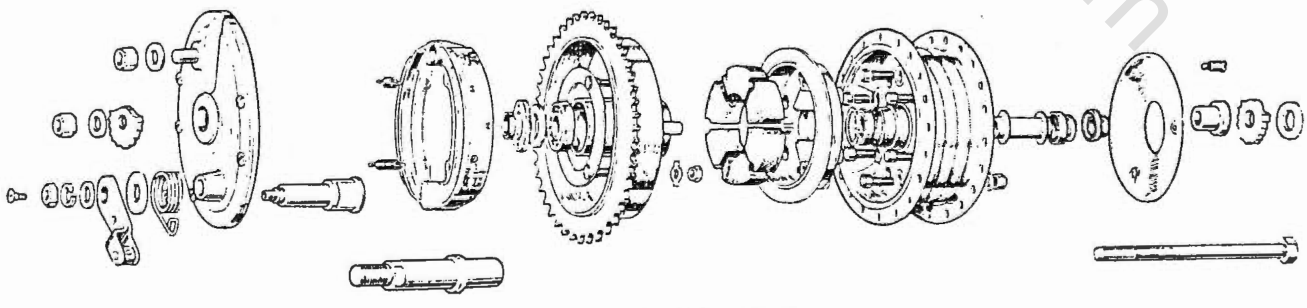
Rear Hub

137. Description

This wheel is of the "detachable" type, which enables the main portion of the wheel to be removed from the machine without disturbing the chain or brake. The wheel incorporates the well-known Enfield cush drive and also a 7 in. internal expanding brake.

138. Removal and Replacement of Main Portion of Wheel for Tyre Repairs, etc.

Place the machine on the centre stand, if necessary putting packing pieces beneath the legs of the stand to lift the wheel clear of the ground. Unscrew the loose section of the spindle and withdraw this, together with the chain adjuster cam, preferably marking it to ensure that it is replaced in the same position. Now slide the distance collar out of the fork end and lift away the speedometer drive gearbox, which can be left attached to the driving cable. The spacing collar and the felt washer behind it may now be removed to prevent risk of them falling out when manipulating the tyre. If, however, these are too tight a fit in the hub to come out easily they may be left in place. The main body of the wheel can



EXPLODED VIEW OF QUICKLY DETACHABLE REAR HUB
Fig. 44

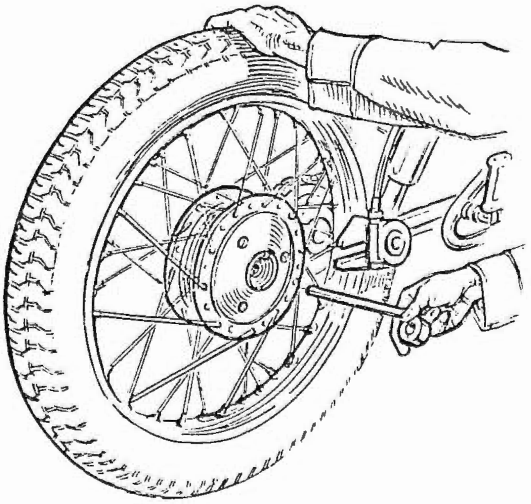
now be pulled across to the right-hand side of the machine, thus disengaging the six driving pins from the cush drive shell and enabling the wheel to be removed from the machine. (See Fig. 45).

When replacing the main portion of the wheel, reverse the foregoing procedure. The cush drive shell can be prevented from rotating when turning the wheel to engage the six driving pins, if the machine is placed in gear or the rear brake is operated, taking care, when replacing the speedometer drive gearbox, that the driving dogs inside the gearbox engage with the slots in the end of the hub barrel. Before tightening the centre spindle make sure that the speedometer drive gearbox is correctly positioned so that there is no sharp bend in the driving cable.

139. Removal and Replacement of Complete Wheel for Access to Brake

Place the machine on the centre stand and remove the rear mudguard unit. Disconnect the rear driving chain at the spring link and remove the chain from the rear wheel sprocket. Unscrew the rear brake rod adjusting nut completely and depress the brake pedal so as to disengage the rod from the trunnion in the brake operating lever. Unscrew the brake cover plate anchor nut and remove this together with the washer behind it. Unscrew the loose section of the spindle two or three turns and the spindle nut by a similar amount. Mark the chain adjuster cams to ensure replacing in the same position.* Disconnect the speedometer driving cable and slide the wheel out of the fork ends, tilting it so as to disengage the end of the brake shoe pivot from the slot in the fork end.

