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F. NEILL AJS & MATCHLESS TWINS 1955-1965 Lodgemark Press

AJS

SERVICE AND OVERHAUL MANUAL FOR THE

AJS & MATCHLESS TWIN MOTORCYCLES

by

F. NEILL

Covering all 1955 to 1965 twin cylinder models including the
AJS G9 G9CS G9CSR G11 G11CS G12 G12CS G12CSR
MATCHLESS 20 20CS 20CSR 30 30CS 31 31CS 31CSR

Working instructions together with technical data given in ensuing chapters are devoted solely to the Matchless and AJS twin cylinder models. It is not universally known that these two models are dimensionally and technically identical – the difference is confined to the emblem on the petrol tank – also in some cases to the finished colour of the frame parts.

The design changes that have taken place since the first model was produced including modifications are detailed for the benefit of readers who may wish to convert the engine up to a later specification.

The general arrangement of the early 500 engine and later types are basically the same, thus the details given, are suitable for models made from 1955 up to 1965. The early 500 twin established a first-class record for reliability – it is commonplace for engines of this type to cover 65,000 to 100,000 miles – before an engine overhaul is contemplated. Crankshaft failures on the 650 engine was overcome by the introduction of the Nodular Iron crankshaft which is unbreakable.

The use of the special high compression ratio pistons with race kit cams is not recommended unless the crankshaft is of the latest type.

The author and the publishers wish to express their thanks to Norton Villiers Ltd for their co-operation in the preparation of this book and permission to publish the text and illustrations.

SERVICE AND OVERHAUL MANUAL
FOR THE

AJS & MATCHLESS TWIN MOTORCYCLES

by

F. NEILL

S.B.N. 850770130

Bank House, Summerhill, Chislehurst
Kent BR7 5RD, England

Contents

PERIODICAL MAINTENANCE

Regular maintenance attention to lubrication and certain adjustments must be made to ensure unfailing reliability and satisfactory service. This necessary attention is detailed below and owners are strongly recommended to carefully follow these suggestions and to make a regular practice of doing so from the first.

DAILY

Oil tank	Inspect oil level and top-up to top line level if necessary. Check oil circulation.
Petrol tank	Check level and re-fill if necessary.

WEEKLY

Oil tank	Check level and re-fill to top line level if necessary.
Tyres	Check pressures and inflate if necessary.

EVERY 500 MILES

Oil tank	Drain at first 500 miles and re-fill to top line level with new oil, and clean filter.
Ignition	Check contact breaker points.
Gear box	Drain at first 500 miles and re-fill one pint.
Chaincase	Check level of oil when machine is standing vertically on level ground when level of oil should be just below bottom edge of inspection orifice. Fill up if level is low.
Battery	Inspect each cell for level of electrolyte and top up with distilled water if necessary. Level of electrolyte should just be over top of plates. Beware of overfilling.

EVERY 1,000 MILES

Oil tank	Drain at first 1,000 miles and re-fill with new oil.
Rear chain	In wet weather remove and soak in molten grease.
Gear box	Add two fluid ounces of specified oil.
Hubs	Inject small amount of grease.
Expanders	Inject small amount of grease.
Steering head	Inject small amount of grease.
Small parts	Smear all moving parts with engine oil and wipe off surplus.
Chaincase	Drain, and re-fill, or monthly.

EVERY 2,000 to 5,000 MILES (according to road conditions)

Air filter	(If fitted) clean and re-oil filter element.

EVERY 3,000 MILES

Rear chain	In dry weather remove and soak in molten grease.
Brake pedal	Inject small amount of grease.
Speedometer	Inject small amount of grease into speedometer gear box, if fitted with grease nipple.
Ignition	Clean contact breaker points and re-set if necessary.
Plugs	Clean sparking plugs and re-set points as necessary. When re-fitting reverse respective positions.

Steering head	Test steering head for up and down movement and adjust if necessary.
Bolts and nuts	Check all nuts and bolts for tightness and tighten if necessary but beware of over-tightening.
Rockers	Check OHV rocker adjustment and correct if necessary.
	EVERY 5,000 MILES
Oil tank	Drain and re-fill with new oil. If machine is only used for short runs renew oil every three months instead of mileage interval.
Filters	Clean metal mesh filter in oil tank and filter in crankcase on twins.
Ignition	Clean and adjust as detailed in Electrical section.
Dynamo	Clean as detailed in Electrical section.
Front fork	Check each side of front fork for hydraulic fluid content and, if necessary, top up. Insufficient oil content is indicated by abnormally lively action.
Carburetter	Remove carburetter float chamber side cover and clean interior. Also detach petrol pipe banjo and clean gauze strainer.
	EVERY 10,000 MILES
Magneto and Dynamo	Get a **Lucas Service Station** to dismantle, clean, lubricate and generally service.
Air filter	(If fitted) renew filter element.

RECOMMENDED LUBRICANTS

Efficient lubrication is of vital importance and it is false economy to use cheap grades of oil. When buying oils or grease it is advisable to specify the brand as well as the grade and, as an additional precaution, to buy from sealed containers.

Engine

Ambient temperature above 32°F use SAE 20/40 or straight SAE 30 oil.
Ambient temperature below 32°F use SAE 10/30 or SAE 20 oil.
The following brands are recommended:

Mobiloil
Castrol
Energol
Essolube
Shell
Regent Advanced Havoline

Gearbox

Ambient temperature above 32°F: SAE 50 or GX90
Ambient temperature below 32°F: SAE 30

Hub and frame parts

Mobilgrease MP
Castrolease Heavy
Energrease C3
Regent Marfax
Shell Retinax A or CD

Teledraulic front forks

Mobiloil Arctic (SAE 20)
Castrolite (SAE 10W-30)
Energol (SAE 20)
Essolube 20 (SAE 20)
Shell X-100 Motor Oil 20/20W (SAE 20)

LUBRICATION

TWIN CYLINDER MODELS, 1957 to 1962

The design of the oil pumps for the Twin Cylinder Models, first introduced in 1949, has remained unaltered by reason of their reliability and longevity. Both pumps are of the gear driven type, the feed pump circulates 26 gallons per hour at 6,500 rpm. The widest of the two pumps is for the return to efficiently scavenge the crankcase. The two pumps can be inadvertently reversed (see paragraph 'Over oiling'). The general arrangement of the pump assemblies are shown in fig 1. To keep the return pump 'wet' thus ensuring an immediate oil return, when the engine is just started, a bleed valve (see Nos 1, 2 and 3 in fig 1) is mounted in the left-hand side of the pump plate. Access to the ball and spring is made by removing the grub screw (No 3, fig 1).

Oil circulation. (Refer to general arrangement drawing, fig 13). Oil is fed under pressure from the feed pump to the filter tunnel under the influence of the pressure relief valve plunger 026133. At the drive side end of the filter tunnel a non-return valve 026139 which is spring loaded, is also part of the filter assembly. When oil pressure is built up in the filter tunnel the ball 011645 is moved off its seating, oil passes to the two-way drilling for the main crankshaft bearings, with a by-pass to the oil distributor compartment. From here oil is distributed to the rocker gear by the oil distributor bush 022385, which is rotated by the exhaust camshaft. The oil drilling in the crankcase is via the aperture for the bolt 014292, which is sealed by the rubber backed washer 022580. Oil is fed to a channel machined in both portions of the crankcase (see paragraph 'Oil leaks from the cylinder base'). Two metering plugs are used at this point to balance the oil feed to the camshaft tunnels and the OHV rocker gear. Drillings in the face of the crankcase line up with holes machined in the cylinder barrels also cylinder heads through which oil is fed to the rocker spindles and bushes, which in turn falls by gravity down the push rod tunnels into the camshaft chambers. The main oil feed is taken to the centre web bearings, where it is diverted to the connecting rod bearings. Overspill from the camshaft tunnels causes oil to build up in the timing side crankcase, lubricating the train of gears. A predetermined oil level hole in the crankcase wall keeps the oil level constant.

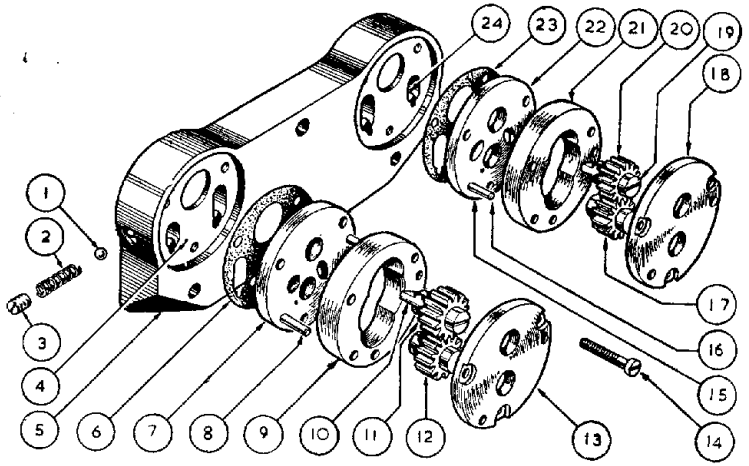


FIG 1 **Delivery Oil Pump** (*on the right*). **Return Oil Pump** (*on the left*)

1 Ball, for non-return valve.
2 Spring, for non-return valve.
3 Plug, retaining non-return valve spring and ball.
4 Bleed hole.
5 Plate, carrying oil feed and return pumps.
6 Paper washer for oil return pump.
7 Back plate of oil return pump.
8 Dowel pin, locating pump plates and body.
9 Body of oil return pump.
10 Dog end of pump gear to engage in end of camshaft.
11 Driving gear, for oil return pump.
12 Driven gear, for oil return pump.
13 Front plate of oil return pump.
14 Screw (1 of 6) used to retain plates and bodies of oil pumps to the carrying plate.
15 Back plate of oil feed pump.
16 Dowel pin, locating pump plates and body.
17 Driven gear, for oil feed pump.
18 Front plate of oil feed pump.
19 Screwdriver slot, to enable driving gear to be correctly positioned during assembly.
20 Driving gear, for oil feed pump.
21 Body of oil feed pump.
22 Back plate of oil feed pump.
23 Paper washer for oil feed pump.
24 Bleed hole.

1964 to 1966

Oil pumps. Engines with a number after 8084, are fitted with large capacity oil pumps, which increase the oil flow by 100 per cent. The new pumps can be fitted to earlier models by using also new type timing cover 029610 together with 10 screws 028492, as the new pumps are wider. The part number for the new feed pump is 028521, the return pump is 028522.

Pressure relief valve. This valve was located in the base of the filter tunnel, and is now transferred to the plate carrying the oil pumps, on engines after 8912. The valve needs no attention and consists of a plunger and spring, which are retained by a split pin.

Crankcase fabric filter. The filter element is now separate from the non return valve, and uses a blow off plunger, which will lift, if there is obstruction in the felt filter, to prevent oil being cut off to the engine.

The wire frame supporting the filter element is overlapped to avoid collapse when the oil pressure is high, with a cold engine.

Where machines are used frequently for short journeys, particularly in winter, the filter should be cleaned at monthly intervals, in preference to a fixed mileage.

TABLE OF OILING MODIFICATIONS

1956 Twin Cylinder Models

1. A balanced oil feed to cam tunnels and OHV rocker gear introduced, by using two metering jets in the channel machined in the crankcase (see 'Lubrication').
2. Crankcase pressure relief valve discarded.
3. Oil hole in oil distributor bush $\frac{1}{32}$".
4. Magnetic filter incorporated in drain plug for crankcase.
5. Oil feed to OHV rocker gear diverted to the top front crankcase bolt. Bolt is sealed with rubber-faced washer.

1957 Models

Non-return valve for filter compartment now a sealed unit 023331.
Oil hole in distributor bush enlarged to $\frac{3}{64}$".
Tufnol diaphragm for crankcase release valve discarded and replaced with steel type, use spring also for diaphragm.

1958 Models

Hole $\frac{3}{64}$" in oil distributor bush discarded. Bush now uses a flat machined on outside diameter of bush.

1959 Models

The four metering plugs in the cylinder heads discarded. New type crankcase release valve sealed unit type introduced.

1960 Models

A $\frac{3}{32}$" hole drilled in the cylinder spigot aperture (drive side only) the intention being to increase the oil supply to the drive side cylinder and piston. Engines with number X1994 to X2619 had a similar hole in the cylinder spigot. These cylinders must be used on the right (timing side) side of the engine.

An improved type of pressure relief valve introduced and now located in the base of the crankcase filter compartment. The fabric type crankcase filter discarded and replaced by fine metal gauze type with valve attached.

1961 Models

The $\frac{3}{32}$" hole in crankcase spigot (see 1960 models) now transferred to the end of inlet camshaft tunnel.

Oil spills from the hole on the inside wall of the drive side crankcase so falling on to the crankshaft bob weight. From here oil is flung up and into the near side cylinder to augment oil supply. The four cylinder head metering plugs discarded in 1959 re-introduced.

1962 Models

Duaflex rings incorporated to improve oil consumption.

A new type crankcase filter 028496 using a felt fabric surrounding the gauze filter is used on the above models. This filter can be used in 1960 and 1961 models. Clean filter every three thousand miles.

OILING FAULTS

Oil builds up in crankcase (over oiling). This can be due to:

(*a*) The oil pumps have been reversed.
(*b*) There is an oil leak between the pump and the pump plate (faulty gasket) or between the pump plate and the crankcase.
(*c*) Obstruction in the form of a broken portion of a piston ring, sucked into the oil passage cast in the crankcase to the return pump drilling, or the pumps are loose on the pump plate.
(*d*) The gears are damaged, on the return pump, by the introduction of foreign matter (portion of piston ring).

In the case of (*b*) if the pump plate is bruised or deformed at the point where the oil pick up takes place, the oil return will be spasmodic. When there is evidence of air bubbles emerging from the spout in the oil tank, this indicates an air leak. If difficulty in dislodging the obstruction occurs, a good tip is to feed a line of $\frac{1}{4}$" diameter ball bearings down the passage cast in the crankcase and when nearly full apply pressure on the last ball, which should push out the obstruction. If a machine is left stationary for a lengthy period, oil can accumulate in the crankcase, due to a slight seepage past the oil feed pump, which is inevitable. Should this happen after standing for a short period, check the feed pump for loose fixing screws on the pump plate (No 18, fig 1).

Oil discharge from crankcase into chaincase. This is usually due to the crankcase release valve being deranged. This valve also retains the engine sprocket to the crankshaft. Should the diaphragm be buckled or trapped oil will escape from the crankcase into the front chaincase. This oil discharge will also occur if oil builds up in the crankcase as previously described. Abnormal positive crankcase pressure caused by gas leakage past the piston rings can have a similar effect. A distance piece is used between the engine sprocket and the main crankcase bearing. The outside diameter of this distance piece is a close fit in the crankcase, being designed to prevent oil leakage. If the aperture is damaged or deformed, an efficient seal cannot be made, which would result in a build up of oil in the front chaincase.

Oil shortage to rocker gear. If the oil supply to the rocker gear is cut off, first check the metering plugs 018890 in the cylinder heads by removing both heads and take out, in turn, the rocker spindles which are held in position by the clamp bolt (No. 10, see fig 2) and note the location of the plain also spring washer. The oil feed hole drilled in the rocker post will now be exposed. Force petrol through this aperture which should emerge through the metering plugs, if they are unobstructed. Check also the oil hole in the cylinder, which may be masked by the base washer or head gasket. If it is found that the metering plugs are obstructed use a $\frac{1}{32}$" drill held in a pin vice to clear the drilling. The drill should be manipulated with care to avoid breakage. If it is desired to remove or replace these plugs, apply gentle heat to the cylinder head, then push the plug through the drilling, when it will come out of the hole in the rocker post. Insert the new plug, small end inwards, a light tap with a centre punch inserted in the larger hole will retain the plug in position

Oil failure to big end journals. The big end shells used on the Two Cylinder Models are materially and dimensionally identical to those used on high. powered racing motor car engines. With smooth journals and a continuous supply of clean oil, these bearings will be trouble free for many thousands of miles. If the oil supply is cut off, even temporarily, the bearings will run and usually the drive side is the first to be affected. This is because the overspill from the timing gear falls on to the timing side crankshaft, which keeps the bearing 'alive' for a slightly longer period. When the bearing 'runs' the clearance between the con rod and the crankshaft increases considerably. The hammering effect produced will tend to loosen the con rod nuts,which gives rise to the opinion that loose nuts are responsible for the trouble. With further use, and the engine in this condition, can result in a broken con rod, with additional damage. It follows that should an unusual noise develop, the cause should be investigated without delay. It is imperative that the reason for the oil shortage is traced and rectified before the crankshaft is assembled also reinstalled into the crankcase.

Possible cause of oil failure. If the fault develops after an oil change or when the engine has been refitted to the frame, the oil pipes may be reversed at the oil tank end.

Crankcase filter. Early 1960 engines were issued with a close mesh gauze metal filter (see table of oiling modifications). If this type of filter has collapsed, this indicates that oil cannot pass through the filter. Lack of cleaning and the use of additives, which tend to varnish the outside diameter of the filter, prevents oil penetrating. This type of filter should be discarded and replaced with the modified, felt type.

Non-return valve. Make sure the ball can be lifted off its seat, the spring may be corroded.

Pressure relief valve. This is a vital part of the oiling system. On earlier type engines (see table of oiling modifications) this valve was located in the timing side crankcase, just below the dyno fixing stud. The valve consists of a spring loaded plunger, the spring will be exposed when the timing cover is removed. If the spring is buckled, or there is foreign matter in the plunger orifice, the plunger will be held off its seat, thus cutting off the oil supply to the engine.

Twin Cylinder Models, made in 1960 and onwards, the pressure relief

valve was transferred to the base of the filter compartment (see 'general arrangement' drawing fig 13), the plunger 026133 is retained by a spring, washer and circlip. The possibility of this valve becoming deranged is extremely remote. A case has been known where the valve washer 026134 has been trapped in the square bottom recess machined in the timing cover. Originally this recess was $\frac{1}{8}$" diameter, which in the interest of safety should be enlarged to $\frac{17}{32}$". With the engine in a dismantled state, test the plunger for free movement by pressure on the plunger with a suitable object.

Oil distributor bush (022385). As previously described, this rotating bush delivers oil to the rocker gear and needs no attention. It is of paramount importance to use a copper washer of the correct thickness, between the cap 014247 and the crankcase, the washer should be $\frac{1}{16}$" thick. The use of a thin washer will lock the bush solid with serious damage to the crankcase.

Checking the oil pressure. After engine overhaul, or when an oil feed shortage has taken place, when the engine is refitted to the frame, the oil pressure should be checked. An oil pressure gauge reading from zero to at least 150lb per square inch is required. It must be mentioned that when a pressure relief valve is not incorporated in the oiling system (see table of oiling modifications) the engine must idle for several minutes until the oil has become warm and the viscosity lowered. Spinning the engine in a cold condition will generate a pressure of about 300lb, which can burst the gauge. The shank of the gauge should be $\frac{1}{4}$" BSP (·518) × 19 TPI. Use a filter compartment cap of an early type 016179 assembled with ball and spring to accommodate the gauge, for test purposes. When an oil pressure relief valve is fitted, the recorded pressure when cold is between 100 to 110lb per square inch falling to 25 to 30lb when hot. Without a relief valve the pressure is about 140lb after warm up and 25 to 30lb hot. In the event of damage to the thread in the crankcase for the cap 016179 use a tap $1\frac{1}{8}$"×20 TPL to clear the threads. This tap can also be used for the oil distributor cap orifice.

Oil leaks. If the engine is carefully assembled, oil leaks are extremely rare, providing the gaskets are sound and not deformed during the process of assembly.

Oil leaks from cylinder head joint. If the oil leak is persistent and does not respond to the use of new gaskets, the cylinder head face may be distorted. To remedy, the head face should be 'rubbed down' on a face plate, alternatively, use a sheet of reasonably coarse emery cloth placed on a stout sheet of glass until the head face is perfectly flat. Use also heat treated cylinder head holding down nuts (part no 028082).

Oil leaks from cylinder base. An oil leak from this part of the engine may develop after the cylinders have been removed. When the leakage persists, and when the base joint is remade, without improvement, it is quite likely that the leak is from the crankcase joint and not from the cylinder base. As explained previously in paragraph 'oil circulation', oil is fed under pressure to a channel in the crankcase midway between the two cylinders. During the process of removing and refitting the cylinders, the crankcase joint has broken down, particularly if the bolts passing through the crankcase have been released, or if the cylinders have been 'racked' sideways to remove them. To prove if the leak does come from the crankcase joint, take off the right side cylinder head and barrel. Use a WESCO pressure oil gun, with the spout

placed in one of the two oil holes drilled in the crankcase spigot aperture, seal off the other hole with one of the fingers of the free hand. Work the gun to build up pressure, if the crankcase joint is leaking, oil will emerge between the two halves of the crankcase midway between the two cylinders.

TABLE OF SPRINGS (Lubrication System)

1957 Models (only)

Spring for crankcase release valve 018282 $\frac{9}{16}$"+$\frac{3}{8}$" 10 coil 26 gauge.

1957-1959

Spring for filter non-return valve 014241 $1\frac{1}{2}$"+$\frac{5}{16}$" 15 coil 17 gauge.
Spring for pump bleed valve 000701 $\frac{13}{32}$"+$\frac{1}{4}$" 10 coil 26 gauge.

1960-1962

Spring for pressure relief valve 026132 ·984"+·423" 9 coil 18·1 gauge.
Ball for pump bleed valve $\frac{1}{4}$" diameter.
Ball for non-return valve $\frac{3}{8}$" diameter.

Timing gear noise. This is due to backlash between the train of gear wheels in the timing cover, and is most pronounced when the engine is idling. Wear on the bush or shaft for the intermediate pinion can be responsible. A new pinion with closer mesh is also beneficial.

Piston slap. A little piston noise when the engine is cold is not unusual, particularly when high compression pistons are fitted. In the ordinary way this noise clears up when the normal running temperature is reached. Should the noise prevail, a seized piston is suspect.