*Note that the wheel is not necessarily correctly lined up when the same notch position is used on both adjuster cams. Once the position of the cams which gives correct alignment has been found this alignment will, however, be maintained if both cams are moved the same number of notches. See also Subsection 119.



REMOVAL OF WHEEL (OFFSIDE VIEW)
Fig. 45

When replacing the wheel make sure that the dogs on the gear in the speedometer drive gearbox are engaged with the slots in the end of the hub barrel. Make sure also that the speedometer drive gearbox is correctly positioned so that there is no sudden bend in the driving cable. When replacing the connecting link in the driving chain, make sure that the closed end of the spring link points in the direction of travel of the chain. Replace the chain adjuster cams in their original positions or, if necessary, turn each of them the same number of notches to tension the chain and maintain correct wheel alignment. The chain should have $\frac{1}{2}$ in. up and down minimum movement when the rear suspension is fully extended as it will be tighter in the normal laden position. Do not forget to refit the brake rod and adjust the brake so that the wheel turns freely when the brake is off, while at the same time only a small travel of the brake pedal is necessary to put the brake on.

140. Removal of Brake Shoes for Replacement, etc.

Remove the complete wheel as described above, then remove the spindle nut, chain adjuster and the distance collar, thus permitting the complete brake cover plate assembly, with operating cam, pivot pin, shoes and return springs, to be lifted off the hub spindle. The brake shoes can then be removed after detaching the return springs. Brake linings are supplied either in pairs ready drilled complete with rivets (Part No. 41285A/BX) or ready fitted to service replacement brake shoes (Part No. 41343A). When riveting linings to shoes, secure the two centre rivets first so as to ensure that the lining lies flat against the shoe. Standard linings are Ferodo AM2, which are drilled to receive cheese-headed rivets.

141. Removal of Brake Operating Cam

To remove the operating cam unscrew the nut which secures the operating lever to the splines on the cam. A sharp tap on the end of the cam spindle will now free the lever, after which the cam can be withdrawn from its housing.

Do not try to remove the brake shoe pivot pin as this is cast into the cover plate.

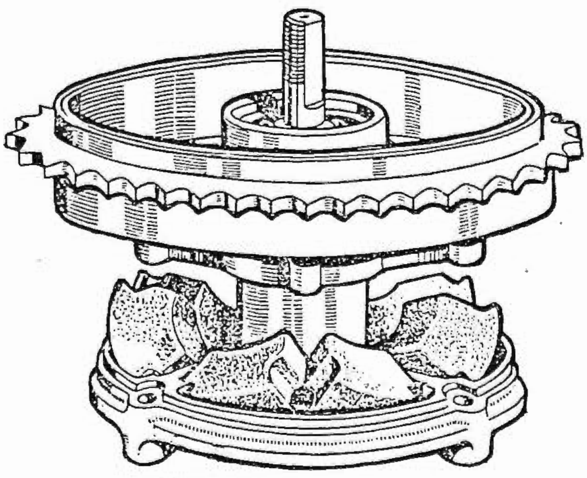
142. Cush Drive

The sprocket/brake drum is free to rotate on the hub barrel. Three radial vanes are formed on the back of the brake drum and three similar vanes are formed on the cush drive shell. Six rubber blocks are fitted between the vanes on the brake drum and those on the cush drive shell, thus permitting only a small amount of angular movement of the sprocket/brake drum relative to the hub barrel and transmitting both driving and braking torques and smoothing out harshness and irregularity in the former.

If the cush drive rubbers become worn so that the amount of free movement measured at the tyre exceeds $\frac{1}{2}$ in. to 1 in., the rubbers should be replaced. To obtain access to them remove the complete wheel as described above; then unscrew the loose section of the spindle completely. The main portion of the wheel can then be lifted away from the assembly consisting of the fixed portion of the spindle, sprocket/brake drum complete with brake and the cush drive shell. Now remove the brake cover plate complete with brake shoes as described above, and unscrew the three nuts at the back of the cush drive shell after bending back the locking washers. The three studs are brazed to the lockring and should be driven out of the cush drive shell, each a little at a time to avoid distorting the lockring or bending the studs. The sprocket/brake drum can now be separated from the cush drive shell and the six such drive rubbers lifted out.

When reassembling the cush drive the entry of the vanes between the rubbers will be facilitated if the latter are fitted into the driving shell first and then tilted. The rubbers should be liberally smeared with soapsuds to facilitate entry of the vanes. Grease the inner face of the lockring before assembling and tighten the three nuts down solid as there is a shoulder on the stud which prevents tightening of the nuts from locking the operation of the cush drive. Do not forget to bend up the tabs of the three locking washers.

When reassembling the cush drive, coat the inside of the bore of the sprocket/brake drum liberally with grease where it fits over the hub barrel.



REASSEMBLY OF CUSH DRIVE
Fig. 46

143. Removal of Ball Bearings

To remove the ball bearings take the complete wheel out of the machine and separate the main portion of the wheel from the sprocket/brake drum cush drive shell assembly as described above. To remove the bearing from the sprocket/brake drum, first remove the brake cover plate complete with brake shoe assembly; then remove the distance collar and unscrew the bearing retaining ring with a peg spanner. Now screw the loose section of the spindle into the fixed section and drive out the bearing by hitting the hexagon-headed end of the loose section of the spindle.

To remove the bearings from the loose half of the hub barrel, first lift away the distance collar, speedometer drive gearbox, the spacing collar and the felt washer. Remove the bearing retaining circlip from the driving sprocket end of the barrel. Between the two bearings is a spacer, slotted at one end to enable a drift to be used on the bearing at that end. Remove this bearing first, then enter the loose section of the spindle into the spacer and drive out the remaining bearing by means of a hammer and drift applied to the hexagon-headed end of the spindle.

144. Hub Bearings

These are deep-groove single-row journal ball bearings. The sprocket/brake drum bearing is a Skefko RLS7, $\frac{7}{8}$ in. i/d, by 2 in. o/d, by $\frac{9}{16}$ in. wide. Equivalent bearings of other makes are Hoffmann LS9, Ransome & Marles LJ $\frac{7}{8}$ in., and Fafnir LS9. The two bearings in the hub barrel are Skefko RLS5, $\frac{5}{8}$ in. i/d, by $1\frac{9}{16}$ in. o/d, by $\frac{7}{16}$ in. wide. Equivalent bearings of other makes are Hoffman LS7, Ransome & Marles LJ $\frac{5}{8}$ in. and Fafnir LS7. Bearings with slack fitting internal clearances marked "C3," "000" or "***" should be specified.

145. Fitting Limits for Bearings

The fit of the bearings in the hub barrel and sprocket/brake drum is important. The following are the manufacturing tolerances which control this and also the fits on the fixed and loose portions of the wheel spindle.

RLS5 Bearing o/d	1.5622/1.5617 in.
Hub Barrel bore	1.5620/1.5616 in.
RLS5 Bearing bore	.6252/.6248 in.
Loose Spindle dia.	.624/.622 in.
RLS7 Bearing o/d	1.9995/1.9990 in.
Sprocket bore	1.9994/1.9990 in.
RLS7 Bearing bore	.8752/.8748 in.
Fixed Spindle dia.	.8749/.8745 in.

All inner races are locked in position when the spindle nuts are tightened. The outer race of the RLS7 bearing is located by a screwed retaining ring and one of the RLS5 bearings is located by a circlip. Axial movement of the sprocket and/or barrel is therefore not possible. We recommend "Loctite" Sealant Grade C to secure any outer races which appear to have been rotating.

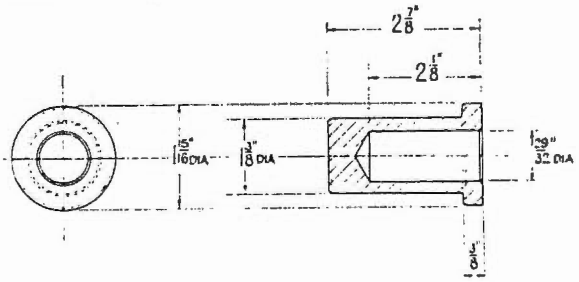
146. Removal of Hub Driving Pins

To remove the six driving pins from the aluminium full-width hub, first remove the hub cap after unscrewing the three screws attaching it to the hub. Unscrew the six Simmonds nuts and drive out the pins.

147. Refitting Ball Bearings

To refit the sprocket/brake drum bearing, use a hollow drift as shown in Fig. 47. The bearing is first fitted to the fixed section of the spindle; the spindle and bearing are then entered into the sprocket/brake drum and driven home, preferably under a press or using light hammer blows.

The two bearings in the hub barrel are pressed in, using the drift part of E.4823. First assemble the bearing into the circlip grooved end of the barrel and fit the circlip. Replace the bearing spacer, the slot in the spacer can be at either end of the hub, and assemble the second bearing, supporting the hub on the inner race of the other bearing. If the drift part of E.4823 is not available it is essential that the last bearing is assembled by applying pressure to both inner and outer races simultaneously to avoid pre-loading the two hub barrel bearings.