Rattle in top part of engine. A noise that is difficult to locate can develop as a result of either one, or both, exhaust pipes becoming loose in the exhaust ports, when the engine is hot. Racking the pipe sideways to get it out of the port tends to close in the pipe. Drive a steel or hard wood tool shaped like a carrot into the pipe end to 'bell out' the end to make it a close fit in the port.

ENGINE NOISES

No engine will remain mechanically quiet throughout the whole period of its life, so after considerable mileage some engine noise is inevitable. Under such conditions the possible engine noises are detailed together with the symptoms to assist in quick detection. Firstly, disregard the so-called experts' diagnosis of 'worn small end bearing' (wrist pin), as this does not happen on the twin engine.

Overhead rocker noise. This can develop if the rocker clearance is excessive and is easy to locate. An oil shortage to the rocker gear will produce a similar noise, with the possibility of wear on the valve ends, also rockers. If the wear on the rocker end (which makes contact with the valve) is to any noticeable extent the use of a feeler gauge will give a false reading. If the wear is slight, the rocker gear can be hand stoned to remove the ridge formed by wear.

Cam follower wear. This noise is usually audible when running between 30 to 40 mph and is not affected by load on the engine. As a temporary measure close up the rocker clearance to ·002 on all valves. If the noise is still

there, the followers are worn. If after examination, the exhaust cam followers only are worn, this would suggest overload by the valves being tight, or prone to seize in the valve guides. After reassembly the valve motion should be checked to verify that the valve springs do not become coil bound when the valve is at full lift. This can happen when pattern valve springs are used, or the lower valve spring seat has been fitted upside down. The wide face of the spring seat should abut against the valve guide boss on the cylinder head.

Big end noise. Can be detected when engine is running at a small throttle without load, or when the machine rotates the engine on down gradient. This noise usually disappears when the engine is pulling.

TECHNICAL ASPECTS OF THE TWINS

Technical aspect of the Twin Cylinder Models. The twin cylinder engine for Touring Models was first produced in 1949. Since this time the design has undergone many changes, far too numerous to describe in this manual.

In the main the technical details given are to cover engines made from 1957 onwards, although a description of lubrication modifications are mentioned in preceding chapter for earlier models.

Engine design. Originally the cubic capacity of the 500cc Twin was 498cc, bore size 66mm, stroke 72·8mm. Then the 600cc engine was introduced, capacity 592cc, bore 72mm, the stroke being the same as the 500cc version. From this it is apparent that the technical aspect of both engines are identical with the exception of carburetter settings and engine sprocket size, which are given in Technical Data.

The 650cc engine was first introduced in 1959, which has a cubic capacity of 646cc, bore size 72mm, stroke 79·35mm. The standard engine uses a compression ratio of 7·5 to 1. The CS and CSR models have a ratio of 8·5 to 1, which necessitates a slightly retarded ignition timing (see paragraph 'setting ignition') and KLG FE220 sparking plugs.

Camshafts. An improved type of camshaft was introduced in 1959 for the CSR models which can be used in all twin cylinder engines. Earlier types are no longer available. Replacements now issued will be of the improved type.

Fitting new camshafts. It is essential when new camshafts are fitted particularly to early type engines, that the valve motion is checked when the engine is assembled as far as adjusting the rocker clearance. Deal with each valve in turn by turning the engine until the valve is at full lift (fully open) when it should be possible to compress the valve spring further by applying pressure on the rocker to a minimum of ·040" (1mm). This is to ensure the valve springs are not coil bound, or closing up solid at full lift. This can also happen if the valve spring seats have been reversed (the wide face should go against the cylinder head) or pattern type valve springs are used. An incorrectly located valve guide will also limit valve movement thus causing cam gear wear.

Cam followers. If premature wear occurs with this part of the engine, the cause can be due to overload (see paragraph 'Valve springs'). The use of unsuitable lubricating oil will affect cam gear wear. If the wear is confined to the exhaust cam followers only, the exhaust valves may be tight in the valve

guides when the engine reaches its normal running temperature (see Technical Data for dimensions). Continual short distance running can have some bearing on this trouble. Unbreakable forged steel cam followers, with stellite pads, are a standard fitting on the 1963/64 twin engines, which can be used on earlier type twin engines. The part number for these new parts is 029936.

The use of delcrome cam followers will offset premature wear.

Cylinder heads. Cylinder heads on the 500cc and 600cc engines were identical prior to 1957 when a slightly larger valve head diameter was introduced. The inlet port was also enlarged to $1\frac{1}{16}$" for the 600cc engine. A new design of cylinder head is used on all twin engines made for 1960 onwards. The head sphere is more shallow, with an alteration to the shape of the piston crown. The new parts do not interchange with earlier types.

To convert new cylinders, also cylinder heads and pistons together with new type head gaskets, are required.

Cylinder base gasket. Cylinder base gaskets, of an improved type material (WB1) are available which should be used if persistent oil leakage takes place from the cylinder base, and crankcase joint. Jointing compound is not needed with this type of gasket.

Cylinder holding down studs. The long cylinder studs passing through the cylinder barrel was originally $\frac{5}{16}$" in diameter, which have now been increased to $\frac{3}{8}$" in diameter, with larger nuts, and washers to suit.

This alteration is entirely machining, the conversion can be carried out if first class machining facilities are available. These new studs were first fitted to engine number X9712. To tighten the stud nuts use a torque spanner set to 25 foot lbs. New gaskets will also be needed to complete the conversion.

Connecting rods. All connecting rods used on the twin engine since its conception are materially and dimensionally identical with one exception, namely, the detachable cap on the connecting rod which is chamfered to clear the crankcase for the 650cc engine. If an early type rod is used as a replacement, the cap must be filed to give the required clearance. There is also a chamfer on one side of the connecting rod just above the big end 'eye'. The rod should be assembled with the chamfer pointing away from the centre of the crankshaft to clear the crankcase.

Raising the compression ratio. This is accomplished by exchanging the pistons. A table of pistons available for twin cylinder engines indicates the part number, also ratio for identification. The part number for the bare piston is quoted, which is stamped on the piston crown.

500cc	**1957-59**	**1960-62**
Standard ratio	022415 (7/1 CR)	026323 (8/1 CR)
H.C. ratio..	022598 (8/1 CR)	—
600cc		
Standard ratio	022226 (7·4/1 CR)	—
H.C. ratio..	023503 (8/1 CR)	—
650cc		
Standard ratio	025042 (7·5/1 CR)	026324 (7·5/1)
H.C. ratio..	025045 (8·5/1 CR)	026325 (8·5/1)

Valve springs. Whilst the valve springs used on various Twin Cylinder Models are similar in appearance, they differ in free length, also on poundage when assembled.

It is important to use the correct type of springs to avoid overloading the cam gear, apart from the risk of the springs being coil bound, when the valve is at full lift.

TABLE OF VALVE SPRINGS

All 500cc and 600cc engines (1949-1959).

	Part No.	*Free length*	*Number of coils*	*Wire gauge*
011770	Inner spring ..	$1\frac{9}{32}$″	7	12 SWG (·104)
011769	Outer spring ..	$1\frac{3}{4}$″	6	9 SWG (·144)

500cc and 650cc engines (1960 – onwards).

018347	Inner spring ..	2·030″	$8\frac{3}{4}$	·116″
018348	Outer spring ..	2·523″	8	·140″

Note: This type of valve spring must NOT be used on engines made before 1960. These springs are rated, the end marked with yellow paint is assembled against the cylinder head. The inner spring is an interference fit with the outer spring to prevent valve spring surge.

ENGINE SERVICING

Overhead rocker adjustment. This adjustment is effected by turning the eccentric rocker spindle to increase, or decrease, the rocker clearance as desired. As quietening curves are used on the camshafts the engine must be correctly positioned to obtain correct clearance.

All twin engines made before 1960 use a clearance of ·006″ and ·008″ after 1960, engine cold.

Tools required are: Allen Key 018055 for rocker cover; open end spanner 015264 for clamp nut; feeler gauges or strip foil ·006″ or ·008″.

Remove the rocker covers.

Turn the engine until the right side inlet rocker goes down so that the valve is fully open.

Release the clamp nut (8) turn the rocker spindle with a screwdriver to move the rocker away from the valve.

Place the feeler on the valve end.

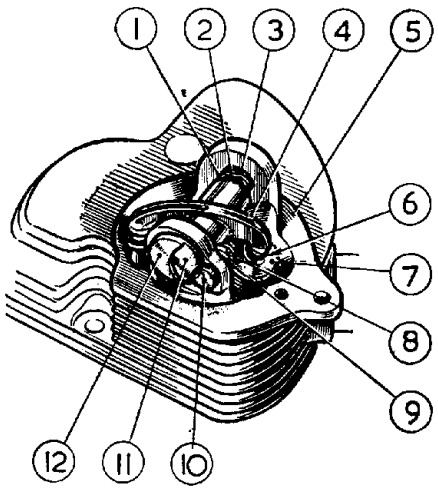
Turn the rocker spindle (12) in a reverse direction so that the rocker just 'nips' the feeler.

Tighten the clamp nut – do not use undue force. Rotate the engine until the left side inlet valve is fully opened – repeat the process.

Use the same procedure for the exhaust valves.

If the clearance appears to be in excess refer to paragraph 'overhead rocker noises'. Inspect gaskets for rocker covers and renew if they are damaged.

Note: Do not unscrew the clamp nut unduly, the thrust washer will come out of position.



1 Plain washer.
2 Spring washer.
3 Plain washer.
4 Rocker.
5 Cylinder head.
6 Rocker Clearance.
7 Valve spring cap.
8 Clamping bolt nut.
9 Clamping bolt washer.
10 Clamping bolt.
11 Cutaway on rocker spindle.
12 Eccentric rocker spindle.

FIG 2 **Rocker adjustment**

Removing cylinder heads. Remove the sparking plugs.

Remove the exhaust pipes and silencers (no need to separate pipes and silencers) by taking away nuts and washers holding pipes to stays and silencers to rear frame, pulling silencer end of each assembly outwards far enough to allow fixing studs to disengage and then pulling each assembly forwards till disengaged from the cylinder head.

Remove air filter (if fitted).

Remove carburetter by taking away the two fixing bolts and withdrawing to the rear.

Lay carburetter aside.

Remove inlet manifold by taking away the four fixing nuts and washers and withdrawing to the rear. Take care not to damage the gaskets between manifold and heads or rubber ring insert.

Remove cylinder head steady plate (secured by three bolts and nuts).

Remove heads by using box spanner 015213 to remove the four nuts that retain each head.

After removal invert each head to dislodge the spacers under the nuts and lay aside to await re-assembly.

The cylinder head gaskets will generally adhere to the tops of the barrels, but care must be taken not to damage them.

To remove the valves. First remove rockers from cylinder head (see fig 2.) The importance of correctly locating the valve spring seats is stressed, the

wide face of the seat abuts against the cylinder head. Reversal will make the springs coil bound and cause damage to the valve gear. Proceed by removing the rockers (see fig 2 for assembly sequence). If a valve spring compressor is not available, use a wood block 2″ in cube to support the valve with the head on a bench.

Compress the springs to extract the split collets, which are a taper fit. A sharp tap on the spring collar will release them.

If the valve springs are retained, identify their location for refitting. Check the four metering plugs in cylinder heads for obstruction, before refitting rockers.

To remove valve guides. Both guides are a force fit and located by circlips, the cylinder head must be uniformly heated, the guide can then be pressed out of the port sufficiently to remove the circlip.

Reheat the head, press down the guide from outside the port.

Removing cylinder barrels and pistons. Unless it is desired to inspect the pistons and rings during decarbonization, they are, as already advised, best left undisturbed. Having removed the cylinder heads, withdraw the cylinder barrels by: Lift away the four push rods, identify them for refitting and lay aside. Dealing with one barrel at a time, exert upward pressure on a barrel, slightly rocking to and fro while doing so, and steady the piston with one hand as it emerges from the barrel. Cover the crankcase throat with clean rag to prevent entry of foreign matter.

To remove piston. Using 011188 circlip pliers, contract one of the gudgeon pin circlips and with a rotary motion, gently withdraw the circlip from its housing. The gudgeon pin may then be pushed out of the piston, which action frees the piston from the connecting rod.

(Being a parallel, floating fit in the piston and connecting rod, small end it is immaterial from which side the gudgeon pin is withdrawn.)

Note: It may be necessary to apply a little heat to the piston to permit free gudgeon pin removal and replacement.

Rings may be removed from a piston by peeling off or by introducing behind them three thin and narrow metal strips, equally spaced round the piston, and then sliding them off, taking care not to scratch the piston.

Carefully examine the contact edge of each piston ring and replace any which do not show a bright surface over the whole circumference.

Oversize or undersize parts: The following are the only 'oversize' variations provided for the vertical twin machines:

Big-end and crankshaft centre main bearings:

Undersize: ·010 below normal (journals to be re-ground to suit).
·020 below normal (journals to be re-ground to suit).
·030 below normal (journals to be re-ground to suit).

Cylinder re-bore: ·020″ and ·040″ oversize. (See 'Technical Data' for normal size.)

Pistons and rings: ·020″ and ·040″ oversize. (See 'Technical Data' for normal size.)

Fitting pistons and cylinder barrels. Pistons to be free of carbon on their crowns and all piston ring grooves to be clean.

Piston rings to be clean and on pistons.

Fit a piston to its connecting rod by: Smear gudgeon pin with clean

engine oil. Place piston over connecting rod, introduce gudgeon pin to piston and pass through connecting rod, press right home against the circlip still *in situ*. Then again using pliers 011188, contract the other circlip, introduce same into its groove in the piston, using a rotary movement. Make quite certain that the circlip lies snugly in its groove because failure to do so will inevitably lead to serious damage. (See *Note*).

Before fitting the cylinders, make sure they are clean and examine the base washers and renew same if not perfect.

To fit new cylinder base washer, first clean off the old washer and all traces of jointing compound. Then smear one side of the new washer with jointing compound and, when that is nearly dry ('tacky') apply to the cylinder.

Place rings on piston, scraper first, then the two compression rings.

On all models, the top compression ring is chromium plated. These chrome plated rings have a slightly tapered exterior and when new are clearly marked with the word 'TOP' on one side to indicate assembly position.

After use, this word tends to become indiscernible, but over a large mileage the assembly position can be determined by brightness of the edge contacting cylinder wall. This bright edge is the lower one. When as the result of wear, contact with the cylinder wall appears uniform over the whole width of the ring, it is immaterial which way round it is refitted. The 650cc two-piece ring, if used, is marked 'TOP'. Space the piston rings so that the gaps are 120° to each other, smear piston and rings and bore of barrel with clean engine oil and supporting the piston with one hand, gently pass over the barrel, compressing each piston ring with the fingers, as it enters the barrel. Press the cylinder barrel right down into the throat of the crankcase.

Fit the second piston, gudgeon pin, rings and barrel in a like manner.

Revolve the engine till the pistons are at the top of their strokes and then, with a clean rag, wipe off all surplus oil. All is now ready to re-fit the cylinder heads.

To re-fit the cylinder heads. *Note:* If the nuts retaining the cylinder heads are finally tightened before the manifold is fitted, a bias can develop between the manifold to cylinder head joint, causing a bad air leak.

Clean the valve stems and the bores of the valve guides with rag moistened with petrol, make sure all other parts are clean, then smear each valve stem with clean engine oil and proceed to re-fit the valve stems by reversing the procedure taken to dismantle them.

Insert the four valve push rods into their original positions and after making sure that the cylinder head gaskets are undamaged and in position, proceed to fit the two heads and *leave the two sets of four cylinder head retaining nuts finger tight.*

Now re-fit the inlet manifold, making sure the two paper gaskets are undamaged and leave the four retaining nuts only just tight enough to ensure correct alignment.

Next, fully tighten down the four retaining nuts on each head, treating each diagonally bit by bit, till all are fully down.

Then fully tighten the inlet manifold retaining nuts and refit the carburetter. Next, carefully check each rocker clearance, as previously described and reset if necessary.

The gasket under each rocker cover should be inspected and if not sound,

should be replaced, after which the rocker covers can be refitted.

Next refit the cylinder head steady plate and securely tighten the three fixing bolts.

Note: Before refitting carburetter make sure the rubber ring in manifold joint face is in position and undamaged.

To re-time the ignition (Magneto Models). Before proceeding to time the ignition it is advisable first to check the contact breaker point gap, which should be from -012″ to -015″, and correct if necessary.

Having loosened the nut securing the magneto driving pinion, release same from the tapered end of the magneto shaft by means of a special extractor, as described on page 22.

Remove the inlet rocker cover from the off-side cylinder head.

Remove the sparking plug from the off-side cylinder.

Insert a small rod into the sparking plug hole, feeling the piston with the end of this rod, carefully turn the engine in its normal direction of rotation until the piston is exactly at the top of the stroke after the inlet valve has closed.

Hold the rod vertical in plug hole, mark the rod where the plug boss registers. Take out the rod, make another mark higher up $\frac{3}{8}$″ for the 500cc and 600cc twins or $\frac{11}{32}$″ for the 650cc models. Re-insert the rod, turn engine *backwards* until the higher mark registers with the plug boss. This applies also to the standard twins. Place the ignition control lever in the fully advanced position.

Next, taking care not to disturb the piston position, turn the magneto in a clockwise direction (looking at the contact breaker end of the magneto) until the contact breaker points are just about to separate by reason of the fibre block on the bell crank lever commencing to mount the lower cam hump.

The exact point of separation is best found by inserting between the contact points a strip of thin tissue paper when the separation point can be determined by the paper just being released with a light pull. Having obtained this position, press the magneto driving gear on to its taper with the fingers and lightly tighten the securing nut.

Re-check the timing by re-positioning the piston and when correct, securely tighten the nut fixing the ignition drive gear.

$\frac{3}{8}$″=39° $\frac{11}{32}$″=35°

Thoroughly clean off all traces of jointing compound from face edges of the timing cover and crankcase, then smear both faces with new jointing compound, which leave till tacky and then re-fit the cover to the crankcase. ('Wellseal' recommended.)

The whole operation of timing the ignition will be found quite simple if the foregoing instructions are carefully followed.

Note: The sparking plug high tension cable for the off-side cylinder is that connected to the rear pickup on the magneto.

To re-time the ignition (Alternator Models). First refer to Electrical Section, paragraph 'Coil Ignition Standard Twins', to understand the principle of the distributor, then remove the distributor cover.

Check the contact gap which should be between ·014″ and ·016″, release clamp bolt, etc.

Position the engine as described for the Magneto Models. If the distributor has been removed, the distributor shaft with the rotor fitted when replaced should be in the approximate position as shown, which is the firing position for the left-hand cylinder. From the near side of the machine turn the rotor in a clockwise direction (fully advanced position). Whilst retaining this position turn the distributor until the contact points are just about to break (see method described for Magneto Models).

Re-tighten the clamp bolt and re-check the timing.

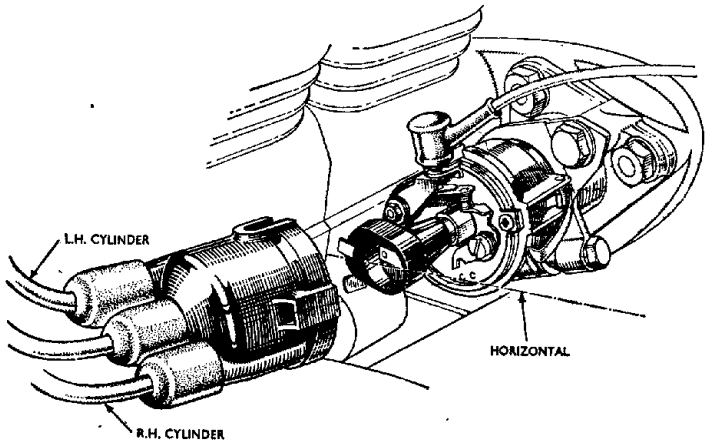


FIG 3 **Coil Ignition timing**

VALVE TIMING. ALL TWIN MODELS

	1957-1958	1959-1962
Inlet valve opens	24° btdc	37° btdc
Inlet valve closes	65° abdc	77° abdc
Exhaust valve opens	63° bbdc	73° bbdc
Exhaust valve closes	25° atdc	43° atdc

(Check valve timing with ·012″ rocker clearance)

Upon removing the timing gear cover (secured by 10 screws) also the pump plate assembly, it will be observed the valve timing gears are marked to facilitate correct assembly.

One tooth gap of the mainshaft small pinion is marked with one centre punch dot and a tooth of the idler pinion into which it meshes, is similarly marked. With these two marks coinciding it will be seen that a tooth on each

side of the intermediate pinion is marked with two centre punch dots which also coincide with a similarly marked tooth gap on each of the camshaft driving gear wheels.

During assembly it is only necessary to mesh the gears with these various marks coinciding to ensure correct valve timing. The dynamo and magneto drive pinions are not marked.

The dynamo does not need 'timing' and if, for any reason, the magneto timing has been disturbed, it is reset as described earlier.

Removal of gears. When completely dismantling the engine there is no necessity to remove the small timing pinion from the crankshaft before splitting the crankcase because the complete crankshaft can be taken away with the pinion still in position.

If, however, it is desired to remove the pinion without completely dismantling the engine a special extractor is required (part number 015273). This consists of a nut, threaded externally and internally. The external threads enable it to be screwed into the threaded centre of the pinion and the internal threads accommodate a specially designed and hardened bolt which, upon screwing down, pulls off the pinion. This same tool is used for the removal of the magneto gear.

The intermediate gear needs no extractor.

The gears on the two camshafts (secured by nuts having left-hand threads) have to be mechanically withdrawn and each has two holes drilled and threaded to accommodate the two bolts of a bridge type extractor (part number 015374), which has a central bolt threaded in the bridge. The two outside bolts are screwed into the holes in the gears whereupon application of the centre bolt being screwed into the bridge bears on the end of the shaft thereby causing the gear to be withdrawn.

The gear on the dynamo needs no extractor because the dynamo, complete with gear assembled, is easily and quickly removed from the engine and the subsequent removal of the gear from the dynamo shaft is a simple workshop operation.

Alternator Twins. To remove distributor pinion, spring outwards the circlip, take out the parallel pin passing through the pinion and distributor shaft – the pinion can then be removed.

ENGINE OVERHAUL

Removing engine from frame. Commence by removing the cylinder heads, cylinders and pistons as detailed earlier.

Removing the chain case (Alternator and Magneto Models). Take out the drain plug and catch oil in a tray.

Remove left side footrest.

Remove brake rod adjusting nut.

Remove inspection cap and alternator wires from connectors.

Remove 14 screws and central fixing nut.

Depress brake pedal and pull chaincase cover away.

Removing the engine sprocket and clutch. Straighten the tab washer, use a

close fitting ring spanner for the engine sprocket nut, which is also the crankcase release valve.

Refit the brake rod adjuster, engage top gear.

Press on the brake pedal and give the ring spanner a series of sharp blows to release the nut.

Remove the three clutch spring adjusters and take out the springs and cups, then the pressure plate or pull off the plate with the springs and cups in it.

Use a stout box key for the gear box mainshaft nut $\frac{13}{16}$" across the flats, press again on the brake pedal and remove the nut. Take out the chain connecting link the clutch, rotor (if fitted) and engine sprocket, watch for the

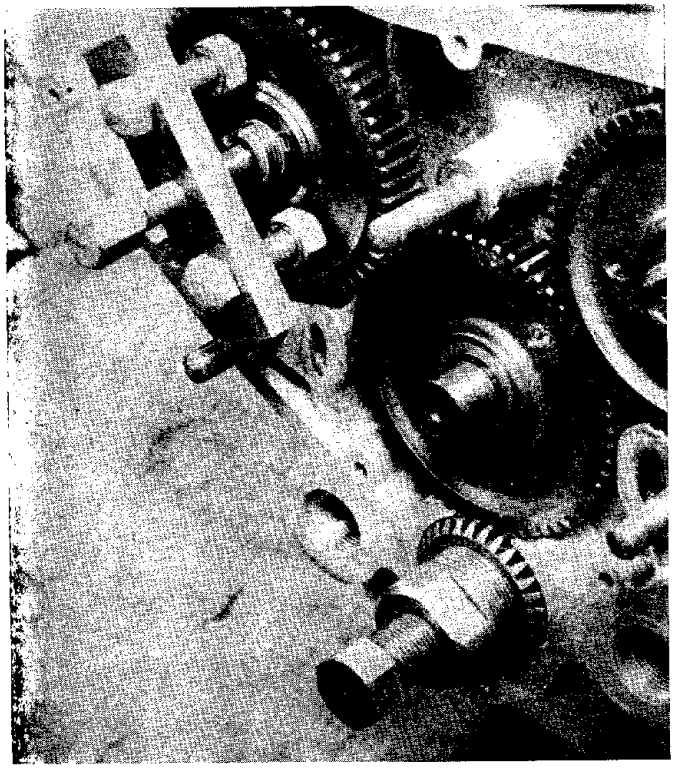


FIG 4 **Extractor tools in use**

engine sprocket distance piece behind the sprocket.

Removing rear portion chaincase. Remove three countersunk screws at front end. Remove central nut, if alternator is fitted. Remove chaincase portion. Drain the oil tank.

Disconnect both oil pipes at crankcase end first, then detach the pipes from the oil tank. A piece of wood or a stout screwdriver placed under the tank can be used as a lever to separate the pipes from the tank. If an engine overhaul is contemplated take off the oil tank for a thorough cleaning.

Removing the crankcase assembly. Remove distributor cover and LT wire or magneto control wire and HT cables, whichever fitted. Remove the dynamo if fitted.

Remove all bolts passing through the crankcase and frame and release only the two gear box fixing nuts. Grasping the cylinder studs, lift the crankcase clear of the frame.

Dismantling the engine. Cleanliness in working is of paramount importance in dealing with an engine of this kind. Clean down the crankcase and get rid of all road grit from the bottom portion, before the assembly is placed on the bench.

Have available magneto pinion extractor 015273, extractor for cam wheels 015374. If the work involved is confined to the cam gear, the magneto, or distributor can be left *in situ*. The pinion for ignition can be marked with a red paint line, with a similar marking on the inlet cam wheel in register, thus leaving the ignition timing undisturbed.

Remove the timing gear cover screws 011820.

Remove nut fixing dynamo.

Remove timing cover.

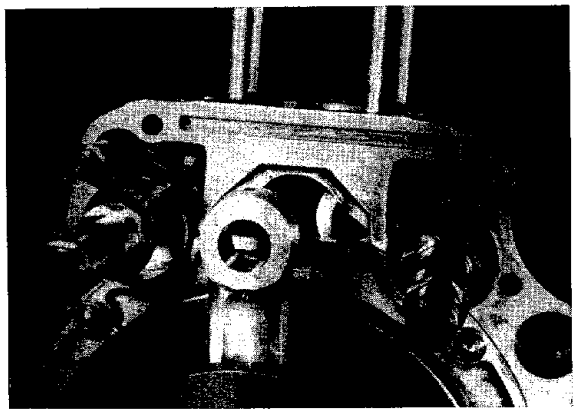


FIG 5 **Camshaft removal**

Remove three nuts 014903 securing pump plate to crankcase and take away pump plate.

At this stage a tool to hold the crankshaft from turning is desirable.

Note: The two nuts securing the camshaft pinions have a *left-hand* thread 011653.

If the magneto has to come off, use the extractor which is also made to remove the small timing pinion 016209.

Remove the two cam wheel nuts 011653, fit the bridge type extractor by engaging the two outside bolts into the holes in the pinion, screw in the central bolt to pull off the pinions.

Remove intermediate gear pinion 021506, the small timing pinion 016209 can remain in position as it will pass through the crankcase, as will the dyno pinion.

Remove crankcase filter unit 026139, the oil distributor cap 014247 and take out the distributor, three 014292 crankcase bolts and bottom crankcase stud.

Note: A rubber-backed seal washer is used on the top front bolt 014292.

Set both con rods at bottom dead centre.

Remove timing side half crankcase from drive side crankcase.

Remove both camshafts, cam followers and spacers (note their location), also tunnels 016472.

Remove six centre web stud nuts 011843.

Remove crankshaft with centre web assembled, the inner members of the two main bearings will come away with the crankshaft.

To remove the magneto. The magneto is located by a spigot on the magneto body. A paper gasket is used between the magneto body and the crankcase. With magneto pinion removed, remove the three nuts fixing the magneto. The two top nuts are on studs, a detachable bolt is used for the lower fixing.

To remove the distributor (fixing as for magneto). Spring outwards the circlip, the parallel pin can then be pushed out through the pinion and distributor shaft. The pinion can then be removed.

To remove the main bearings. The inner member for the main bearing will remain on the crankshaft when it is extracted. Use two screwdrivers, or levers, to prise off the bearing.

Dismantling the pressure relief valve. Press on the plunger via the crankcase filter tunnel and extract the circlip 040049. Take off the washer and spring and remove the plunger.

The centre web. The detachable cap is marked with a letter 'O', the centre web has a similar mark for location after machining. Hold the web in a vice, remove the two self-locking nuts and lift up the crankshaft which will dislodge the cap.

Removing the con rods. The caps on both connecting rods are marked after machining, with an oblique stroke (/), running across the cap and con rod.

Removing the main bearing sleeves. These are a close interference fit in each side of the crankcase, some patience is needed to remove them if damage to the crankcase is to be avoided.

First remove the metal extruded during the process of 'peening' on assembly. Use the sharp point of a scraper, or similar tool, to do this.

Apply heat to the crankcase, concentrated round the bearing housing. In this condition, dropping the crankcase face downwards on to a clean wooden bench, will start the movement of the sleeve sufficiently to get a drift on to the sleeve. Drift out the sleeve parallel with the bore to avoid scruffing the housing.

Removing the camshaft bearings. Two flanged bushes 011654 and one plain bush 010474 are fitted to each camshaft. The plain bush is located in the driving side crankcase. Support the case and drift out the plain bushes, towards the inside of the case.

There is a cavity in the camshaft tunnel between the two flanged bushes.

To extract the inner bush, use a short length of $\frac{5}{16}$" rod, or bar, about the same width as the outside diameter of the bush. If a rod is used, file two flats on each end. Insert the rod or bar diagonally so that it rests on the bush forming a 'bridge'. Place a drift on the 'bridge' and drive out the bush. The second bush can be dealt with without difficulty.

Removing the intermediate pinion shaft. The shaft for the intermediate pinion 021508 is a force fit in the crankcase. To remove, it is preferable to heat the crankcase and drive it out, with the crankcase supported, from inside the case.

Checking the con rod and centre web shells. If attention to the crankshaft bearings is due to excessive movement between the con rods and the crankcase journals, and if the mileage covered is not excessive, a close examination of the bearings shells should indicate the reason for the excessive movement. As already explained, bearings of this kind do not wear prematurely providing the journal surface is smooth and there is a continuous supply of clean and uncontaminated oil passing under pressure through these bearings. If the shells are down and the copper backing is showing with deep score marks, and the *Indium* flash is piled up at one end, this indicates the bearing has 'run', which can only be due to an oil shortage – even temporarily.

Before doing anything further, the cause of the oil shortage should be carefully investigated and before an attempt is made to re-assemble the engine. Where the mileage is considerable, wear on the centre web bearings will cause a fall in oil pressure. Refer to possible cause of oil failure, page 10.

When the bearing shells have a grey matt finish and where the crankshaft journals are worn considerably, abrasive wear is responsible.

Where a groove is cut in the shells, in register with the oil feed hole in the crankshaft, this indicates the presence of foreign matter in the oil. A similar marking will result if the chamfer for the journal oil hole is not restored after a regrind.

If a con rod bearing has been deprived of oil, and the bearing has 'run', without prompt attention the hammering effect, due to the increase in clearance between the bearing and the crankshaft journal can cause ovality in the connecting rod eye.

Usually there is a witness in the con rod eye and in this condition the con rod is scrap. On no account should the faces between the detachable cap and the con rod be filed.

Checking the crankshaft journals. The normal diameter of the journals is

shown in Technical Data. If the wear, ovality or taper exceeds ·001" a regrind is necessary. See page 28 for dimensions.

During the process of regrinding, the radius between the journals and the crankshaft webs must not be removed as this would weaken the structure and possibly cause a fracture.

After regrinding the crankshaft, restore the chamfer for the oil holes in the crankshaft. The journals must have a mirror like finish. A rough surface will tear up the big end shells within short distance.

The small end bearing. The con rod is not bushed for the gudgeon pin. Wear at this point is unknown even after considerable mileage.

Fitting the bearing sleeves. Heat the crankcase in the vicinity of the bearing housing and fit the sleeves before contraction takes place.

Peen the crankcase in three equi-distant positions to prevent the sleeve from moving outwards.

Fitting the camshaft bushes. Introduce into the crankcase the inner flanged bush 011654. Use a draw bolt with two steel washers with an outside diameter of $1\frac{3}{32}$" and pull the bush into position. Deal with the outer bush in a similar manner, but leave this bush protruding approximately $\frac{1}{32}$" so that the end play can be adjusted.

Now fit the plain bush chamfered end first, from inside the case, which is a straightforward assembly.

Ream all bushes to $\frac{3}{8}$"/+ ·001"/— ·000".

Adjusting the end play. When the nut securing the cam wheel pinion is tightened, the pinion will bear hard against the bush flange. A light tap on the pinion fixing nut will move the bush sufficiently to allow free movement. The minimum end play is ·005".

Fitting the intermediate gear shaft. Heat the crankcase in the vicinity of the shaft aperture and press the shaft firmly home.

Assembling the centre web. Hold the straight portion of the web in a vice with soft jaws, with the letter 'O' stamped on it facing the operator.

Fit the bearing shells to the web and cap, apply a little clean grease to each side of the shells (to retain the thrust washer in position). Paint the centre journal with either colloidal graphite or Molybdenum Disulphide. Fit the crankshaft with the drive side facing the operator.

Fit the centre web, cap and thrust washers with the oil slots facing outwards.

Use new self-locking nuts and tighten to 20ft lb.

The crankshaft should be free to turn if the assembly is correct.

Fitting the con rods. Leave the centre web in the vice, paint the big end journals with anti-scruffing compound as prescribed for the centre web.

Fit in turn the con rods, locating the caps with the marking.

Use new self-locking nuts and tighten to 22ft lbs. With new parts and dry bearing the con rod to journal clearance is ·00225". The side play is between ·025" and ·032", and the rod should fall by its own weight.

Assembling the crankcase. The interior of both halves of the crankcase must be perfectly clean.

Carefully examine both crankcase face joints, which must be free from bruises or blemishes particularly at the point where oil is fed under pressure to the channel at the top of the crankcase.

To restore these face joints use a surface plate to remove blemish.

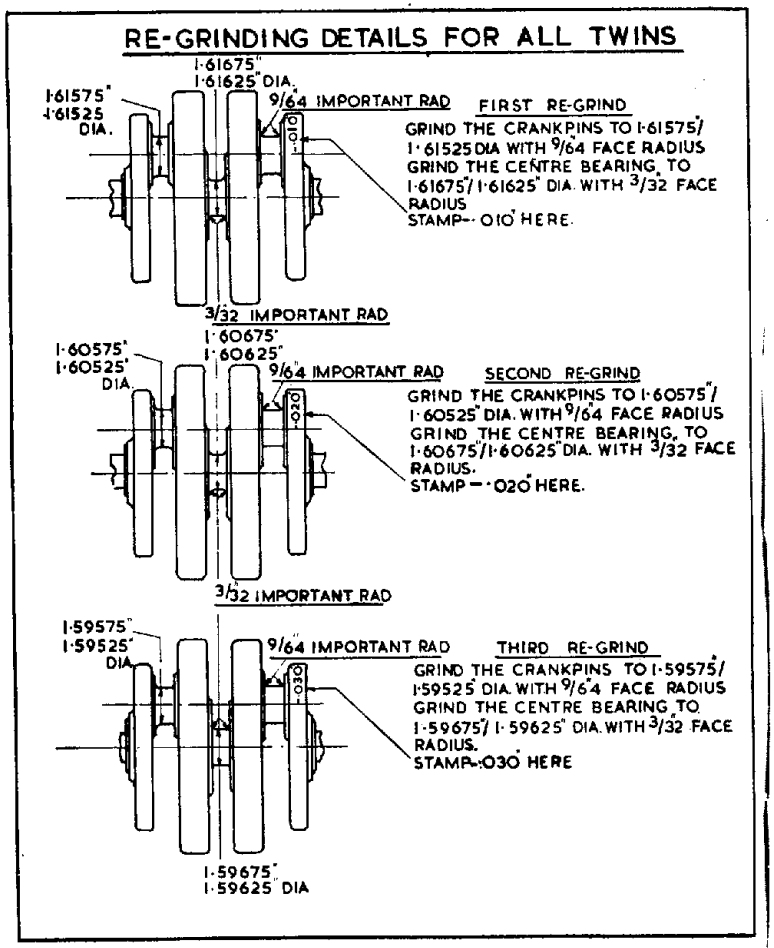


FIG 6

Verify the metering jets are unobstructed.

Oil and re-assemble the pressure relief valve (if fitted) and make sure the plunger works freely, when operated by hand. Needless to say, any moving parts in the engine should be treated with clean oil before fitting.

Fitting the crankshaft. Assemble the two inner members for the main bearings on to the crankshaft.

Insert the crankshaft and centre web assembly into the drive side crankcase, fit the six retaining nuts and washers and tighten to 6ft lb.

Refit the small timing pinion.

Jointing Compound. The use of a shellac base compound should be avoided as this material becomes 'flaky' and particles dislodged can obstruct metered oil passages and cut off the oil supply. A non-flaky compound such as 'Well-seal' is the correct medium to use for an oil-tight joint.

Assembling the crankcase. With the crankshaft in position, apply jointing compound to the driving side crankcase face. Fit the *Paper Gasket* 015304 surrounding the filter tunnel. Paint the camshafts and cam followers with anti-scruffing compound and continue the assembly in the following sequence.

Fit two lower cam followers and two distance pieces.

Fit two camshaft tunnels 016472.

Fit two upper cam followers.

Fit exhaust camshaft 025085.

Fit inlet camshaft 025084, then position the con rods at BDC.

Fit timing side crankcase.

Fit three crankcase clamping bolts and bottom stud.

Fit the magneto or distributor and dyno if fitted.

Fit the cam gear pinions to marking (see paragraph 'Valve timing'), remembering the left-hand nuts for the camshaft pinion and firmly tighten these nuts.

Note: If new camshaft bushes have been fitted see paragraph 'Fitting the camshaft bushes'.

Fit two gaskets 016137 (see fig 1 for location).

Fit one gasket 016138 for feed pump. A little oil on the crankcase will hold these washers in position.

Fit the pump plate with three self-locking nuts.

Note: If the marking on the small timing pinion is not visible, it may be obscured by the washer. The mark is opposite the pinion keyway.

Clean the crankcase filter and see the ball for the non-return valve is free to move, then insert it into the crankcase. Oil and fit the oil distributor bush 022385. Make sure the correct type of washer 023106 for the cap covering the distributor bush hole is used, which is made from copper $\frac{1}{16}$" thick.

Warning: If a thin washer is used between the cap and crankcase, the distributor bush will be end loaded and seize in the crankcase.

Re-tighten the caps on the drive side crankcase when hot.

Re-installing the engine. Pack some clean rag round both con rods to prevent the entry of foreign matter. For ease in handling, the crankcase assembly can be refitted to the frame.

Continue engine assembly as far as fitting both cylinders, then the ignition timing can be set or re-checked, as the piston travel can be measured more easily at this stage.

Before fitting the cylinder heads, flood the camshaft tunnels by pouring some clean oil down the push rod apertures in both cylinders.

Observe the following precautions:

(1) Leave the cylinder head nuts loose until the manifold has been fitted, then tighten to 20ft lbs.

(2) Make sure the oil pipes are correctly positioned at the oil tank end.

(3) Refill the oil tank, with the feed pipe connection loose, allow some oil to drain out and exclude air bubbles to prevent an air lock.

(4) Verify oil is returning to the tank after running engine for a short period.

(5) Do not fit the rocker covers until the oil feed has been checked and reset the rockers if necessary, after settling down.

(6) Re-tighten the cylinder head nuts.

Re-assembling the primary drive. Assemble in the reverse sequence described for dismantling.

Tightening the rotor (Alternator Models). A hammer tight spanner must *not* be used for this operation.

TORQUE SPANNER SETTINGS

Cylinder head bolts	20ft lb
Twin cylinder head bolts (⅜ studs)	25ft lb
Centre web clamp	20ft lb
Con rod nuts	22ft lb
Centre web studs (6 off)	6ft lb

THE GEARBOX

(For 1955/56 gearbox see page 86)

Gear box faults. If difficulty in changing gear from top to third and where it has been ascertained that the clutch is not dragging, the fault can be rectified by attention to the gear change stop plate (55). Take out the plate bolts (73), disconnect the pawl spring. Draw out the two plate holes by elongation to the extent of $\frac{1}{32}$" to enable the plate to go upwards towards the top of the case. The plate must be retained in this position whilst re-tightening the two bolts. Should the fault occur when changing into a higher gear, elongate the holes in the opposite direction to the same amount, so that the plate can be moved downwards.

To summarize, if the fault is in changing *down* move the plate *upwards*, conversely if the fault is when changing *up*, move the plate *down*.

If gear selection is generally uncertain, first verify the location of the pawl spring (88). If this spring is distorted or fitted upside down, gear selection will be uncertain. The correct position is with the straight leg of the spring uppermost.

Oil leaks from kickstarter axle. Check oil content by removing level plug

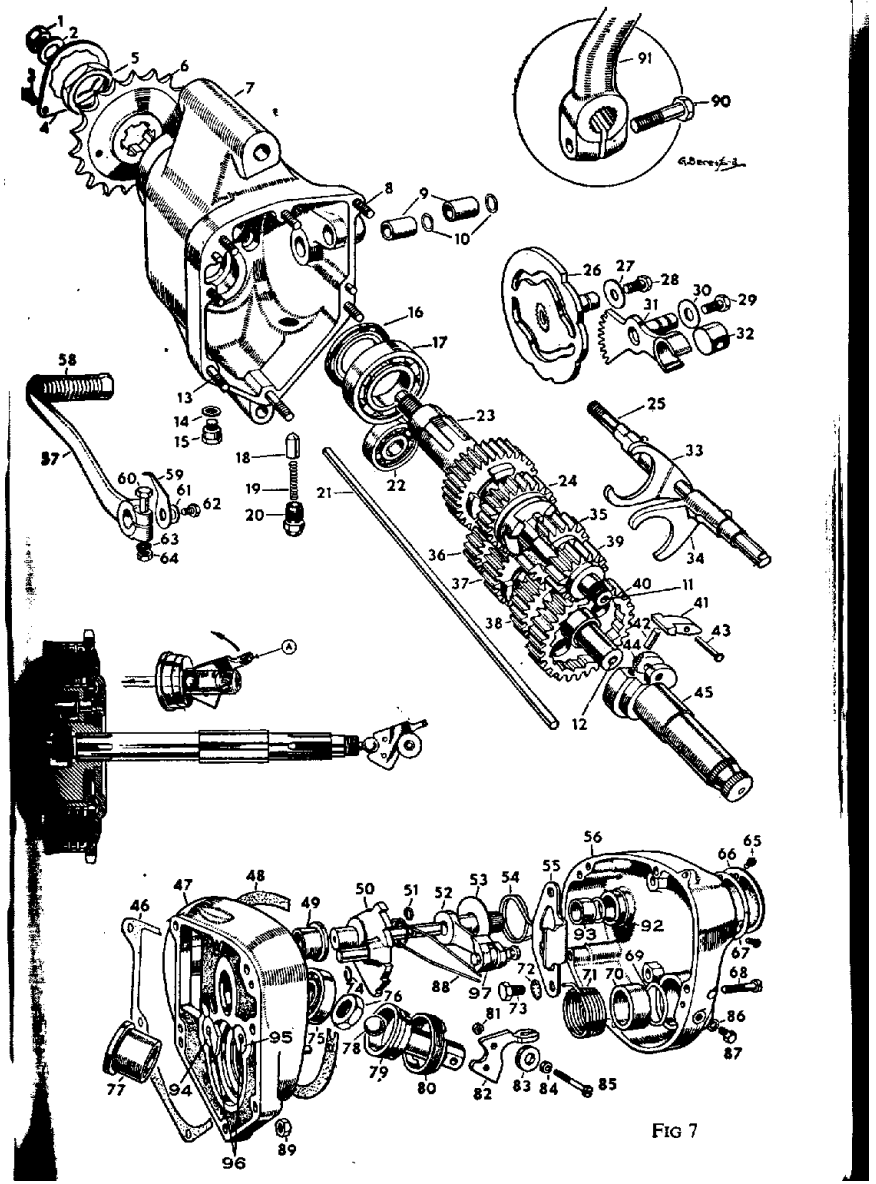


FIG 7

FIG 8
Fitting internals

(87), normal content one pint, or 20 fluid ounces, if normal. Renew the 'O' ring (69), see details 'removing bushes'.