DRIFT FOR REFITTING RLS7 BEARING
Fig. 47

148. Reassembly of Brake Shoes and Operating Cam into Cover Plate

No difficulty should be experienced in carrying out these operations. Put a smear of grease on the pivot pin and on the operating face of the cam; also on to the cylindrical bearing surface of the operating cam if this has been removed. Fit the operating lever and trunnion on its splines in a position to suit the extent of wear on the linings and secure with the nut. The range of adjustment can be extended by moving the lever on to a different spline.

149. Final Reassembly of Hub Before Replacing Wheel

Before replacing the felt washers which form the grease seals, pack all bearings with grease. If new felt seals are fitted, soak these in engine oil.

Recommended greases are:— Shell Retinax A, Castrolease LM, Esso Multipurpose Grease H, B.P. Energrease L2, Mobilgrease MP and Marfak Multipurpose Grease 2. These are all lithium soap greases and should not be mixed with lime, aluminium or soda soap greases.

Make sure that the inside of the brake drum is free from oil, grease, dust or damp. Replace the felt washers, distance collars and brake cover plate and securely tighten the spindle nuts.

150. Wheel Rim

The wheel rim is WM3-18 in. plunged and pierced with forty holes for spoke nipples. The spoke holes are symmetrical, i.e., the rim can be assembled to the hub either way round. The rim diameter after building is 18.06 in. the tolerances on the circumference of the rim shoulders where the tyre fits being 56.783/56.723 in. The standard steel measuring tape for checking rims is $\frac{1}{4}$ in. wide, .011 in. thick, and its length is 56.843/56.783 in.

151. Spokes

The spokes, Part No. 40636, are of the single-butted type, 8-10 gauge, with 90° countersunk heads and rolled threads, .144 in. diameter, 40 t.p.i., thread form British Standard Cycle, $6\frac{3}{16}$ in. long. All spokes initially are bent to approximately 110° at the head end. Spokes threaded from the outside of the spoke flanges are hit with a hide hammer after lacing, but before truing the wheel to make them fit close to the flange. This increases the bend to approximately 80°.

152. Wheel Building and Truing

The spokes are laced one over two and the wheel rim must be built central in relation to the outer faces of the distance collars. The rim should be trued as accurately as possible, the maximum permissible run-out both sideways and radially being plus or minus $\frac{1}{32}$ in.

153. Tyre

The standard tyre is Dunlop Gold Seal K70, 4.00 × 18 in.

When removing the tyre always start close to the valve and see that the edge of the cover at the other side of the wheel is pushed down into the well in the rim.

When replacing the tyre fit the part by the valve last, also with the edge of the cover at the other side of the wheel pushed down into the well. Slightly inflate the tube and, if available, paint the rim and tyre with soapy water, or water containing a soapless detergent to assist the tyre in slipping over the edge of the rim.

If the correct method of fitting and removal of the tyre is adopted it will be found that the covers can be manipulated quite easily with the small levers supplied in the tool-kit. The use of long levers and/or excessive force is liable to damage the walls of the tyre. After inflation make sure that the tyre is fitting evenly all the way round the rim. A line moulded on the wall of the tyre indicates whether or not the tyre is correctly fitted. If the tyre has a white mark indicating a balance point, this should be fitted near the valve.

154. Tyre Pressures

With a solo rider of normal weight (154 lbs.) the correct tyre pressure is 21 lb. per sq. in. for 4.00-18 in. tyres. If the rider's weight exceeds 154 lbs. increase the pressure by 1 lb. per sq. in. for every 14 lb. increase in weight above 154 lb.

If additional load is carried in the form of a pillion passenger or luggage, the actual load bearing upon the tyre should be determined and the pressure increased in accordance with the following table.