Wear on kickstarter pawl (41). Usually due to a weak kickstarter return spring, causing the crank to depress by inertia over bumpy road surfaces. If the crank is too far away from the vertical position the inertia will increase.

Position the crank approximately 20° left of the vertical position.

Damaged kickstarter stop plate (94). Can only be due to violent backfire causing excessive ignition advance, or too much throttle when starting. Drill the rivet head to remove swaging and push out the pin.

Kickstarter spring disengages. This is due to the end of the spring taking 'a set' where it is located in the cover. Usually it is preferable to fit a new spring.

Gear box noises. First check oil content. After considerable mileage check layshaft bearing for wear, also layshaft fixed gear pinion (36).

Removing the kickstarter axle (45). Lever out the kickstarter return spring from its anchorage in the cover, the opposite end of the spring will come out easily, then pull out the axle.

To replace kickstarter assembly. Fit kickstarter axle, with pawl assembled in cover, turn the axle so that the hole in it for the return spring is at 12 o'clock.

Fit return spring on the axle, insert the end of the spring, which is turned down vertically into the hole drilled in axle. Using tool recommended for spring removal, hooked in opposite end of spring, pull the spring sufficiently to enable the turned in end to enter hole drilled in the cover.

Replace inner and outer cover as detailed previously.

Dismantling the gear box. (Figures in parenthesis apply to fig 7.) If the gear box is to be completely dismantled, first remove the clutch as detailed for 'removing engine from frame', including the rear portion of the front chain case. Have available a new set of gaskets.

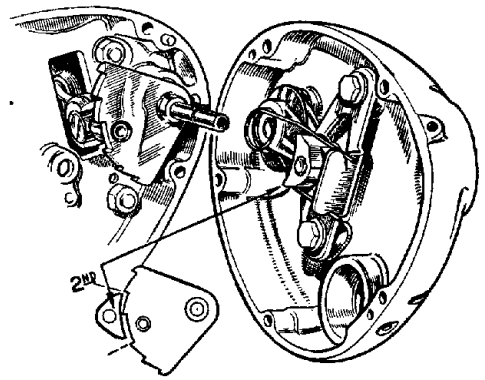


FIG 9.

Removing the outer cover (56). Remove drain plug (15), catch oil as it drains.
Remove inspection cap (66) and disconnect clutch cable inner wire.
Remove bolt for indicator (62), leave pedal in position.
Remove kickstarter crank bolt (90) and take off the crank.
Remove five cheese-headed screws securing cover (68).
Remove cover by pulling on the gear change pedal.

Removing the inner cover (47). Remove ratchet plate and spindle (5).
Remove clutch operating arm and roller (82).
Remove lock ring (80), take away the body and ball.
Remove mainshaft nut (74).
Remove seven nuts (89) securing the cover.
Remove cover by tapping the rear portion until it is clear of the dowels.

Removing gear box internals. Remove low gear on mainshaft (39).
Remove striker fork (25) by unscrewing.
Remove striker forks (33 and 34).
Remove clutch push rod.
Remove mainshaft (11) with the gears on it.

Remove layshaft and gears; it may be necessary to rock the shaft sideways to extract from bearing.

Removing the cam plate (26). Remove the dome nut (20) and take out the spring and plunger.

Remove two bolts (28 and 29) over the plunger housing.

Remove the cam plate and quadrant.

Removing the sleeve gear (23). Remove screw fixing lock plate (4).

Remove sleeve gear sprocket nut (5), which has a *left-hand* thread.

Use a good fitting ring spanner across the flats and refer to method of removing this type of sprocket nut described for 'Lightweight gear box'.

Remove sleeve gear sprocket which is splined; also distance piece.

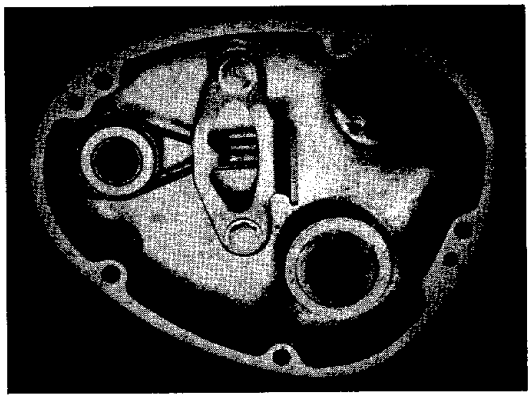


FIG 10.

Remove sleeve gear by tapping it through the bearing (17).

Removing sleeve gear bushes. Two thin bushes of the oilite type are used as a bearing for the mainshaft.

Note the location of these bushes *in situ*, before they are pressed out. As the material is somewhat brittle, exercise extreme care in pressing in the new bushes

The internal diameter of both bushes *in situ* is ·81325" to ·81200".

Removing sleeve gear bearing (17). Remove by prising out the oil seal (16) and sleeve for seal.

Remove bearing after first heating shell and drift out.

Alternatively drop the shell face downwards on a clean bench, when this bearing, also the layshaft bearing (22), will drop out.

Removing the bearings. Pre-heat the inner cover and press out from inside the case the mainshaft bearing (77).

If desired the kickstarter axle bush can be extracted at the same time. To do this, firmly support the inside face of the cover and press out the bush from *outside* the cover.

Removing the footchange spindle bush (99). This is fitted into a blind aperture. Pre-heat the case and screw in a coarse threaded tap to extract. Use the same method to remove the bush in the kickstarter axle.

Note: The footchange bush does not require reaming when renewed. If the kickstarter axle bush 0[illegible]0146 is renewed, ream to ·6875" to ·6865" *in situ.*

Re-assembling the gear box. *Note:* Apply some clean oil to all moving parts before fitting.

Fit the sleeve gear ball race (17) and layshaft bearing (22), pre-heat the shell and ensure bearings are entered squarely; apply a little clean oil.

Fit sleeve gear through bearing, and oil the sleeve or distance piece for oil seal.

Fit sleeve gear sprocket and firmly tighten left-hand sprocket nut.

Fit lock plate and screw.

Refitting the cam plate (26). The cam plate must be correctly positioned on assembly, otherwise the four gears will not be indexed properly.

(1) Fit the quadrant (31) also its bolt and washer.

(2) Raise the lever portion of the quadrant, with the radius of the lever in line with the top right hand cover stud (top gear).

(3) Insert the cam plate so that the first two teeth of the quadrant can be seen through the slot in the cam plate, then fit the bolt and washer (27).

Fitting the internals:

(1) Insert the mainshaft and fit to it the third gear (24).

(2) Fit the second gear (35) with the striker fork (33) in the pinion groove, then insert the projection of the striker into the groove in the cam plate.

(3) Fit the first gear (39).

Assemble the layshaft by:

(4) Fitting the fixed gear (36), third gear (37) and second gear (38) with the striker fork (34) in the slot for second gear.

(5) Insert the projection of striker fork into cam plate slot, with layshaft in the bush.

(6) Line up the two holes in the striker forks and pass through the spindle (25) and firmly tighten.

(7) Fit the first gear (40).

To complete the assembly. Insert the roller (32) into the quadrant in position to receive the spindle for the footchange. Examine the gasket (46) for blemish, locate it and refit the inner cover. Before finally tightening the clutch body lock ring (80) verify the operating lever (82) is in line with the clutch cable entry, to ensure a straight pull on the inner wire. Do not use force, if the cover does not go home easily, take it off and find out why. Check the position of the pawl spring (88) and refit the outer cover. Refill one pint of SAE 50 oil.

Replacing the footchange pedal spring. With the outer cover removed, take out the quadrant (50) and the pawl spring behind it. Tap out the footchange sleeve (52) and its washer (53). Remove two bolts (73) and lift away the plate.

The position of the pedal spring assembled is shown in fig 10.

THE CLUTCH

Three types of clutches have been used since 1957. The original design had loose friction inserts in the clutch sprocket, also in the friction plates.

This type of clutch was used on all heavyweight models up to 1959, with the exception of the CSR models, which were equipped with the bonded type clutch.

All 1960-61 models use bonded type clutches.

For the 1962 season a heavy duty five-plate type clutch was introduced for 650cc CSR models, which can be used on any earlier model.

The early type clutch can be converted by using the following components:

1 Back plate 040584.
1 Clutch sprocket 040359.
4 Steel plates, plain 043191.
4 Friction plates 043192.
1 Friction plate 043193.

Clutch slip. The clutch operating mechanism is shown in fig 7. To enable the clutch to function satisfactorily it is essential to have clearance between the clutch push rod and the thrust stud (C). The fact that there is play, or lost motion, at the handlebar lever end does not guarantee there is clearance between the push rod and thrust stud.

To obtain the correct adjustment run down, as far as possible, the clutch cable adjuster. Remove the chain case cap for the clutch. Release the nut (B) using a screwdriver screw in the thrust stud until it just touches the clutch push rod.

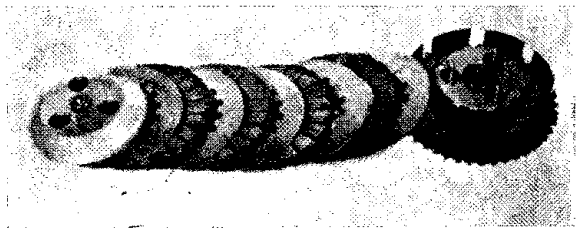


FIG 11 **Early type clutch**

Unscrew the thrust stud half a turn then re-tighten the lock nut with care to avoid the stud moving during this process. Now reset the cable adjustment by unscrewing the adjuster, leaving $\frac{1}{8}$" to $\frac{3}{16}$" free movement between the outer cable and the adjuster.

If the fault prevails, take down the clutch and check the steel plates for buckle. Put all these plates together and hold up to the light, which will indicate if one or more of the plates are buckled, which reduces the friction area.

New type steel plates are 'dimpled' to prevent buckling.

Replace buckled plates with the new type.

An excess of oil in the front chaincase will adversely affect the clutch. Friction plates so affected should be de-greased as they are usually serviceable. Avoid the use of petrol or paraffin and use trichlorethylene. Alternatively,

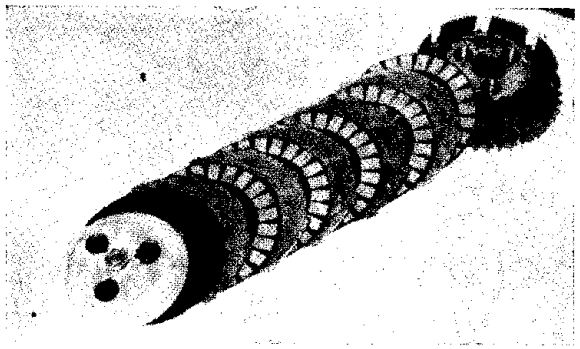


FIG 12 **1962 type clutch**

copiously dust the inserts with Fullers Earth to absorb the oil.

Check also the clutch spring cups, which may be fouling the holes in the alloy pressure plate, preventing the spring from exerting maximum pressure. Apply a little grease to the cups before refitting.

Clutch springs. If the clutch has been slipping for any length of time, the heat generated is calculated to weaken the springs, which should be renewed. The correct free length is $1\frac{45}{32}$". The five-plate clutch spring free length is $1\frac{1}{16}$". Discard springs which have collapsed to the extent of $\frac{3}{16}$".

Clutch spring adjusting screws. If there is a tendency for the springs adjusting screws to become unscrewed, take out the spring, lift up the end of the spring with a penknife and file the end of the spring to give a square abutment of $\frac{1}{8}$" or get rid of the feathered end. The abutment will then come up against the indentation at the back of the adjuster and prevent it unscrewing. The correct location of the adjusting screws is with the head of the spring stud just flush with the face of the adjusting screw.

If the machine is a combination and heavy loads are carried, and the early type clutch is used, convert the clutch to the bonded type as already described.

Clutch drag. This is due to torque on the gear box mainshaft and creates noisy gear engagement. The cause is due to the clutch plates not separating when the clutch is operated. The fault may be due to:

(1) Excessive play in the operating mechanism (see clutch slip).
(2) Uneven adjustment of the clutch springs.
(3) The steel plates are buckled.
(4) The clutch plates are gummy.

In the case of (2), take off outer portion of chaincase, operate the clutch lever and note if the outside plate is withdrawn parallel with the plate behind it. If the gap between the two plates is uneven, manipulate the spring adjuster until the gap is equal and evenly between the two plates, with a preference for screwing in the adjuster to balance.

In the event of (4), treat the clutch plates as recommended for clutch slip to get rid of the gumminess.

Needless to say, continual use with clutch drag can cause damage to the gear box pinions.

Clutch nut works loose. If the mainshaft nut securing the clutch to the mainshaft works loose, this is due to damage to the splines in clutch centre for the shock absorber 040354. To remedy, replace the centre and avoid overtightening the mainshaft nut.

To remove a clutch control cable. Remove the oil filler cap from the kickstarter case cover.

Screw right home the clutch cable adjuster that is located in the top of the kickstarter case cover.

Disengage, from the operating lever, the clutch cable inner wire by operating through the oil filler cap opening.

Completely unscrew the clutch cable adjuster.

Disengage, from the handlebar operating control lever, the clutch inner wire.

Pull cable, by its lower end, till removed from the machine, easing it through the frame cable clips while doing so.

FRONT FORKS UP TO 1963

(The figures in parenthesis refer to fig 15)

Stiff fork motion. First try the effect of releasing the two bolts securing the front mudguard to the fork slider (15). If normal movement is restored use washers between the mudguard and the slider to relieve side strain, or remove the guard and spread the sides. Try also releasing the four cap nuts (33) and work the forks violently to line up the inner tube and re-tighten the nuts.

If the fork motion is unduly stiff, and assuming the fork tubes are not bent by impact, it is possible that the back bushes (9) have swollen and are a tight fit on the tubes.

To rectify, dismantle the forks and ease down the inside diameter of the bush with emery cloth, until it is an easy sliding fit. Oil the fork tube, or use graphite before assembly.

Fork noise on full deflection. Check the bottom cover tube (53) for contact with the slider extension (54), the cover tube may be deformed or canted. Remove the cover tube and set the tube face where it abuts against the fork crown (39) so that it is at complete right angles to the axis of the tube. The tube should be concentric with the slider extension. Usually there are score marks on the slider, under these circumstances.

Rattle in forks. One of the damper rods (25) may be detached from the top anchorage. A low oil content will have the same effect.

Fork spring rattle. Three neoprene rubber sleeves (Nos 2, 4 and 5) are placed over the fork inner tubes, near the top, bottom and centre of the fork spring. If these sleeves have piled up at the bottom of the spring, the spring can rattle against the fork tube. Reposition or renew the sleeves to rectify. Apply some grease to the fork springs before refitting.

Lateral fork movement. If the steering head bearing adjustment is correct and if there is a juddering effect when the front brake is applied, this can be due to lateral movement caused by wear on the black fork bushes. The movement can be detected also by jacking up the front wheel clear of the ground when, by raising and lowering the front wheel, the movement will show up. Replace the bushes to rectify.

It is rare for the steel bushes to be affected, providing the fork oil content is not contaminated by abrasive. When replacing the bushes make sure the inside of the fork tubes is perfectly clean.

Indifferent steering. If the machine is inclined to steer in an elongated figure of eight, this denotes unwanted friction in the steering which can be due to:

(1) Steering head bearing over tightened.
(2) There is friction, which cannot be released if a steering damper is used.
(3) The steering head bearing is unduly loose and the fork stem is rubbing against the inside of the ball race.
(4) The ball races are pitted, as a result of driving with a loose bearing adjustment (see 'Steering head adjustment').

In the case of (2) take out the bolt securing the steering damper plate to the frame. If the friction is removed, use washer(s) between the plate and the lug on the frame.

Handlebars oscillate at low road speed. This trouble is not associated with the front forks, or wheel alignment. If the handlebars oscillate or 'wobble' at low road speed and stops as the road speed increases, this is due to either one or both tyres not running true with the wheel rim and invariably becomes manifest after the tyres have to be changed. In the main the front tyre is responsible.

Oil leaks from forks. First try the effect of tightening the slider extension (7) to compress the oil seal against the bush. If the leakage persists, replace the oil seal (8).

Should the leak take place at the lower end of the fork slider (15) check the damper tube bolt (31) and its washer for security.

Loose head lamp brackets. The top fork cover tube (20) with lamp bracket incorporated is compressed between the handlebar lug (41) and the fork crown (39) with a rubber packing ring (18) interposed. If the rubber ring deteriorates or collapses, the tension on the tube will be reduced. Usually the trouble can be rectified without completely dismantling the front forks, by using a fork spring leather washer 021116 for each cover tube as packing.

Release the two nuts (45 and 46).

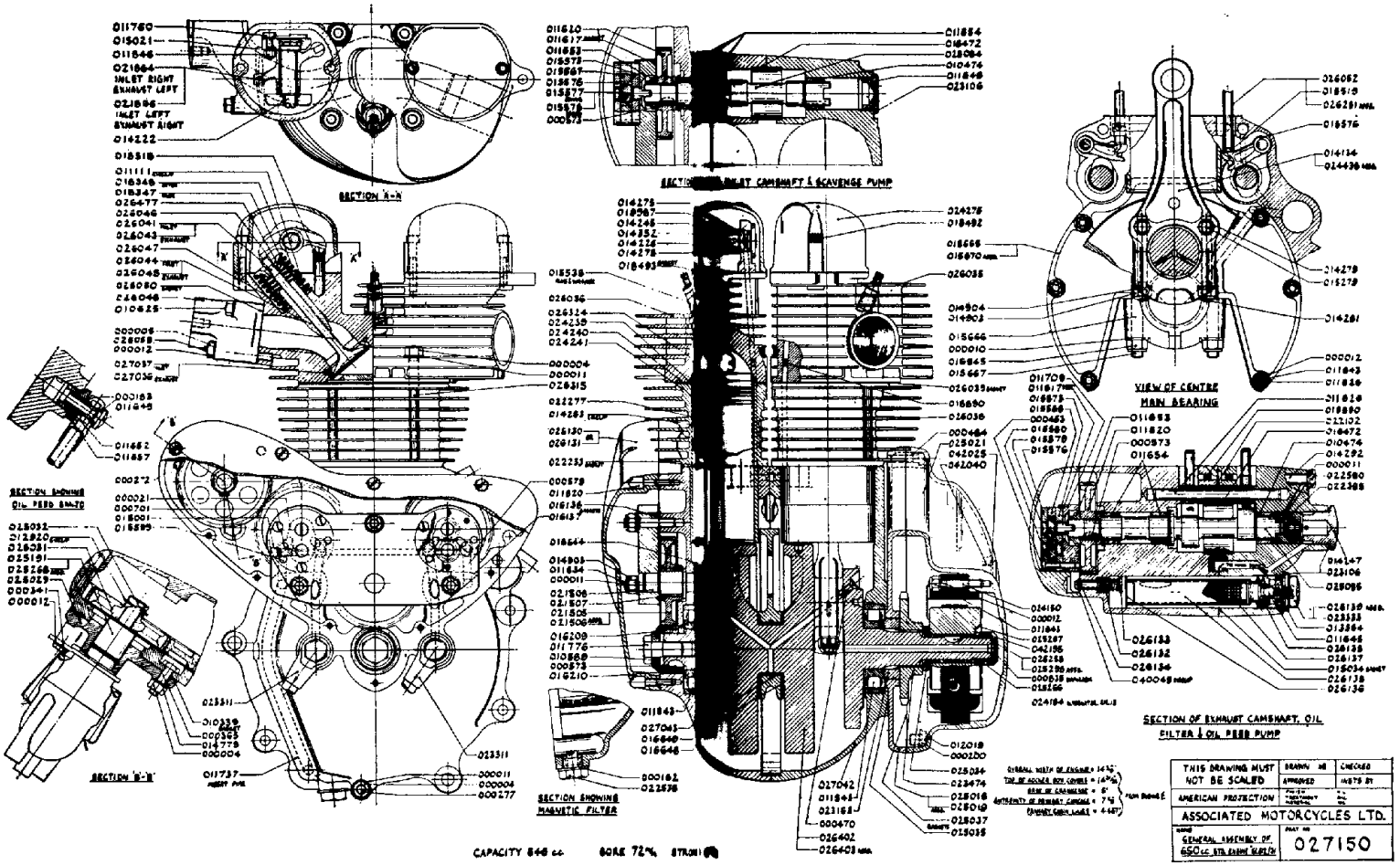
Tap upwards the handlebar lug (41).

Make a cut across one side of the washer and feed it round the fork tube between the rubber and the fork crown. A little soapy water will assist the washer to slide over the rubber.

Re-align the head lamp and tighten the two nuts.

Head lamp beam. If the lamp beam is out of parallel to the machine, thump the head lamp shell with the heel of the hand in the required direction.

Bent fork inner tubes (17). The fork tubes can be straightened providing the set does not exceed 10° out of true.