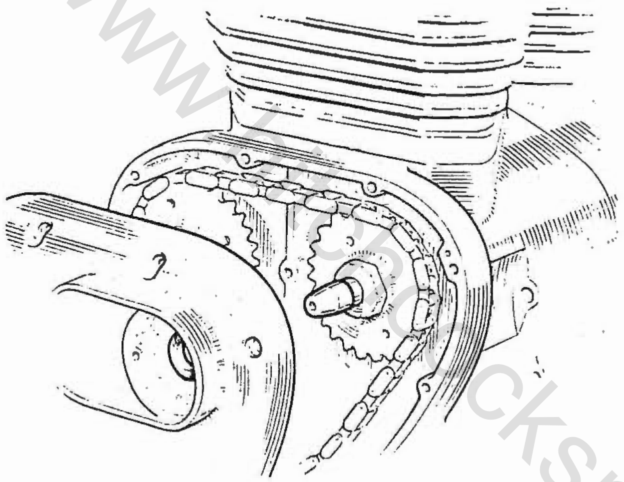
Tyre Section ins.	Maximum Load lb. at Pressure of lbs. per sq. in.					
	16	18	20	24	28	32
3.25	200	230	260	320	380	440
3.50	280	310	335	390	450	500
4.00	360	395	430	500	570	640

155. Lubrication

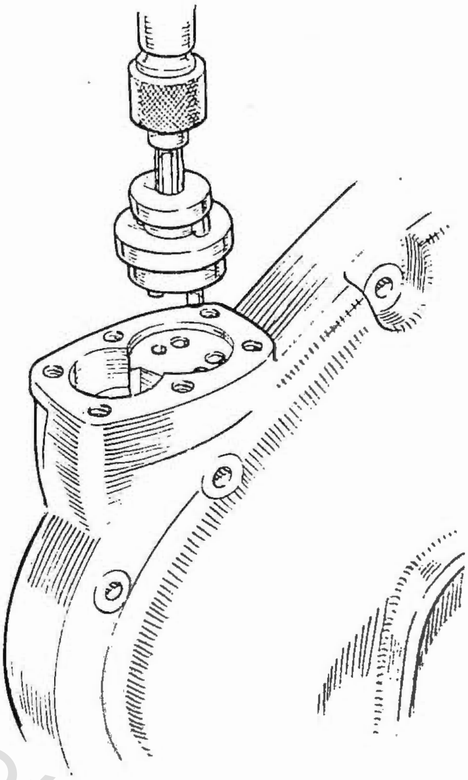
Grease the bearings by packing them with grease after removal of the brake cover plate and speedometer drive gearbox as described above.

Note that the brake cam is drilled for a grease passage but the end of this is stopped up with a countersunk screw instead of being fitted with a grease nipple. This is done to prevent excessive greasing by over-enthusiastic owners. If the cam is smeared with grease on assembly it should require no further attention but in case of necessity it is possible to remove the screw, fit a grease nipple in its place and grease the cam by this means.

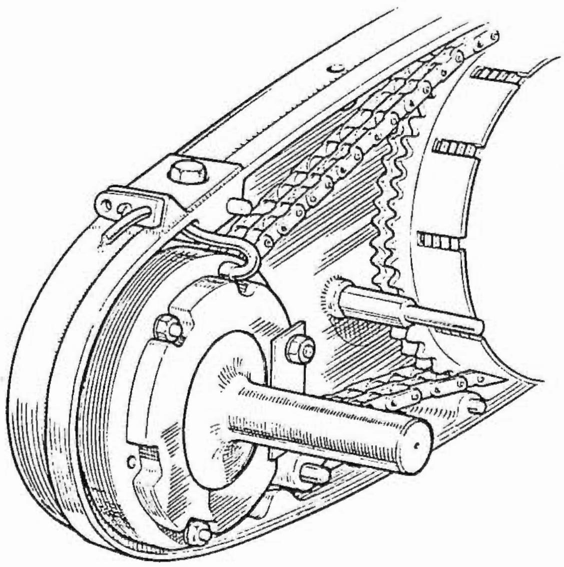
Special Tools



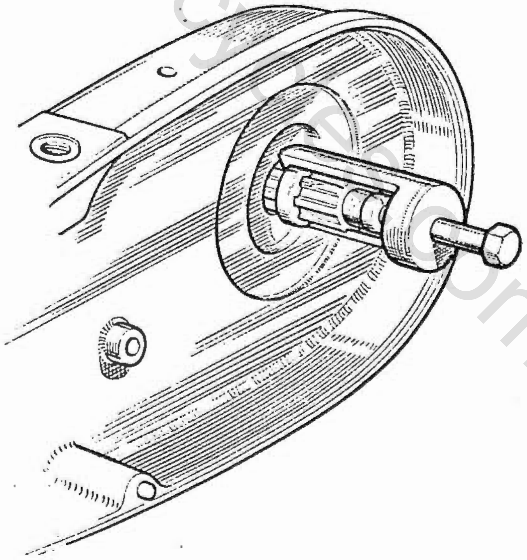
W.49994
CAMSHAFT SEAL ASSEMBLY THIMBLE



E.5425
PUMP DISC LAPPING TOOL



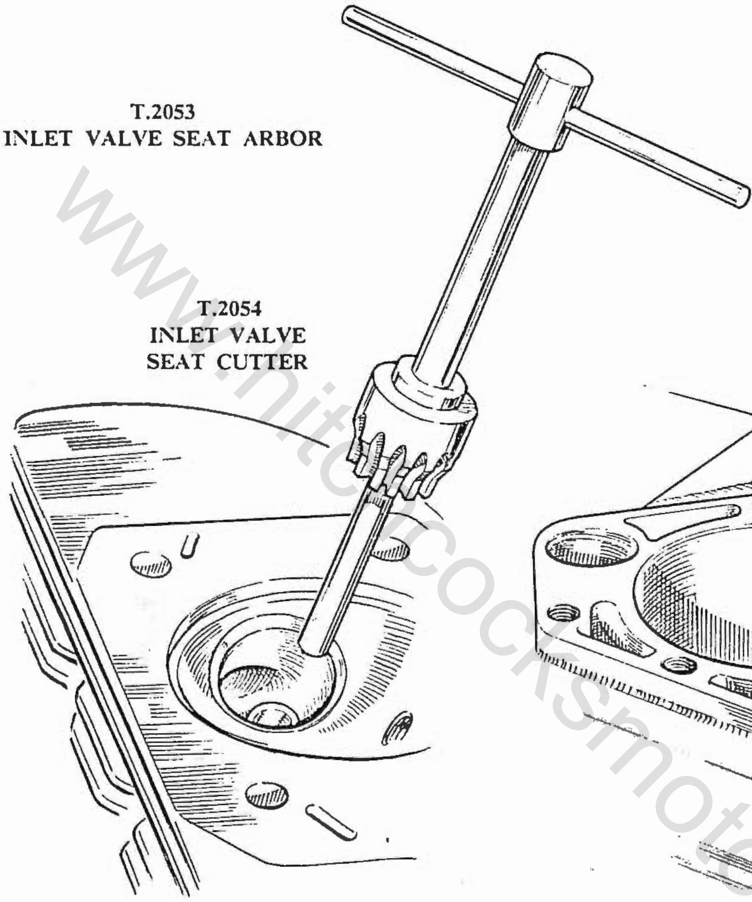
T.2055/19
ASSEMBLY GAUGE IN USE TO
CENTRALISE ROTOR