SECTION A-A
SECTION SHOWING INLET CAMSHAFT & SCAVENGE PUMP
VIEW OF CENTRE MAIN BEARING
SECTION SHOWING Oil FEED SHAFT
SECTION 'B-B'
SECTION SHOWING MAGNETIC FILTER
SECTION OF EXHAUST CAMSHAFT, OIL FILTER & OIL FEED PUMP
INLET RIGHT EXHAUST LEFT
INLET LEFT EXHAUST RIGHT
THIS DRAWING MUST NOT BE SCALED
AMERICAN PROTECTION
ASSOCIATED MOTORCYCLES LTD.
GENERAL ASSEMBLY OF 650cc 6TH EDITION SERIES
027150
CAPACITY 646 cc
BORE 72%
STROKE

Support the tube in 'V' blocks and use an Arbour press.

Note: The fork tubes must be smooth and free from bruises and blemish, particularly in the part where the oil seal operates, otherwise the seal will be damaged beyond further use, with serious oil leakage.

Dismantling the forks. Hold the fork stem in a vice.

Remove slider extension (7) from the slider (15) by unscrewing from the slider.

Remove slider by giving it a sharp jerk downwards. The oil seal is a close fit in the top of the slider. If there is resistance in separating the slider, apply a little heat to the top part, which will expand and enable the slider to come away with ease, with the damper assembly attached.

Remove two Allen screws (38) then pull out the fork tubes.

To remove steel bush. Prise out the circlip (12) and pull off the bush. If the circlip becomes distorted during removal, replace it with a new one.

To dismantle the damper tube. Use a thin wall box key to take out bolt (31) in the slider recess $\frac{1}{2}$" across the flats, pull out the damper tube, with damper rod assembled.

Pull out the circlip (37), extract the damper rod with valve assembled. If the valve is taken off the rod, watch for small pin (27).

To remove one fork tube. If attention to one fork tube only is necessary, the fork tube and components can be extracted by:

(1) Taking out the front wheel, mudguard and stays.
(2) Remove the domed nut (22), disconnect the damper rod and release the Allen screw (38).

Usually the fork tube is a close fit in the two top members (39 and 41), thus to avoid damage to the internal thread in the fork tube, a draw bolt is required, which is also used to pull back the tube.

Insert the tool into the fork tube which can now be driven out.

If at this stage the slider has to be removed, and if the tube is held in a vice, use a suitable clamp and hold the tube at the top and away from the oil seal travel.

Assembling the forks (without a draw bolt). Hold the fork crown in a vice.

Assemble a fork tube with its components as described in 'Assembling the forks with a draw bolt'.

Push the fork tube into the fork crown.

Insert the key 018667 in the Allen screw.

With one hand pull up the tube until it protrudes $6\frac{1}{2}$" and quickly tighten the Allen screw.

Then assemble the second tube in a similar manner.

Fit the crown races with bearings as previously described and pass the fork stem through the frame.

If assistance is available hold the forks in position, assemble the top frame race and bearings.

Alternatively, place a box under the forks to support.

Assemble the two top cover tubes and handlebar lug, connect the damper rods to the top bolts.

Engage the top bolts as far as possible, then release the clamp screws.

Firmly tighten the top bolts then the clamp screws. (See 'Special precautions'.)

Adjust the steering head bearings and fill oil to each fork tube.

Steering head adjustment. The steering head frame races are of the floating self-aligning type and have spherical seats. Therefore they do not fit tightly in the head lug.

Occasionally test the steering head for correct adjustment by exerting pressure upwards from the extreme ends of the handlebars.

Adjust steering head bearings by: Jacking up the front of the machine so that all weight is taken off the front wheel. (A box under each footrest serves that purpose.)

Slacken the two fork crown Allen screws.

Slacken the domed nut at top of the steering column.

Screw down the nut underneath the domed nut a little at a time and while doing so, test the head assembly for slackness by placing the fingers over the gap between handlebar lug and frame top lug, at the same time exerting upward pressure by lifting from the front edge of the front mudguard. Tested in this manner the slightest slackness is discernible.

Continue to tighten the lower adjusting nut until no perceptible movement can be felt and yet the steering head is perfectly free to turn, then tighten down the domed nut in order to lock the adjustment.

Securely tighten the two fork crown Allen screws (this is very important).

Remove packing from under footrest.

Special Precautions: It is vitally important to firmly and positively tighten the two Allen screws (38) which clamp the fork tubes.

Movement between the tubes and the fork crown (39) will cause 'fretting' which can weaken the tube.

Never attempt to repair a fork slider after damage by impact, by welding. Where serious damage has occurred after frontal impact, carefully examine the slider for latent cracks.

Steering angle. When the Duplex tube frame was introduced in 1960, a slight alteration to the steering angle was made to improve steering, also road holding. The parts affected are the fork crown and stem and the handlebar lug.

Whilst the difference between the old and new parts is exceedingly small, it does affect interchange of the fork parts individually, *viz*, whilst both the new type handlebar lug with fork crown can be used on early models (with the exception of CSR models with siamesed exhaust pipes) as a pair, they cannot be used separately.

As the new parts are virtually identical in appearance, they can be identified by the figure 6 stamped on each part.

Fitting a sidecar. To accommodate the extra load the solo fork springs should be exchanged for a stronger type (see 'Table of fork springs'). In the case of a heavy type sidecar, the rear suspension springs must be exchanged also. Fit a steering damper to offset heavy steering and stop handlebar wobble.

See 'Technical data' for engine sprocket.

To re-assemble the forks (using a draw bolt). Check steering head races for pitting or damage. Pack the lower crown race with grease and fill with 28 steel bearings, put the lower frame race over the stem to retain the bearings. Pack the top frame race with grease, fill with 28 bearings and place it in the frame.

Take up the fork crown and pass it through the frame, fit the handlebar lug and hold these two members together by fitting the nut (46).

Assemble the top cover tubes in the sequence shown in fig 16 and fit them between the fork crown and handlebar lug. It may be necessary to release the nut (46) to do this, then re-tighten this nut to clamp the cover tubes. The steering head adjustment can be dealt with later.

Assembling the fork tube. With the fork tube horizontal apply a little oil to the bottom end of the tube.

Fit the oil seal, metal backing towards the top, use a rotary motion at the bottom end of the tube.

Fit the black bush, flange upwards, buffer spring and collar (42).

Fit one circlip, the steel bush and second circlip.

Fit from the top end, slider extension, leather washer (6).

Take up the fork slider, with damper rod assembled, pass it over the fork tube from the bottom end, engage the slider extension.

Fit rubber sleeves, spaced over fork spring length.

Fit main spring, leather washer and top tube (16).

Fit the tube assembled into the two top members, as far as it will go, tighten the clamp screw lightly to hold the tube in position.

Fit the draw bolt, well engaged in the tube and pull the tube home.

Firmly tighten the clamp screw to stop the tube from moving and take away the tool.

Fit damper rod (see 'Changing fork springs') to top bolt and firmly tighten. Fill each tube with 6½oz (186cc) SAE 20 oil.

Changing the fork springs. The fork springs can be examined, or exchanged, without entirely dismantling the forks. A draw bolt is necessary for this operation.

First detach the front brake cable at the handlebar end.

Take out the two fork tube nuts (49), disconnect damper rods.

Release the two Allen screws (38), clamping the fork tubes.

As the front wheel spindle is attached to the forks, it is obvious that the fork tubes are extracted simultaneously. To do so, engage the fork tool in the tube (a fair way down) and drive the tube downwards a small amount.

Transfer the tool to the other fork tube and treat it likewise.

Repeat the operation, transferring the tool from one tube to the other, until they are clear as depicted.

To re-assemble. Refit the assembly and enter the tubes as far as they will go. The tubes should be parallel with the covers. Run back the large nut on the tool and engage it in one of the tubes. Run down the tool nut and tighten, to pull the tube back a slight amount, thus reversing the method used for extracting the tubes.

An old engine push rod, with the adjusting cup taken out can be used to bring up the damper rods. Alternatively, use a loop of copper wire. Assemble the damper rods to the top anchorage and firmly tighten the lock nuts. Refit the tube top bolts, firmly re-tighten the two clamping screws.

Frame strip down. Strip down as detailed for removing the engine and gear box.

Take out both wheels, also take off the head lamp and loom by:

Disconnecting the battery wires and removing the twin seat.

Disconnecting horn, coil and rectifier cables (if alternator model).

Disconnecting control box cables (if fitted) and take it out of the tool box.

Disconnecting stop light switch and rear lamp wires.

Release screw on head lamp rim and take it away with reflector assembly. Disconnect main and pilot bulb wires; also speedo lamp wire. Place the reflector in a safe place.

Disconnect speedo drive cable, pass the cable through the head lamp and fork crown.

Remove dipper switch with cables.

Remove head lamp bolts, release clips on frame, take the head lamp away with the loom.

Remove the front forks as described in 'Fork section'.

Remove frame cover, secured by two slotted screws.

Remove oil tank by taking out the top front fixing bolt.

Remove air cleaner (two bolts).

Remove tool box attached to rear frame loop by two $\frac{1}{4}$" bolts.

Remove both rear suspension units.

Removing the rear mudguard. Remove $\frac{1}{4}$" bolt securing gear guard to frame loop.

Remove $\frac{5}{16}$" stud fixing bottom front of the guard to the frame lug.

Remove bolt (3) and spacer (see fig 74), and chain guard.

Remove bolt fixing rear chain guard at front.

To remove the rear loop. Remove stud uniting rear loop to seat lug.

Remove nut for stud on right side of rear loop.

Remove this stud with brake pedal attached, take away the rear loop.

Remove screw for plate in swinging arm.

Release the two cotter pin nuts which locate the bearing tube. Push out the bearing tube.

Swinging arm bushes. The two flanged bushes are housed in steel sleeves which are not supplied separately. The bushes are of the oilite type, but provision is made for lubrication via the centre plate screw (use heavy duty oil). If lateral movement develops at the wheel end this could be due to end float between the arm and the frame lug, particularly after long mileage, with a sidecar attached.

Taking up side play. When it has been ascertained that end play is manifest, it is extremely difficult to absorb this movement by moving the bushes with the arm assembled in the frame, even with a sturdy support on one side of the arm. Whilst the bush in the opposite end is drifted in, there is always a certain amount of spring in the two extremities of the arm. It is therefore preferable to take the swinging arm away from the frame.

To decide if the bearing tube or the bushes are worn, the spindle diameter is ·9995"/·9990", the bush diameter *in situ* is 1·001". At the factory a pilot reamer 1" diameter is used for these two bushes, for correct alignment.

WHEEL BEARINGS

The break down of the front wheel bearings is shown in fig 14. It is vitally important to avoid tightly adjusting bearings of the taper roller type, as a crushing action takes place, the rollers will be damaged beyond further use.

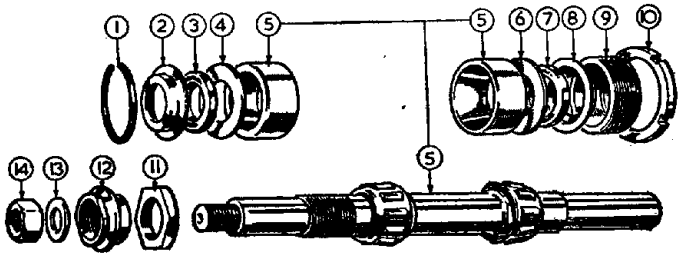


FIG 14 **Front wheel bearings**

1 Circlip.
2 Oil seal cup.
3 Oil seal.
4 Washer retaining seal.
5 Wheel spindle complete.
6 Washer retaining seal.
7 Oil seal.
8 Oil seal cup.
9 Adjusting ring.
10 Adjusting ring locknut.
11 Nut locating brake coverplate.
12 Nut securing brake coverplate.
13 Spindle end washer.
14 Spindle end nut.

Should excessive movement suddenly develop, the bearing should be dismantled for inspection, for with correct adjustment and constant lubrication, these bearings will last indefinitely.

To dismantle the bearing. Remove the front wheel.

Remove nut securing brake cover plate (12).

Remove locating nut (113) and washer.

Remove locking ring (10) and cover disc.

Remove adjusting ring (9).

Press out the spindle from the threaded end which will push out items 6-7-8 and bearing ring 5.

The bearing ring will remain in the left side of the hub.

To extract the bearing ring. Press in the washer (4) sufficiently far enough to permit the circlip (1) to be extracted.

Use a piece of steel tubing passed through the hub and drift out the bearing sleeve, which will also eject the washer (4), oil seal (3) and collar (2).

Avoid using heavy hammer blows when taking the spindle out as this action can cause indentations in the bearing sleeve.

Adjusting the front wheel bearing. Release the locking ring (10), screw in the adjusting ring (9) until the bearing is devoid of end movement, unscrew the adjusting ring half a turn only, give the opposite end of the spindle a light blow to move the bearing ring away from the bearing.

Position the cover disc and firmly re-tighten the lock ring.

There should be approximately ·002" side rock at the wheel rim if the adjustment is correct. The friction of the oil seals can create a false impression that the bearing is tight.

Dismantling rear wheel bearing (fig 18). Before removing the rear wheel, release the speedo drive fixing nut (16), disconnect speedo cable and take out the wheel.

Remove the nut (16) and speedo gear box, release the lock ring (13).

1963 INTERIM MODELS

For the 1963 season all models, excluding the model CSR, were fitted with journal type wheel bearings, as opposed to the taper roller type previously used. No adjustment to these bearings is possible, or necessary; the only attention needed is to renew lubricant and clean every 10,000 miles, the bearings being lubricated on initial assembly.

The front wheel (excluding models CS-CSR-Trials). Two journal bearings type RMS 6 are used in the front hub with a pull-out wheel spindle. A super oil seal is fitted against the bearing on the brake drum side to prevent grease entering the brake drum.

A similar oil seal is used in the bearing retaining sleeve at the opposite end of the hub, also a felt sealing ring.

The hub is packed with grease during assembly, subsequent lubrication should not be necessary until the machine has covered 10,000 miles, when the bearings can be re-greased if necessary. (See table of lubricants.)

To remove the front wheel. With the machine on the centre stand, disconnect the front brake cable from the brake expander lever, then remove the bolt (securing the torque stay) from the brake plate and release the spindle nut 000001.

Remove the four nuts securing the detached fork slider caps, take off bolt slider caps, when the front wheel can be removed.

Dismantling the front hub. Both wheel bearings are a press fit into the hub.

To avoid 'scruffing' the bearing housings in the hub during the process of removing and refitting the bearings, the hub must be gently heated to cause the hub material to expand and relieve the interference fit. Have available a new oil seal 029263.

With the front wheel removed, take off the spindle lock nut 029246, pull out the spindle and brake plate.

Remove oil seal collar 029262.

Prise out the oil seal 029263.

Gently heat the hub in the vicinity of the wheel bearing 029264 (do not concentrate the applied heat in one place) drop the hub on to a flat wood bench, when the bearing will move away from the centre of the hub. Invert the hub, use a suitable drift to drive out the bearing, placing the drift on opposite sides of the bearing so that it is extracted parallel with its housing.

Pull out the bearing spacing tube 029266.

Remove the lock ring *left-hand thread* 029238, also the hub disc.

Unscrew the bearing retaining sleeve 029269.

Re-heat the hub and drift out the second bearing as described for the first one.

To assemble the front hub. Gently heat the right side of the hub, insert the bearing and press it fully home by screwing in the bearing retaining sleeve (*left-hand thread*). Invert the hub and pack some grease against the bearing just fitted. Insert the bearing spacing tube and fill some more grease to the hub. Re-heat the brake side of the hub, insert the bearing and press it fully home.

Fit the oil seal (metal backing outwards) flush with the hub.

Fit the hub disc and secure it with the lock ring.

Insert the oil seal collar into the oil seal, put the spindle through the brake plate and the hub and tighten the spindle fixing nut.

Refitting the front wheel. Refit in the reverse sequence given for removal, with the following precautions: ensure the bolt fixing the brake torque arm to the brake plate is securely tightened. Do not over tighten the four nuts securing the two fork slider caps.

The rear wheel (excluding models CS-CSR-Trials). A journal type bearing RMS 5 is used in the right side of the rear wheel hub, also a roller type bearing CRL 8 in the brake drum. The pull-out spindle passes through both bearings and the hub.

The wheel is detachable from the brake drum.

To remove the rear wheel. Using the box key 029385 (supplied with the tool kit) remove the five extended nuts 029235.

Remove the wheel spindle nut 014869, pull out the wheel spindle, when the speedometer drive will come away from the hub with the drive cable attached.

Slide out and towards the rear the spindle distance piece 029243, the wheel will now come away from the brake drum.

If the machine is leaned over on the right side, the wheel will come out under the brake drum. Alternatively, detach the right side silencer.

To re-fit the rear wheel. Put the wheel back, insert the spindle through the frame and hub (without the distance piece of speedometer drive), which will help to line up the wheel.

Fit the five extended nuts and screw home lightly.

Take out the wheel spindle, fit the distance piece, put back the spindle with speedo drive through the hub and frame.

Position the speedometer drive and cable, re-fit and tighten the wheel spindle nut. Now firmly re-tighten the five extended nuts.

Re-fit the silencer, if removed.

Dismantling the rear hub. With the rear wheel removed, unscrew the bearing retainer sleeve 029236 (*left-hand thread*) together with the oil seal and distance piece, which will come away with the retainer. Invert the hub, extract the circlip 029234 (use round-nose pliers) take out the distance piece 029231.

Gently heat the hub in the vicinity of the bearing 029233, drift out the bearing.

Removing the oil seal 029237. Tap the oil seal distance piece out of the bearing retainer, which will dislodge the oil seal.

Rear brake drum. To remove the roller bearing, use a suitable drift or a piece of steel tube to drift out the roller bearing. Invert the brake drum and press out the oil seal.

WHEELS AND BRAKES 1964-1966

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.

To re-fit 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 re-tighten the spindle nut.

To remove the rear wheel. The rear wheel is detachable from the brake drum. With the rear wheel clear of the ground: Take out the three rubber grummets (4). Remove the sleeve nuts (8) which retain the wheel to the brake drum. Unscrew the wheel spindle (20) and remove it. Take away the distance piece, between the speedometer drive, which will come away also, there is no need to separate the cable from the drive. Pull the wheel away from the driving studs in the brake drum. Incline the machine to the right side, then pass the wheel under the left side silencer, clear of the machine.

To remove the brake drum. With the rear wheel removed: Take off the brake rod hand adjuster, then remove the rear chain connecting link. Release the nut securing the dummy spindle, pull back the brake drum clear of the fork ends.

To dismantle front hub. The wheel hubs are packed with grease during initial assembly, and should not need further lubrication for at least 10,000 miles, when the hubs should be dismantled for cleaning and fresh grease used. To dismantle the front 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.

Assembling the hub. Clean and re-pack 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.

FIG 15 **Exploded view of Teledraulic Forks**

1 Washer, leather, for fork spring top seating.
2 Buffer, rubber, for fork inner tube.
3 Spring, main, for front fork.
4 Buffer, rubber, for fork inner tube.
5 Buffer, rubber, for fork inner tube.
6 Washer, leather, for fork spring bottom seating.
7 Extension for fork slider.
8 Oil seal, for fork inner tube.
9 Bush, top, plastic, for inner tube.
10 Spring, buffer, for front fork.
11 Washer, plain, for fork slider cap securing stud.
12 Circlip, locating fork inner tube bottom bush.
13 Bush, bottom, steel, for fork inner tube.
14 Circlip, locating, fork inner tube bottom bush.
15 Slider, for fork, with studs (right side).
16 Tube, fork cover, bottom.
17 Tube, fork, inner.
18 Rubber ring for top cover tube housing ring.
19 Housing ring, top cover tube.
20 Tube, fork cover, top, right, with lamp lug.
21 Spigot ring top cover tube.
22 Bolt, top, for fork inner tube.
23 Adaptor.
24 Nut, lock for top end of damper rod.
25 Rod, for fork damper.
26 Sleeve, plunger, on fork damper rod.
27 Pin, stop, for fork damper valve.
28 Nut, lock, for damper valve seat.
29 Stud, securing cap to fork slider.
30 Washer, fibre, for damper tube bolt.
31 Bolt, fixing damper tube to slider.
32 Cap, for fork slider.
33 Nut, for fork slider cap securing stud.
34 Tube, for fork damper.
35 Seat, for fork damper valve.
36 Valve, for fork damper.
37 Clip retaining damper rod sleeve.
38 Screw, pinch, for fork crown.
39 Fork crown, not sold separately.
40 Stem, for fork crown, not sold separately.
41 Lug, for handlebar and steering head.
42 Collar for buffer spring.
43 Washer for fork stem adjusting nut.
44 Ring, rubber, sealing, for inner tube top bolt.
45 Nut, lock, for fork stem.
46 Nut, adjusting, for fork stem.
47 Clip (half only), for handlebar lug.
48 Screw, pinch, for handlebar clip.
49 Bolt, top, for fork inner tube.
50 Spigot ring top cover tube.
51 Tube, fork cover, top, left, with lamp lug.
52 Housing ring top cover tube.
53 Tube, fork cover, bottom.
54 Extension, for fork slider.
55 Slider, for fork with studs (left side).
56 Screw, plug, with fibre washer, for fork slider oil drain hole.

N.B.: Washer (43) deleted from assembly.