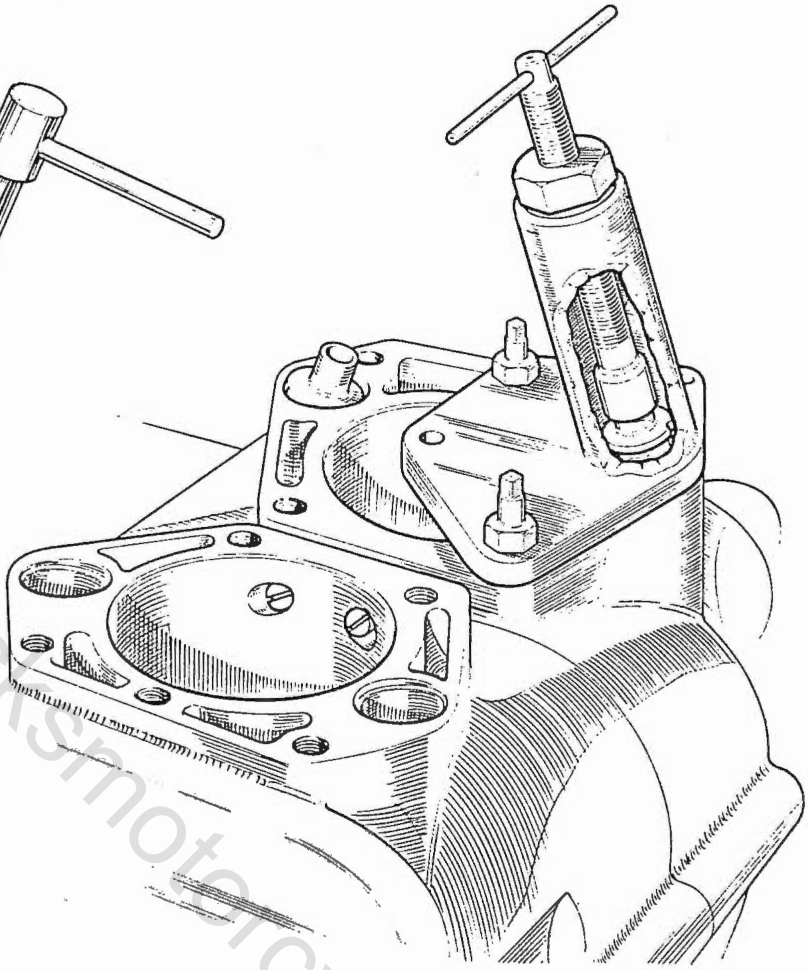


W.49926
GEARBOX COLLAR (SPLINED) EXTRACTOR

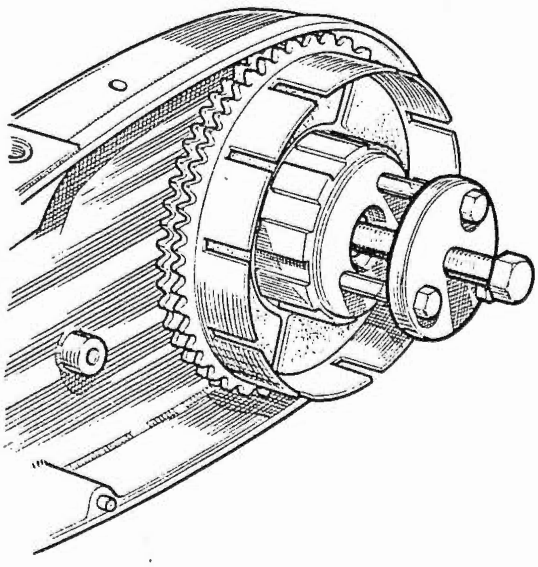
T.2053
INLET VALVE SEAT ARBOR

T.2054
INLET VALVE
SEAT CUTTER

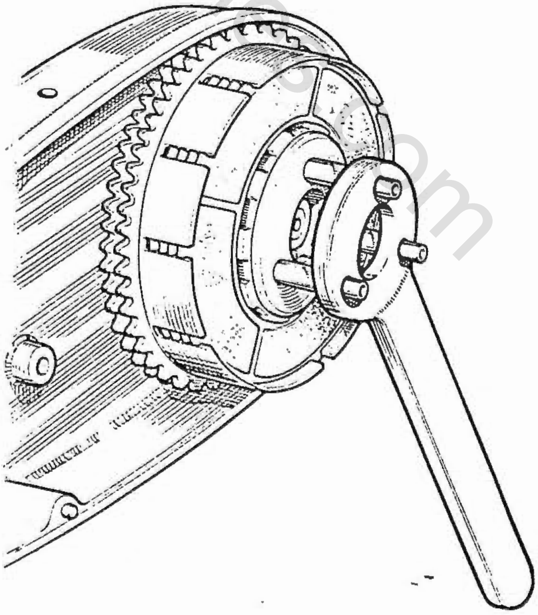




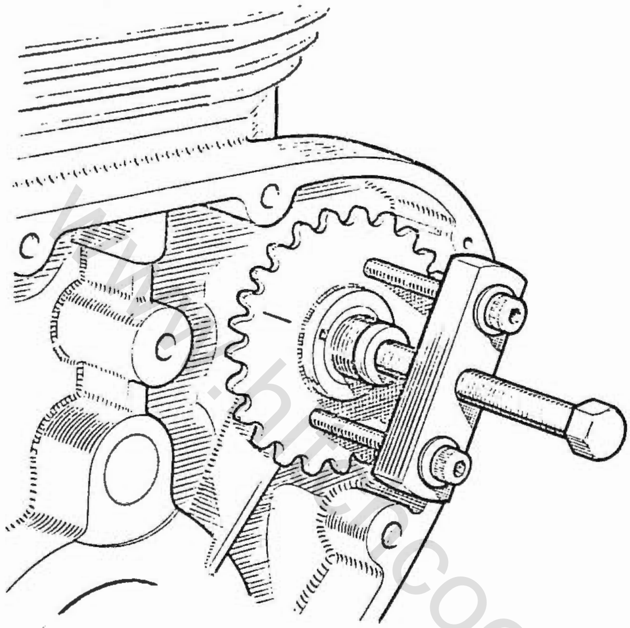
W.49925
TAPPET GUIDE EXTRACTOR



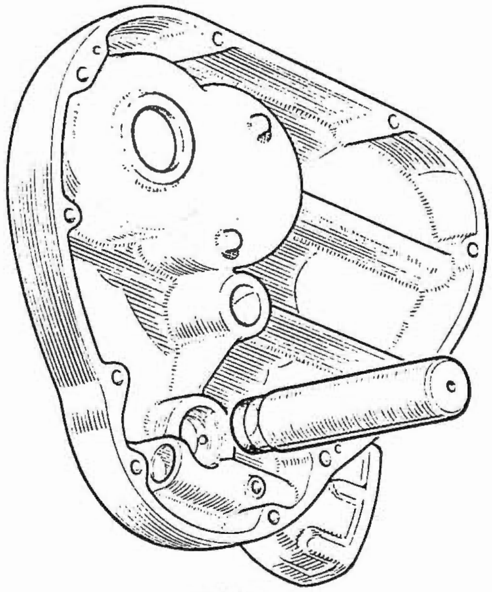
W.49909
CLUTCH HUB EXTRACTOR