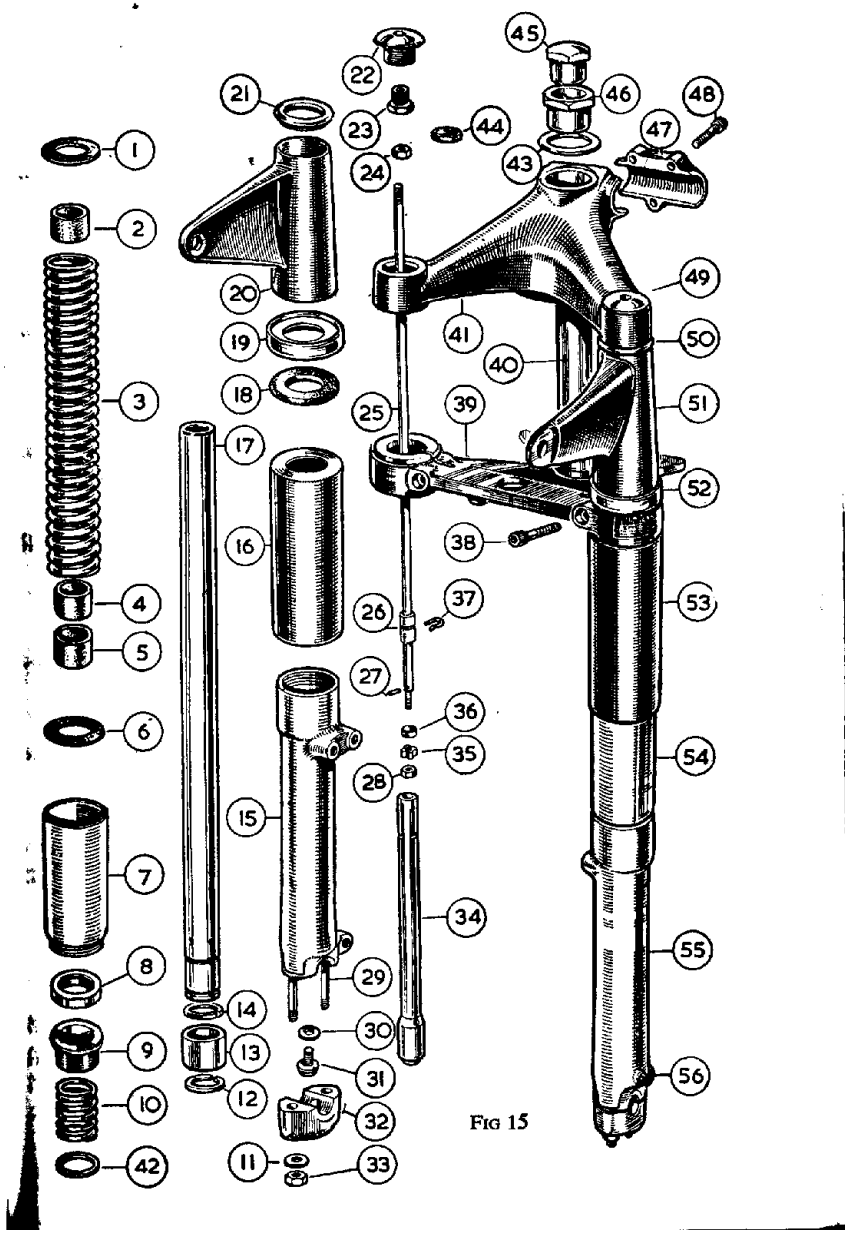


FIG 15

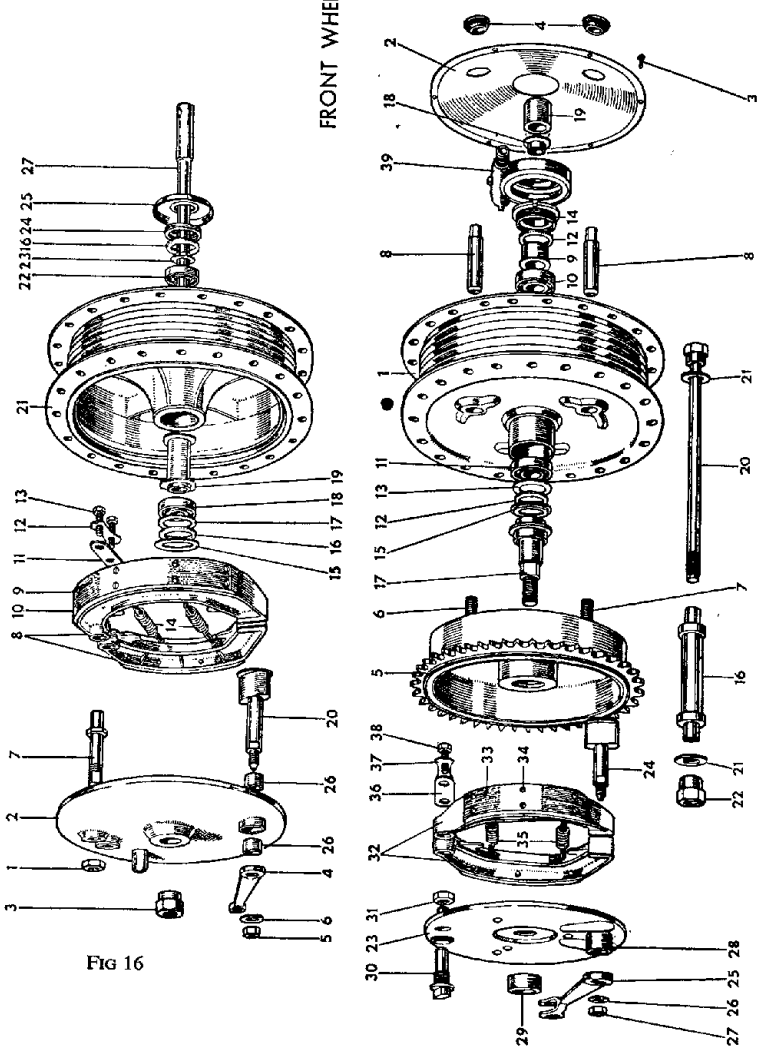


FIG 16

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

Rear hub dismantling. With the wheel removed, remove the speedometer drive lock ring (this has a *left-hand thread*), take out felt washer and distance piece. To eject the bearing use the wheel spindle with its washer also the distance piece that goes between the speedometer drive and the frame placed on the spindle. Partially drive out the bearing until it abuts against the reduced diameter inside the hub. Take out the spindle, use a short length of steel tubing with the outside diameter slightly smaller than the inside diameter of the bearing and drive out the bearing.

Invert the wheel, then drift out the other bearing, which will take with it the steel cup, felt washer and the thin steel washer.

Assembling the hub. Deal with the bearings as already described and assemble by first fitting the single row bearing, in the reverse order described for dismantling, with the following precaution: when tightening the *left-hand* lock ring avoid damage to the slots for the speedometer drive. Finally 'peen' the hub dished washer to the hub. The hub assembly sequence is shown in fig 20.

Dismantling the brake drum. A bearing is not used in the brake drum; when the spindle nut is removed together with the spacer and washer, the spindle can be taken out.

FRONT FORKS 1964 TO 1966

Lubrication. Use one of the grades of oil, SAE 20 as shown in the table of lubricants. The normal oil content is five fluid ozs (142cc). 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 17 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.

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.

Filling oil. It will be seen that 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 5 ozs. Replace the drain plugs before filling, also firmly tighten the filler plugs after.

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 bearing at the first 100 miles, and then occasionally, as the mileage increases. Using the machine with movement in these bearings will damage the races.

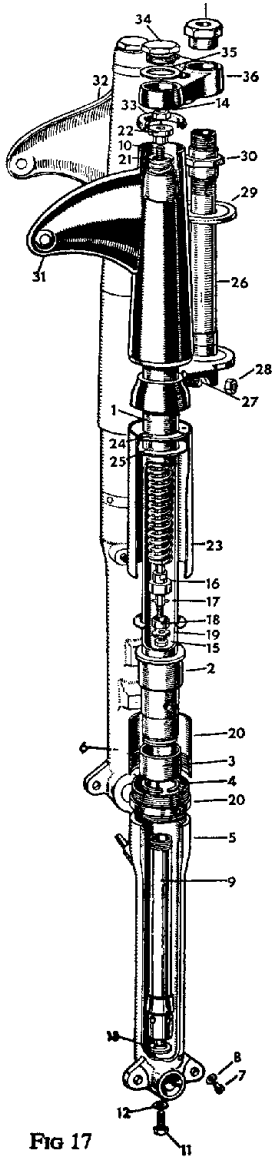


FIG 17

1964 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.
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.

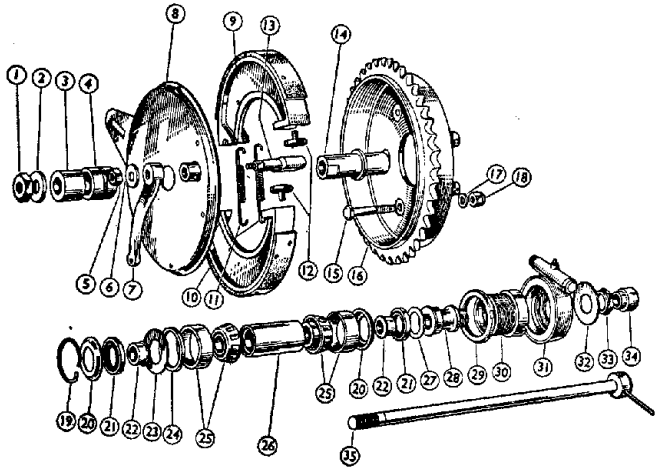


FIG 18 **Non-quick-detachable Wheel Assembly**

1 Nut for wheel solid spindle.
2 Washer, for wheel spindle nut.
3 Spacer, for wheel spindle nut.
4 Spacer, for cover plate, outer.
5 Nut, for expanded lever.
6 Washer, for expander lever nut.
7 Lever, expander.
8 Plate, cover.
9 Shoes, brake, with linings.
10 Linings, for brake shoes.
11 Spring, for brake shoes.
12 Pin thrust, adjusting brake shoes.
13 Expander, for brake shoes.
14 Spacer, for cover plate, inner.
15 Bolt, retaining, sprocket to hub shell.
16 Sprocket and brake drum.
17 Washer, sprocket retaining bolt.
18 Nut, sprocket retaining bolt.
19 Ring, spring, locating bearing.
20 Cup, for bearing oil seal.
21 Oil seal, for bearing.
22 Spacer, on spindle, for oil seal.
23 Ring, retaining hub bearing, large.
24 Spacer, between bearing and oil seal.
25 Bearing, roller.
26 Spacer, between bearings.
27 Ring, retaining hub bearing, small.
28 Spacer, on spindle, for speedometer gearbox.
29 Nut, lock, bearing adjusting ring.
30 Ring, adjusting bearing.
31 Speedometer gearbox.
32 Washer, outside, speedometer gearbox.
33 Nut, locking, speedometer gearbox.
34 Spacer, on spindle, speedometer gearbox side.
35 Spindle, rear wheel solid.

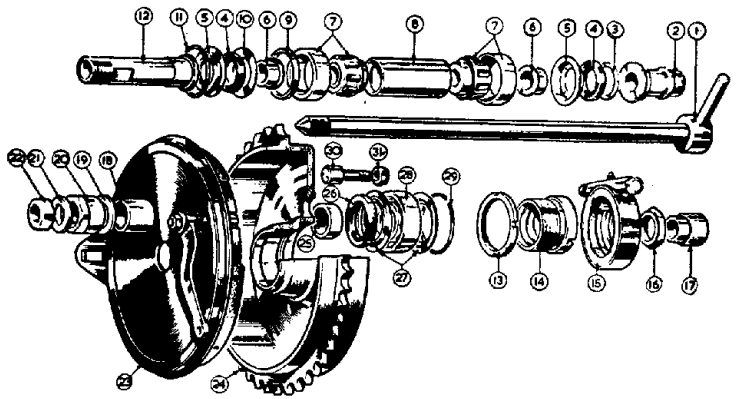


FIG 19 **Rear Brake and Wheel Bearings, De-luxe Models**

1 Withdrawable wheel spindle.
2 Speedometer gearbox sleeve.
3 Ring retaining oil seal (small).
4 Oil seal.
5 Cup for oil seal.
6 Oil seal distance piece.
7 Taper roller bearing complete.
8 Spacer between bearings.
9 Bearing spacing collar (brake side).
10 Ring retaining oil seal (large).
11 Circlip.
12 Brake drum dummy spindle.
13 Lock nut for adjusting ring.
14 Adjusting ring.
15 Speedometer gearbox complete.
16 Speedometer gearbox fixing nut.
17 Spacer for withdrawable spindle.
18 Outer spacer for brake cover plate.
19 Washer for cover plate fixing nut.
20 Brake cover plate fixing nut.
21 Spindle end washer.
22 Spindle end nut.
23 Brake cover plate complete.
24 Rear brake drum.
25 Inner spacer for brake cover plate.
26 Brake drum bearing oil seal.
27 Brake drum oil seal washers.
28 Brake drum ball bearing.
29 Circlip retaining bearing.
30 Driving peg (5 off).
31 Nut securing driving peg (5 off).

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 1⅜" 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 movement. Re-tighten the column nut, also the clamping stud nuts.

Steering lock. The lock is pressed into the handle bar lug, and can be removed by driving it out from underneath. A number is stamped on the bottom of the lock for key identification.

Dismantling the forks. The forks can be removed as a unit, or the fork legs can be removed individually. To take out one fork leg remove the front wheel as described elsewhere. Take off the front mudguard with stays. Release nut for pinch bolt (28). 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.

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 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 18 in each race (36 in all) if a steering damper is fitted detach the fixed plate from the frame.

To dismantle a fork slider. Remove from the fork slider the bolt fixing damper tube (11). Unscrew the bottom cover (23), holes are provided for a C spanner. 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 tube cap (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 17.

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.

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 5oz of SAE 20 oil to each fork leg.

ELECTRICAL SERVICE

LUCAS A.C. LIGHTING-IGNITION UNIT

ALTERNATOR MODEL RM15

The alternator consists of a spigot-mounted 6-coil laminated stator bolted to the outer portion of chaincase with a rotor carried on and driven by an extension of the crankshaft. The rotor has an hexagonal steel core, each face of which carries a high energy permanent magnet keyed to a laminated pole tip. The pole tips are riveted circumferentially to brass side plates, the assembly being cast in aluminium and machined to give a smooth external finish.

Thus there are no rotating windings, commutator, brushgear, bearings or oil seals and consequently the alternator requires no maintenance apart from occasionally checking the snap connectors in the three output cables are clean and tight, which are located behind the frame cover which is located by two knurled screws.

If it is necessary, for any purpose, to remove the rotor, there is no necessity to fit keepers to the rotor poles. When the rotor is removed wipe off any metal swarf which may have collected on the pole tips. Place the rotor in a clean place.

Normal running. Under normal running conditions (*ie* ignition switch in IGN position) electrical energy in the form of rectified alternating current passes through the battery from the alternator – the rate of output depends on the position of the lighting switch. When no lights are in use, the alternator output supplies the ignition coil and trickle-charges the battery. When the lighting switch is turned, the output is automatically increased to meet the additional load of the parking lights and again when the main bulb is in use

Emergency starting. An EMERGENCY starting position is provided in the ignition switch for use if the battery has become discharged. Under these conditions, the alternator is connected direct to the ignition coil, allowing the engine to be started independently of the battery.

Once the engine is running, turn the ignition switch back to the normal running position, otherwise misfiring will occur.

Emergency charging. Should the battery become discharged a temporary boost charge can be effected during daylight running, by an alteration to the alternator connections.

The snap connectors are located behind the frame plate, which is secured by two knurled screws.

(1) Disconnect the green and yellow and green and black connectors.

(2) Reconnect the green and black to the green and yellow.

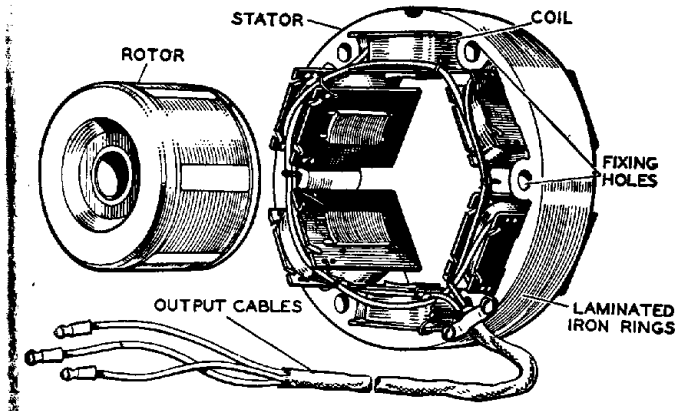


FIG 20

(3) Do not interfere with the green and white cable.

It is stressed that this is a temporary measure, prolonged use will adversely affect the battery.

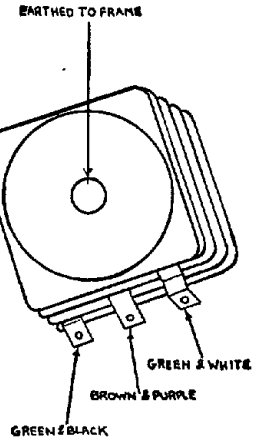


FIG 21

Rectifier. The rectifier is a device to allow current to flow in one direction only. It is connected to provide full-wave rectification of the alternator output. The rectifier is mounted on the tool box under the twin seat.

The rectifier requires no maintenance beyond checking that the connections are clean and tight. **The nut clamping the rectifier plates together must not under any circumstances be slackened, as it has been carefully set during manufacture to give correct rectifier performance.** A separate nut is used to secure the rectifier to the frame of the motor cycle.

Note: It is important to check periodically that the rectifier is firmly attached to its mounting bracket.

LUCAS COIL IGNITION (ALTERNATOR TWINS)

The ignition equipment comprises a Model MA6 coil with a Model 18D2 distributor assembly. The contact breaker with automatic advance mechanism is mounted in the distributor body.

The distributor has a flange fitting retained to the crankcase by one bolt and two nuts.

The drive is by gear pinion on the distributor shaft which is located by a parallel pin passing through the distributor shaft and the pinion. The parallel pin is retained by a circlip encircling the boss on the pinion.

An efficient oil seal encircles the distributor shaft to prevent oil entering the contact breaker compartment with an 'O' ring on the body for oil retention. A bronze thrust washer is fitted between the pinion and the distributor body. A clamp incorporated in the flange mounting, when released, will allow the distributor to be moved for ignition timing. The rotation is anti-clockwise.

Cleaning. To be carried out every 6,000 miles. Remove and clean the distributor cover, which must be handled with care. Pay particular attention to the spaces between the metal electrodes in the cover, and check that the small carbon brush moves freely in its holder.

Lubrication. Lift off the rotor arm, and unscrew the two screws securing the contact breaker base plate. Remove the base plate and lubricate the automatic advance mechanism with clean engine oil, paying particular attention to the pivots.

Re-fit the base plate and rotor arm.

Examine the contact breaker. The contacts must be free from grease or oil. If they are burned or blackened, clean with fine carborundum stone or very fine emery cloth, afterwards wiping away any trace of dirt or metal dust with a clean petrol-moistened cloth.

Contact cleaning is made easier if the contact breaker lever carrying the moving contact is removed. Before re-fitting the contact breaker lever, lightly smear the cam and pivot post with clean engine oil.

No grease or oil must be allowed to get on or near the contacts.
After cleaning, check the contact breaker setting.

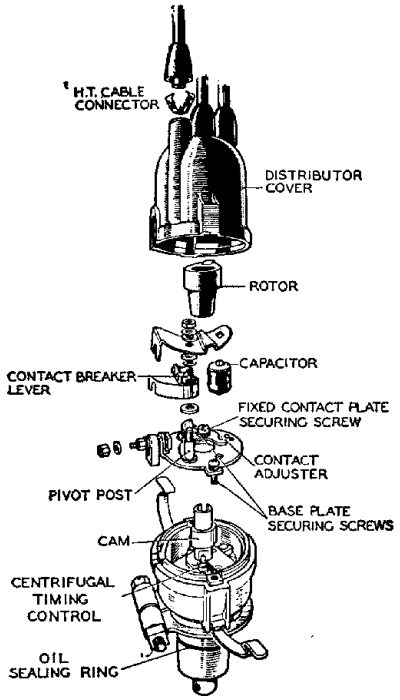


FIG 22

Contact breaker setting. The contact breaker gap should be checked at the first 500 miles and subsequently at every 6,000 miles. To enable the engine to be rotated freely and slowly, remove both sparking plugs and distributor cover. Turn the engine slowly until the heel for the moving contact is on the peak of the cam (maximum separation). Check the gap by introducing a feeler gauge (which must be clean) between the points which should be a sliding fit with the correct gap, the correct setting is ·014″ – ·016″.

To adjust the gap, ensure maximum separation, slacken slightly the screw securing the fixed contact plate.

Insert the screwdriver between the two projections on the base plate and the notch in the fixed contact plate and adjust to obtain the correct gap.

Re-tighten the fixed contact screw and re-check the gap.

IGNITION COIL (ALTERNATOR TWINS)

The coil, Type MA6, requires no attention whatsoever beyond keeping its exterior clean, particularly the terminals and occasionally checking that the connections are tight.

When the high tension cable shows signs of perishing or cracking it must be renewed, using 7mm pvc-covered or neoprene-covered rubber ignition cable.

To remove the old cable from the ignition coil, pull the cable together with its connector from the moulded terminal socket. It is advisable to fit new connectors when renewing ignition cables.

The coil is clipped to the front-frame top tube underneath the petrol tank.

CAPACITOR (ALTERNATOR MODELS)

The capacitor is now attached to the base plate by a screwed extension. Take away the base plate to remove capacitor. Fig 22 shows the early type.

MAGNETO MODELS

ELECTRICAL EQUIPMENT

Lucas electrical equipment is fitted and this comprises three independent electrical circuits, as follows:

(1) IGNITION – Magneto, High-tension wires, Sparking plugs and Cut-out switch.
(2) CHARGING – Dynamo compensated voltage control unit and Battery.
(3) LIGHTING AND ACCESSORIES – Lamps, Horn, Switches and Wiring.

IGNITION

A Lucas type K2F magneto is fitted. The replacement part number is 42230-A and the part number of the complete contact breaker is 492854.

Lubrication and adjustment is required every 3,000 miles, cleaning is required every 5,000 miles and every 10,000 miles the complete unit should be handed to a Lucas Service Station for dismantling, replacement of worn parts, cleaning and lubrication.

Lubrication every 3,000 miles. Smear the cam ring inside and out with Mobilgrease No 2. Apply a spot of clean engine oil to the tip of the pivot post.

No oil must be allowed on or near the contacts.

To remove contact breaker. Take out the hexagon-headed screw from the centre of the contact breaker, then pull the assembly off the tapered shaft. When re-fitting, ensure the projecting key on the assembly engages with the keyway cut in the armature shaft. Incorrect assembly will affect ignition timing.

Adjustment every 3,000 miles. Remove the contact breaker cover and turn the engine until the contact points are fully opened. Check the gap with a gauge having a thickness of ·012" (spanner 015023 has a gauge of this thickness as an integral part of it). If the setting is correct the gauge should be a sliding fit, but if the gap varies appreciably from the gauge it should be

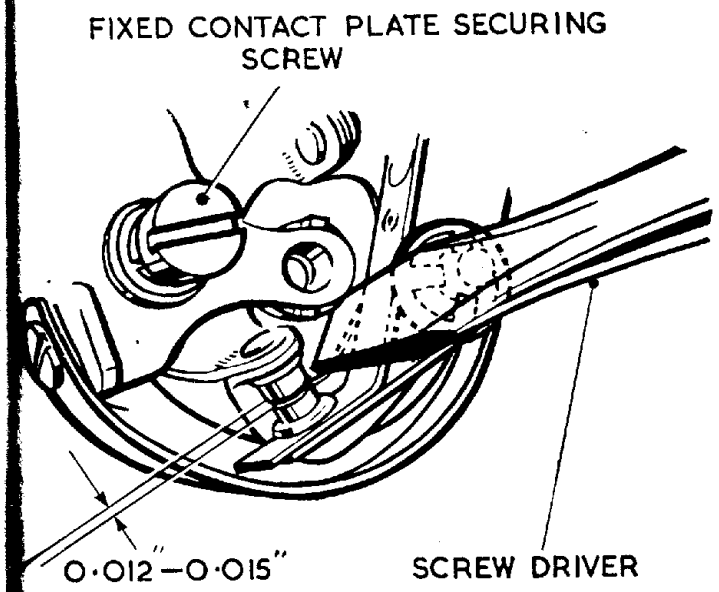


FIG 23

adjusted by releasing the fixed contact plate securing screw and using a screwdriver as shown in fig 23.

Cleaning every 5,000 to 6,000 miles. Take off the contact breaker cover and remove the contact breaker. If the contact points are burned or blackened, clean them with a fine carborundum stone or with very fine emery cloth, and afterwards wipe away any dust or dirt with a petrol-moistened cloth. After replacing the contact breaker check the point gap and, if necessary, re-set it.

Remove the high tension pick-ups (held by swinging spring clips), wipe clean and polish with a fine dry cloth. The high tension pick-up brush must move freely in its holder.

If it is dirty, clean with a cloth moistened with petrol. If the brush is worn to within $\frac{1}{8}$" of the shoulder it must be renewed. Treat both pick-ups and their brushes.

While the pick-ups are removed, clean the slip ring track and flanges by holding a soft cloth on the ring by means of a suitably shaped piece of wood, while the engine is slowly turned.

If, on inspection, the high tension cable shows signs of perishing or cracking, it must be replaced by a suitable length of 7mm pvc-covered, or neoprene ignition wire.

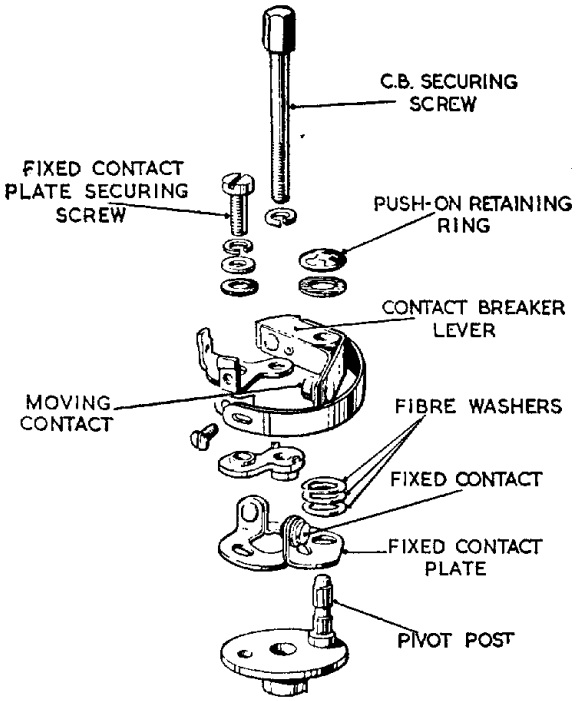


FIG 24

Magneto removal and fitting. The magneto is 'spigot fitting' and is retained to the crankcase by two studs and one bolt.

To remove the magneto it is necessary to:

Take away the timing gear cover.

Withdraw the driving gear from the magneto shaft. (Already described in the 'Engine Section').

Disconnect the high tension wires from the sparking plugs.

Disconnect the ignition control cable.

Remove the nuts from the two studs and one bolt that secure the magneto body to the crankcase and the unit is free to be taken away.

The re-fitting is done by the above procedure reversed and the method of timing has already been described.

DYNAMO

A Lucas type E3L-LI-O dynamo is fitted. It is anti-clockwise in rotation. The cutting in speed is 1,050 – 1,200 rpm at 6·5 volts and at 1,850 to 2,000 revolutions per minute it gives an output of 8·5 amps at 7 volts. The positive brush is earthed. The two exterior terminals are marked 'D' and 'F', indicating the respective terminals for the output and field wires that lead to similarly marked terminals on the regular unit.

Inspect commutator and brush gear every 5,000 to 6,000 miles (maker's recommendation).

Remove the cover band to inspect commutator and brush gear.

The brushes are held in contact with the commutator by means of springs. Move each brush, see they are free to slide in their holders, if dirty, or if sticking, remove and clean with a cloth moistened with petrol. Take care to replace brushes in their original positions, otherwise they will not 'bed' properly on the commutator.

If, after long service, the brushes have become worn to such an extent that the brush flexible wire is exposed on the running face, or if the brushes do not make good contact with the commutator, they must be replaced by genuine Lucas brushes.

The commutator must be free from any trace of oil or dirt and should have a highly polished appearance. Clean a dirty, or blackened, commutator by pressing a fine dry cloth against it while the engine is slowly turned over by means of the kickstarter. (It is an advantage to remove the sparking plugs before doing this.) If the commutator is very dirty, moisten the cloth with petrol.

At every 10,000 miles the complete dynamo should be handed to a Lucas Service Station for dismantling, replacement of worn parts, cleaning and lubrication.

Electrical breakdown of the dynamo is most unusual and therefore before assuming this unit is defective, it should be tested as follows:

Check that the dynamo, regulator and battery are correctly connected.

Test dynamo in position by:

(*a*) Remove the two wires from the dynamo terminals and connect the two terminals with a short length of wire.

(*b*) Start the engine and set to run at normal idling speed.

(*c*) Connect the negative lead of a moving coil voltmeter (calibrated not less than 0 to 10 volts) to either of the two dynamo terminals and connect the positive lead to a good earth point on the dynamo or engine.

(*d*) Gradually increase the engine speed, when the voltmeter reading should rapidly rise and without fluctuation.

Do not allow the voltmeter reading to rise above 10 volts.

Do not race the engine in an attempt to increase the voltage. It is sufficient to run up the engine to a speed of 1,000 rpm.

If the above reading is obtained the dynamo is in order.

If there is no reading, check the brush gear.

If there is a low reading of approximately ½ volt, the field winding may be at fault.

If there is a low reading of approximately 1½ to 2 volts, the armature winding may be at fault.

If the tests, mentioned above, clearly indicate the dynamo is not charging, it is then desirable to remove the dynamo from the machine in order to make further tests and repairs or replacements.

To remove and re-fit dynamo. The dynamo rests on a cradle forming part of the crankcase and is retained by a band having an adjustable clamping action and one stud passing through timing gear case.

It is rotated by a gear meshing with the timing gear wheel on the exhaust cam shaft.

Upon merely slackening the clamping strap and removing the sleeve nut on the outside of timing cover, the dynamo, complete with its driving gear, can be withdrawn from the crankcase. The two wires from dynamo to regulator unit are retained by an insulated bridge secured by one screw and, upon removing that screw, the bridge, with the two cables, can be taken away from the dynamo.

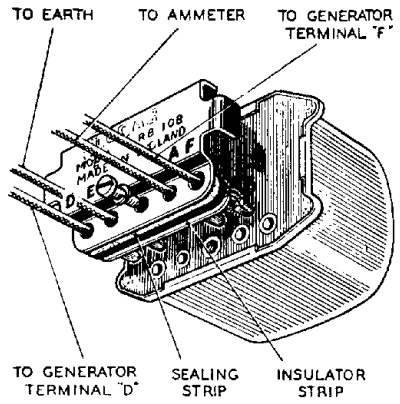


FIG 25

Control box. The regulator is set to maintain a pre-determined dynamo voltage at all speeds and regulate the output of the dynamo to the battery according to the state of charge of the battery. The charge rate is at its maximum when the battery is discharged, automatically tapering off to a minimum as the battery becomes charged and its voltage rises.

Normally, during day-time running, when the battery is in good condition, the dynamo gives only a trickle charge, so that the ammeter reading will seldom exceed 1 to 2 amperes, *ie* half to one division of scale.

If, under normal running conditions, it is found that the battery is continually in a low state of charge, or is being constantly overcharged, then the regulator setting should be checked by a qualified electrician and, if necessary,

re-set. Whenever possible, this should be carried out by a Lucas Service Depot or agent.

To remove control box. The AVC unit is held in sponge rubber and housed in a partition at the rear top corner of the tool box. To remove it, open the box lid, grasp the unit between the fingers and thumb of one hand, and gently and firmly pull it out. Re-fit with cover outwards.

The four terminals of the control box are plainly marked by the letters D.E.A.F. Wires from F and D go to similarly marked terminals on the dynamo. The A terminal is connected to one of the ammeter terminals and the E terminal is 'earthed'.

We specially warn against unskilled meddling with the settings of the regulator and the cut-out contacts.

Battery – All Models (ML Z9E). A lead-acid battery Lucas type is used on all models.

The voltage is 6, the capacity is 12 ampere hours, at the 10 hour rate.

Machines are issued with dry charged batteries, the acid is filled by the dealer.

All models have the POSITIVE battery terminal connected to 'EARTH'.

Battery unit (all Models). The battery is housed in the front portion of the tool box and retained in position on its platform by a stout rubber strap.

To remove the battery, grasp the rubber strap with the fingers between the strap and the battery case. Push the strap downwards sufficiently to release the metal toggle from the strap retaining clip. The battery can now be lifted out.

Fitting the battery. The battery must be inserted with the negative terminal on the right side of the battery compartment.

Topping up the battery. Fortnightly or more often in warm climates, check if the electrolyte in each cell is level with the top of the separators. Top-up, if necessary, with distilled water. Do not allow distilled water to come into contact with metals – always only use a glass or earthenware container and funnel.

If a battery is found to need an excessive amount of topping-up, steps should be taken to find out the reason. If one cell in particular needs topping-up more than another, it is likely the case or container is cracked, in which event the battery must be replaced and arrangements made to clean up the battery carrier. Metal parts should be well cleaned and, if possible, washed with a solution of ammonia or bicarbonate of soda, in water.

LIGHTING AND ACCESSORIES

Headlamp. A pre-focus main bulb, also a pilot bulb are mounted in the lamp reflector. The reflector and lamp glass are made up as one assembly and are not sold separately.

To remove the head lamp rim, release the screw retaining the lamp rim with one hand and support the light unit with the other.

The light unit can then be taken off the lamp.

To re-fit. Engage bottom tag on lamp rim with the small slit in the shell and

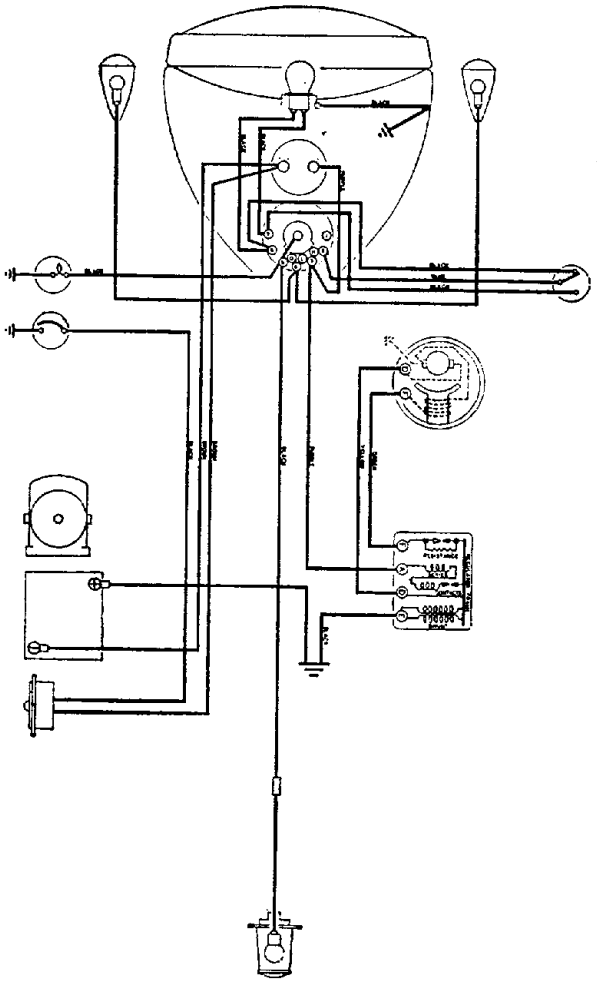


FIG 23 **1957 Twin Models**

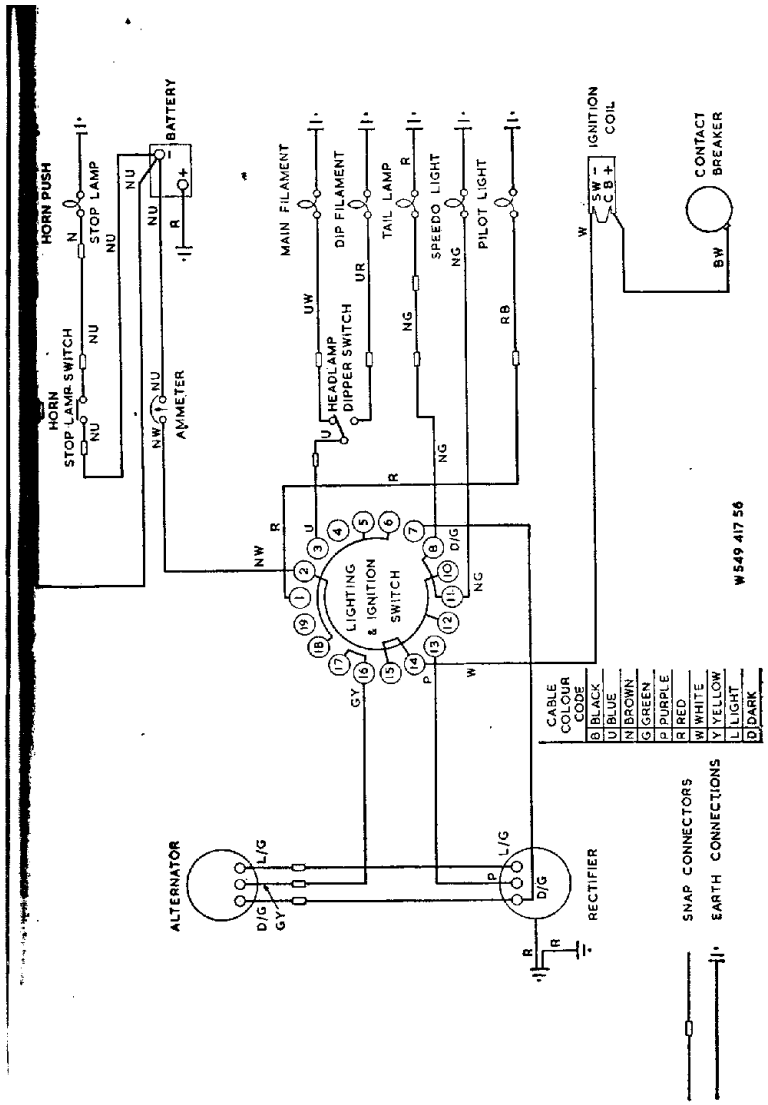


FIG 27 **Wiring diagram, Standard Twins, 1959**

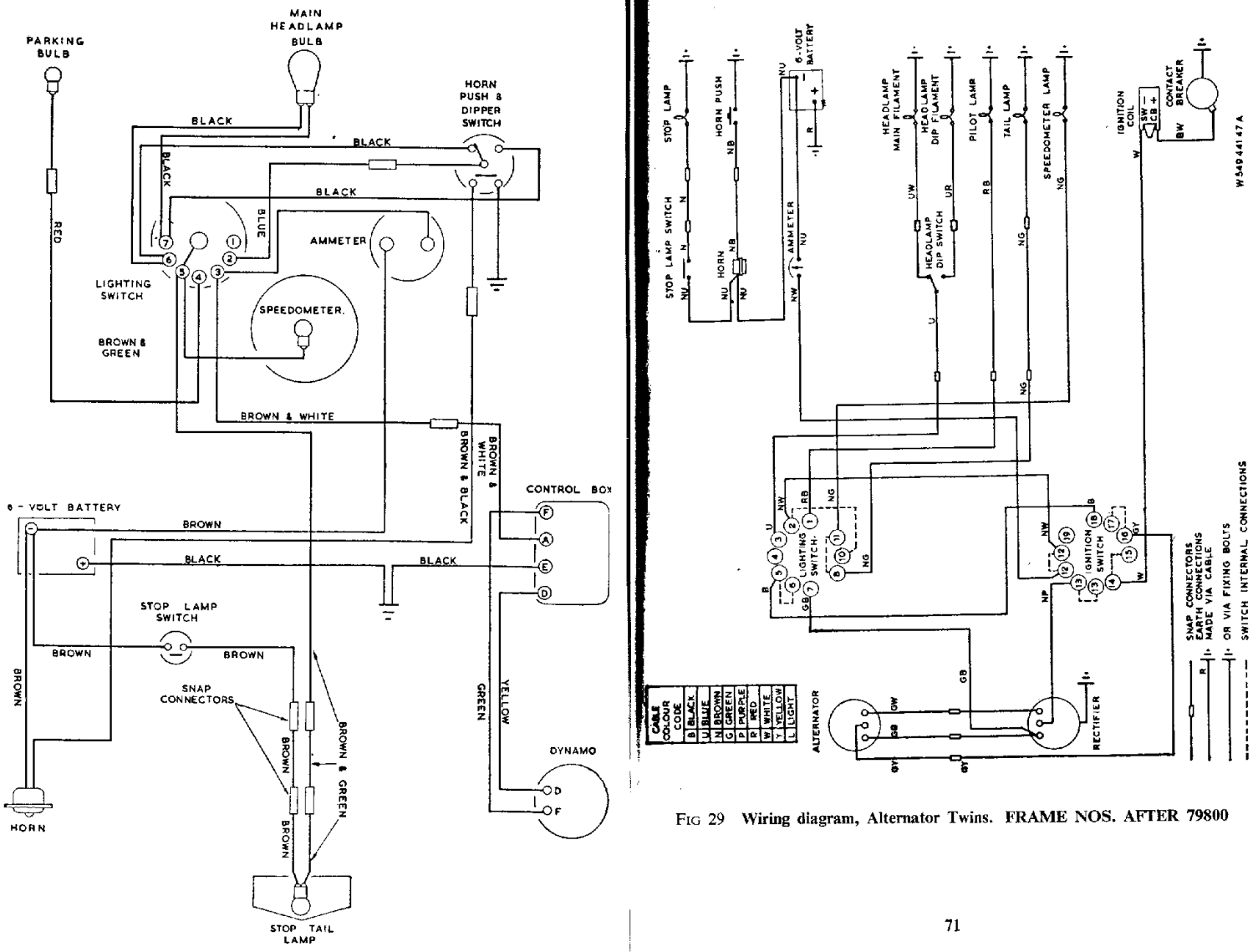


FIG 29 **Wiring diagram, Alternator Twins. FRAME NOS. AFTER 79800**

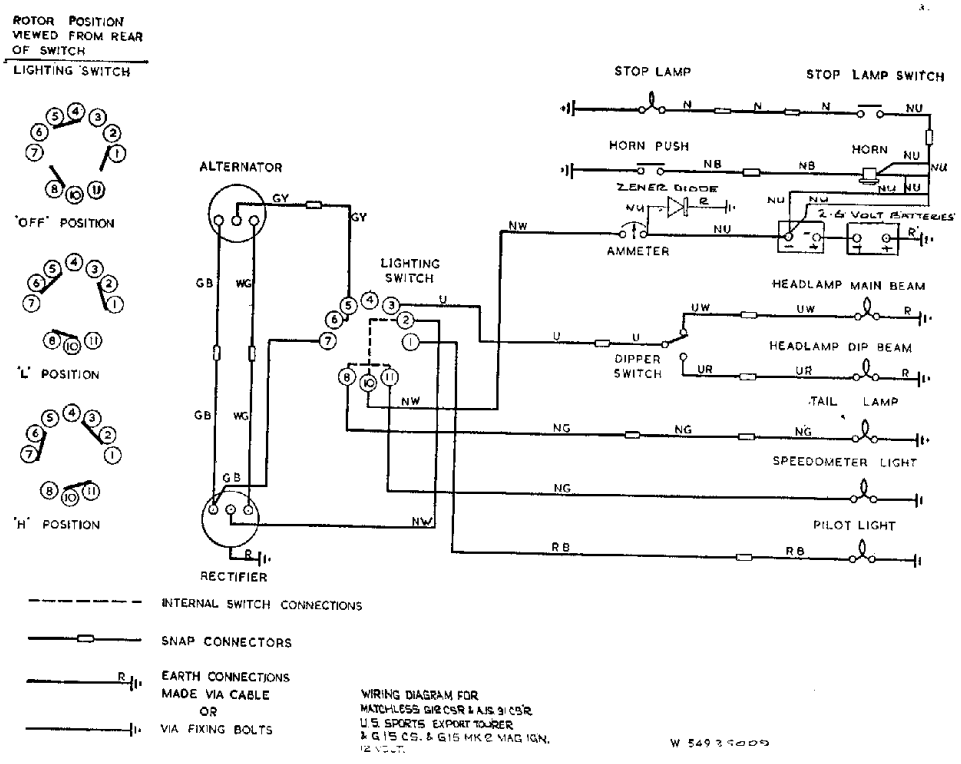


FIG 30
72

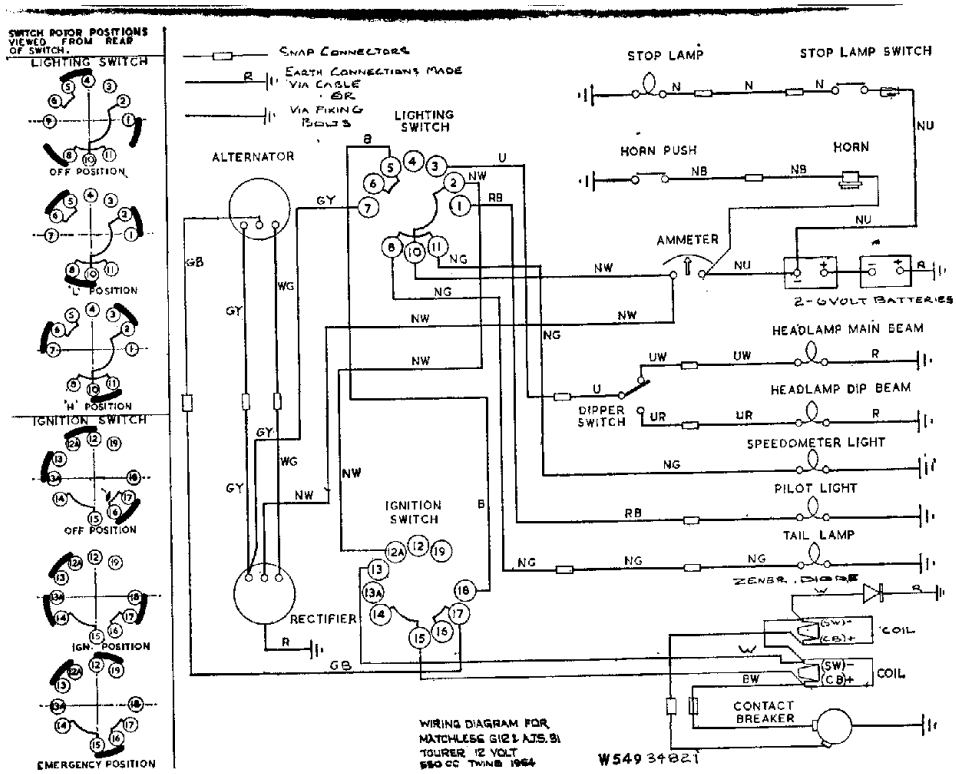


FIG 31
73

gently force the top of the rim back into the shell, after which re-tighten the retaining screw on the top of the lamp body.