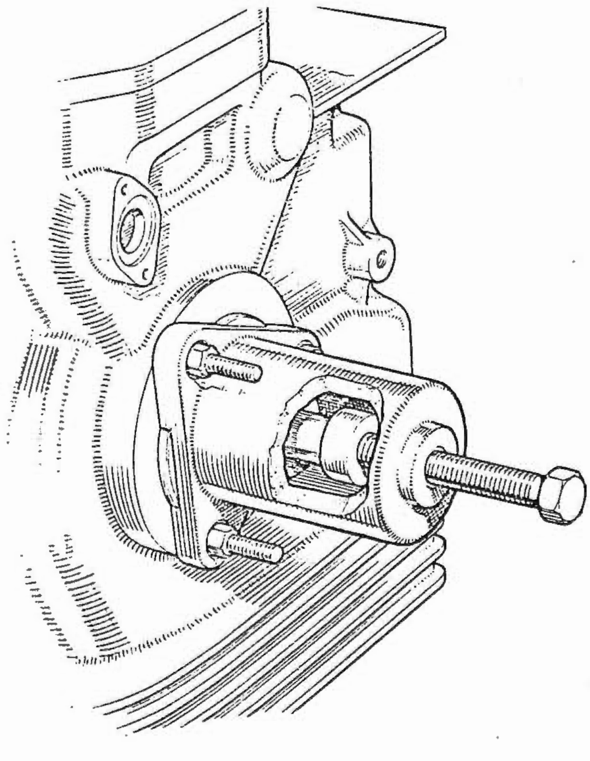
W.49919
CLUTCH HOLDING TOOL



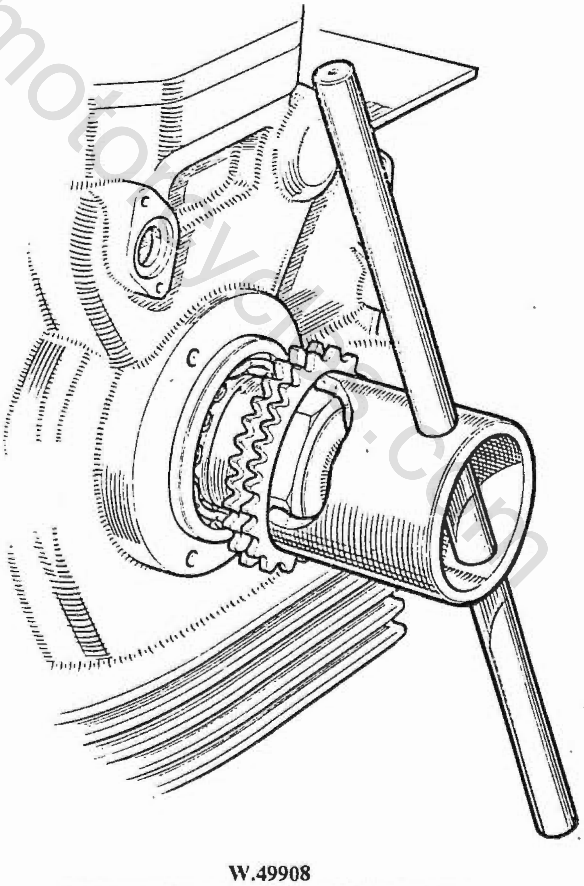
W.49907
CAMSHAFT SPROCKET EXTRACTOR



W.50011
DRIFT FOR ASSEMBLY OF
TIMING COVER SEALS



W.49910
CRANKSHAFT EXTRACTOR



W.49908
ENGINE SPROCKET NUT SPANNER

NOTES

NOTES

Published by GREG PUBLICITY *Stourbridge*
Printed in England by GIBBONS *of Wolverhampton*