The main bulb is secured by a bayonet fixing holder, which is removed by turning anti-clockwise.

The pilot bulb is a plug-in or push fit.

The headlamp rim is detachable from the light unit by removing six spring clips.

Main bulb

Home Models	.. ..	Lucas No. 373 6-volt 30/24 watt prefocus (left-hand dip)
General Export Models	..	Lucas No. 312 6-volt 30/24 watt prefocus (vertical dip)
Continental Models	..	Lucas No 403 6-volt 35/35 watt prefocus duplo (vertical dip)
French Export Models	..	Lucas No 379 6-volt 36/36 watt 3-pin duplo (vertical dip)
Parking Bulb	.. ..	Lucas No 988 3-watt MCC

Setting. The headlamp should be set so that when the machine is carrying its normal load the driving beam is projected straight ahead and is parallel with the road surface.

Dipper switch. Every 5,000 miles the moving parts of the dipper switch should be lubricated with thin machine oil.

Headlamp (Alternator Models). A separate ignition switch is incorporated in the right side of the headlamp body.

Lucas stop tail lamp (Model 564). The correct size of bulb to be used in rear lamps is based on the cubic capacity of the engine. The replacement bulb for this lamp is Lucas No 384, 6-volt, 6/18 watt. Small bayonet cap.

Lucas horn (Model HF1441). Horns are pre-set to give their best performance and, in general, no further adjustment is necessary.

If the horn becomes uncertain in its action, giving only a choking sound, or does not vibrate, it does not follow that the horn has broken down – the trouble may be due to a discharged battery, a loose connection, or short-circuit in the wiring of the horn.

In particular ascertain that the horn-push bracket is in good electrical contact with the handlebars.

It is also possible that the performance of a horn may be upset by its mounting becoming loose.

Terminals. All models have the POSITIVE battery terminal connected to 'EARTH'.

The earth connection, for the electrical system, is connected to the frame, on top of the seat lug tube.

Remove the twin seat for access.

CARBURETTOR SERVICE

Carburetter function. The petrol level is maintained by a float and needle and in no circumstances should any alteration be made to these parts. In the

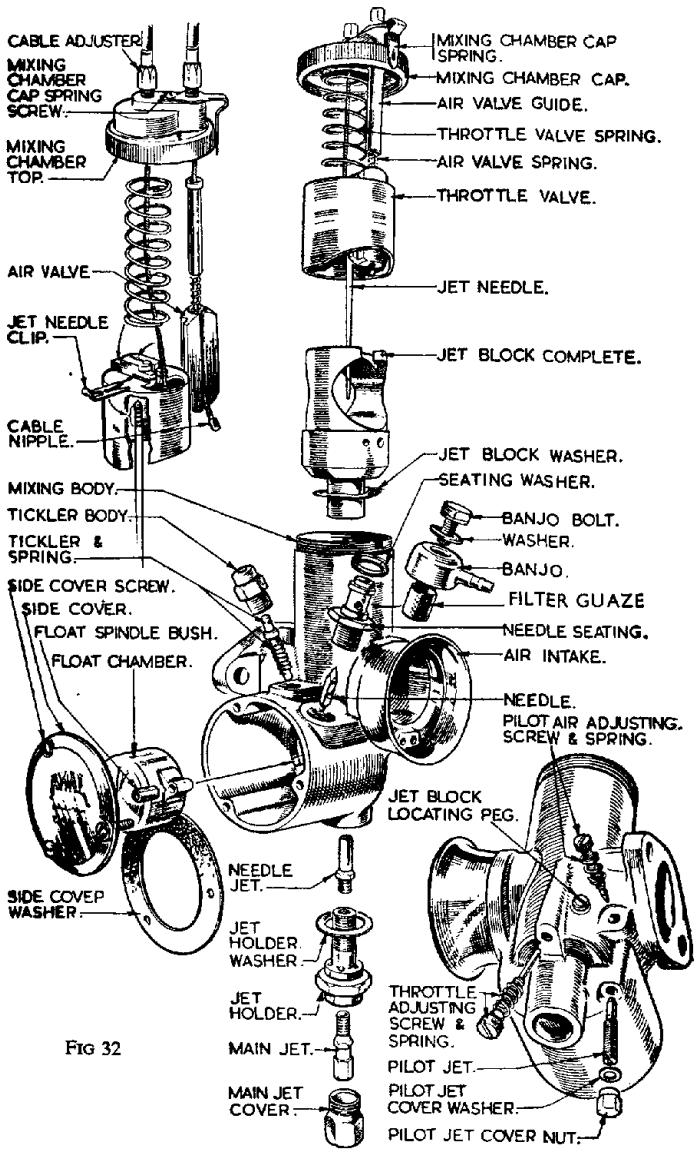


FIG 32

event of a leaky float, or a worn needle valve, the part should be replaced with new. (Do not attempt to grind a needle to its seat.)

The petrol supply to the engine is controlled, firstly, by the main jet and, secondly, by means of a taper needle (see fig 32), which is attached to the throttle valve and operates in a tubular extension of the main jet.

The main jet controls the mixture from three-quarters to full throttle, the adjustable taper needle from three-quarters down to one-quarter throttle, the cut-away portion of the intake side of the throttle valve from one-quarter down to about one-eighth throttle, and a pilot jet, having an independently adjusted air supply, takes care of the idling from one-eighth throttle down to the almost closed position. These various stages of control must be kept in mind when any adjustment is contemplated (see fig 32 for location of the pilot jet air adjustment screw). The pilot jet, unlike on earlier models, is now detachable for cleaning.

The size of the main jet should not be altered save for some very good reason. See 'Data' for details of standard sizes of jet, throttle valve and jet taper needle.

With the standard setting it is possible to use nearly full air in all conditions, except perhaps when the engine is pulling hard up hill or is on full throttle, when some benefit may be obtained by slightly closing the air control.

Weak mixture is always indicated by popping or spitting, at the air intake.

A rich mixture usually causes bumpy or jerky running and in cases of extreme richness, is accompanied by the emission of black smoke from the exhaust.

Carburetter adjustment. With the taper needle projection, main jet size and type of throttle slide specified, correct carburation, except at idling speed is assured. In the event of difficulty being experienced look for cause under heading 'Useful information'.

To check for correct idling mixture, first run the engine until it is just warm, but not too hot, when with the throttle nearly closed and air fully open it should fire evenly and slowly. If it fails to do so, first of all make certain that the sparking plug is clean and the point setting correct. Having done this and idling is still uneven try re-setting the pilot jet air screw.

Adjustment of this air screw is not unduly sensitive and it should be possible to obtain the correct setting for even firing in a few seconds.

In the event of even firing at idling speed being unobtainable by adjustment of the air screw, look for obstruction in the pilot jet.

Having obtained even firing, all that remains is to adjust if necessary the position of the throttle stop screw until the desired idling speed is obtained.

Air Filter. In locations, such as the United Kingdom, where the roads and atmosphere are particularly free from dust, it is not considered necessary to have an air filter fitted to the carburetter, but in countries where the atmosphere contains a very heavy dust content, an air filter is essential in order to prevent abrasive wear.

The filter available (optional extra) for the conditions mentioned above is of the 'Oil Wetted' type, and this requires periodical servicing.

When servicing the air filter, withdraw the filter element. Thoroughly

wash this in petrol, paraffin, or other suitable solvent and allow to dry. Then re-oil, using one of the light oils (SAE-20) and allow to drain before replacing in the filter case. Clean at intervals of 2,500 to 5,000 miles according to road conditions and renew the element every 10,000 miles.

FITTING TWIN CARBURETTORS

(650cc) MODELS

Special carburetter distance pieces for use in place of the manifold are available for the above models. The original carburettor can be retained for use with the additional parts, as detailed.

Discard the original main jet, pilot jet and throttle slide, locate taper needle fourth notch from the top.

Setting the Slow Running. Start by using two clean sparking plugs with a plug gap of ·020" to ·022". Set the slow running on each cylinder separately by starting the engine with the ignition slightly retarded (Magneto Models) then remove the HT plug cable from the left side cylinder. Manipulate the slow running adjustment screw in conjunction with the throttle slide stop screw, until the tick over is slow, also positive. Repeat the process to deal with the other cylinder.

Note: The throttle inner cables must be of equal length to ensure both throttle valves move the same amount when the twist grip is operated, by manipulating the cable adjuster.

Parts Required

1. 028232 Carburetter type 389/49.
1. 376/140 Jet Holder, long.
1. 376/141 Banjo, single.
2. 376/074 Fibre Washers.
1. 389/064 Mixing Chamber top cap.
2. 4/035 Cable Adjusters.
1. 376/076 Pilot jet size 25.
1. 376/100 Main jet size 280.
1. 389/060 Throttle valve size 3.
1. 028219 Spacer.
1. 028221 Spacer.
4. 018873 Allen screws.
2. 041014 'O' Rings.
2. 024308 Spacers.
4. 010624 Studs.
4. 000004 Nuts.
2. 028236 Air cables, carburetter end.
1. 028237 Air cable, lever end.
2. 028238 Throttle cables, carburetter end.
1. 028239 Throttle cable, twist grip end.
2. 019824 Junction boxes for cables.

Carburetter tuning information

Poor idling may be due to:

Air leaks either at junction of carburettor and inlet manifold, or by

reason of badly worn inlet valve stems or guides.
Faulty engine valve seatings.
Sparking plug faulty, or its points set too closely.
Ignition advanced too much.
Contact breaker points dirty, pitted loose or set too closely.
High-tension wire defective.
Pilot jet not operating correctly. Partially choked or incorrect air supply.
Rockers adjusted too closely.

Heavy petrol consumption may be due to:
Late ignition setting.
Bad air leaks. Probably at carburetter or manifold joints.
Weakened valve springs.
Leaky float (causing flooding).
Taper needle extension insufficient.
Poor compression, due to worn piston rings or defective valve seatings. (Test compression with throttle wide open.)

Carburetter flooding. If the carburetter is flooding, the float spindle bush (fig 32) may be pinched between the float swivel and the float chamber cap.

Reduce slightly the width of the tube or renew the gasket for the cover.

Exercise care to avoid over tightening the pilot jet which can deform its seating in the mixing chamber. A defective jet block fibre washer will allow fuel to leak across the choke.

Notes on carburation. The main jet originally fitted is deemed to be the most suitable. There should be no necessity to alter the main jet size without good reason, *ie* by fitting an air filter, running with an open exhaust pipe system or at specified altitudes.

Riders with considerable experience can, after driving at full throttle for at least a third of a mile decide, after 'reading' the sparking plug if the main jet size is suitable or otherwise.

Without such experience it is preferable to drive at full throttle and close the air lever ¼". If the engine speed increases, the main jet is small. Conversely, if the engine speed decreases, the main jet is larger.

Jet alterations should be made in stages of 10cc increase in jet size, *viz* size 200 to 210.

CARBURETTOR SPECIFICATIONS

1955-1956 Models

	500*cc*	600*cc*
Type .. Monobloc	376/6	376/78
Main jet (no air filter)	240	300
Main jet (air filter fitted)	230	220
Pilot jet	30	30
Throttle valve	4	3½
Needle position	Centre notch	Centre notch
Needle jet	·1065	·1065

Model:	1957 Models	500*cc Twin*	600*cc Twin*
Carburettor type		376/6	376/78
Bore size		1"	1 1/16"
Main jet		240	280
Main jet (air filter)		230	270
Slide		4	3½
Pilot jet		30	30
Needle jet		·106	·106
Needle location		central	central
Model:	1958 Models	500*cc Twin*	600*cc Twin*
Carburetter type		376/6	376/78
Bore size		1"	1 1/16"
Main jet		220	280
Main jet (air filter)		210	270
Slide		4	3½
Pilot jet		30	30
Needle jet		·106	·106
Needle location		central	central

1959 Models

Model:	500*cc Twin*	500*cc CS*	650*cc Twin*	650*cc CSR*
Carburetter type	376/6	376/6	389/49	389/22
Bore size ..	1"	1"	1⅛"	1⅛"
Main jet ..	220	220	400	430
Main jet (air filter)	210	210	386	400
Slide	4	4	3	3½
Pilot jet	30	30	30	30
Needle jet ..	·106	·106	·106	·106
Needle location	central	central	central	central

1960 Models

Model:	500*cc Twin*	650*cc Twin*	650*cc CSR*
Carburetter type	376/6	389/18	389/22
Bore size	1"	1⅛"	1⅛"
Main jet	220	390	450
Main jet (air filter)	210	340	390
Slide	4	4	4
Pilot jet	30	20	20
Needle jet	·106	·106	·106
Needle notch location	central	4th	4th

1961-1962 Models

Model:	500*cc Twin*	650*cc Twin*	650*cc CSR*
Carburetter type	376/209	389/50	389/49
Bore size	1"	1⅛"	1⅛"
Main jet	200	390	450
Main jet (air filter)	180	340	390
Slide	4	4	4
Pilot jet	25	20	20
Needle jet	·106	·106	·106
Needle notch location	central	4th	4th

Note: See page 77 for 'Twin Carburetter Settings'.

TECHNICAL DATA

1955-1956 Models

Finished cylinder-bore size, inches	2·598 ·±0·0005	
Piston-skirt diameter, inches:		
Top	H = 2·5976	L = 2·5969
Bottom	H = 2·5984	L = 2·5977
Inlet-valve-stem diameter, inches	H = 0·27975	L = 0·27875
Exhaust-valve-stem diameter, inches	H = 0·3100	L = 0·3090
Inlet-valve-guide bore size, inches	$\frac{9}{32}$ ±0·0005	
Exhaust-valve-guide bore size, inches	$\frac{5}{16}$ ±0·0005	
Valve - rocker - bush internal diameter, inches	$\frac{1}{2}$ + 0·001 — 0·000	
Valve-rocker-spindle diameter, inches	$\frac{1}{2}$ = 0·001 + 0·002	
Intermediate-gear-bush diameter (*in situ*), inches:		
Before 1955	H = 0·6230	L = 0·6223
1955 models	$\frac{3}{4}$ + 0·00025 — 0·00050	
Intermediate-shaft diameter, inches:		
Before 1955	H = 0·6215	L = 0·6210
1955 models	H = 0·7490	L = 0·7485
Camshaft-bush diameter (*in situ*), inches	$\frac{13}{16}$ + 0·001 — 0·000	Inlet and Exhaust
Camshaft-bearing diameter for bush, inches	$\frac{13}{16}$ + 0·00075 — 0·00225	Inlet and Exhaust
Crankshaft external diameter (crank-pin), inches	H = 1·62525	L = 1·62475
Crankshaft external diameter (centre), inches	H = 1·62625	L = 1·62575
Connecting-rod, big-end (internal), inches	H = 1·7715	L = 1·7710
Connecting-rod centres, inches	5·75	
Crankshaft roller bearings	RLS—12½ 1⅜″×3″×$\frac{11}{16}$″	
Small-end diameter (in rod), inches	$\frac{3}{4}$ + 0·0005 — 0·0000	
Piston-ring gap, inches:		
Normal	0·006	
Maximum	0·030	
Piston-ring clearance (in groove), inches	0·002	
Valve-seat angle	45° (all)	
Gudgeon-pin diameter in rod, inches	$\frac{3}{4}$ + 0·0005 — 0·0000	
Cam-follower spindle diameter, inches	$\frac{3}{8}$ + 0·001 — 0·005	

Cam-follower (wide), inches	1$\frac{13}{64}$ + 0·005 — 0·000	
Cam - follower spacer (narrow, inches)	H = 0·159	L = 0·156
Push-rod assembled length, inches	8$\frac{3}{32}$ + 0·015 — 0·015	
Valve-spring free length, inches:		
Inner	1$\frac{13}{32}$	Renew when $\frac{1}{4}$″ less than normal
Outer	1$\frac{3}{4}$	
Shock-absorber-spring free length, inches	1$\frac{3}{4}$ ±$\frac{1}{32}$	
Steel ball diameter for pump plate, inches	$\frac{1}{4}$	
Steel ball diameter for non-return valve, inches	$\frac{3}{8}$	
Crankcase bearing housing diameter, inches	3 + 0·002 — 0·003	
Valve timing (average):		
Inlet opens	35° BTDC	
Inlet closes	65° ABDC	
Exhaust opens	65° BBDC	
Exhaust closes	35° ATDC	
	Taken with 0·012″ rocker clearance.	
Connecting-rod side play, inches	0·026 – 0·032	
Valve-spring pressure (at full lift), lb	140 – 145	
Compression ratio:		
Normal	7 to 1	
Alternative	8 to 1	
Exhaust-pipe length (without silencer), inches	34	
Megaphone size for above	9″ long, outlet diameter 4″	
Engine maximum torque	4,500 rpm	
Torque spanner settings, lb ft:		
Cylinder-head bolts	18	
Big-end nuts	22	
Centre bearing nuts	11	
Centre-web nuts (6)	7	
Standard engine sprocket	20 teeth	
Rear-chain size	$\frac{3}{8}$″×$\frac{5}{16}$″, 96 links	
Front-chain size	½″×0·305″, 66 links	
Rear-wheel sprocket	42 teeth	
Clutch sprocket	40 teeth	
Rear-chain sprocket	16 teeth	
Engine sprocket	20 teeth	

Gear box Ratios:

First gear	Second gear	Third gear	Fourth gear (top)
2·65 to 1	1·70 to 1	1·308 to 1	1 to 1

Gear Ratios:

Engine Sprocket	First gear	Second gear	Third gear	Fourth gear (top)
19	14·55 to 1	9·33 to 1	7·18 to 1	5·49 to 1
20	13·91 to 1	8·91 to 1	6·86 to 1	5·25 to 1
21	13·25 to 1	8·50 to 1	6·54 to 1	5·0 to 1

Close-ratio Gears (Internal Ratios):

First gear	Second gear	Third gear	Fourth gear (top)
1·87 to 1	1·35 to 1	1·09 to 1	1 to 1

Brakes, diameter × width × thickness, inches	$7\times\frac{7}{8}\times\frac{3}{16}$
Tyres:	
Front	3·25×19
Rear	3·50×19
Rims:	
Front	WM2×19
Rear	WM2×19
Tyre pressures, lb/sq in:	
Front	22
Rear	25
Weight, lb	394
Wheelbase, inches	$55\frac{1}{4}$
Seat height, inches	$31\frac{1}{2}$
Ground clearance, inches	$5\frac{1}{2}$
Overall length, inches	$86\frac{1}{4}$
Overall height, inches	$41\frac{1}{2}$
Overall width, inches	28
Shock-absorber spring, inches:	
Before 1955	$1\frac{9}{16}\pm\frac{1}{32}$
1955	$1\frac{3}{4}$
Clutch-spring free length, inches	$1\frac{21}{32}$
Clutch push-rod overall length, inches:	
Before 1952 (CP Type)	$10\frac{1}{8}$″
1952 onwards (B52 Type)	$10\frac{3}{16}$″
Steel ball for clutch rod, diameter, inches	$\frac{3}{16}$

B52 Type Gear box

Nut for rear-chain sprocket (width across flats) Part No 11-11-1, inches	$1\frac{3}{32}$
Nut for mainshaft (clutch end) (width across flats) Part No 11-7-11, inches	$1\frac{5}{16}$

CP Type Gear box (Before 1952)

Nut for rear-chain sprocket (width across flats) Part No 176-X, inches	$1\frac{3}{32}$

1957-1966

	500cc *Twin*	600cc *Twin*	650cc *Twin*
Cylinder bore size	2·598″ + ·0005″ — ·0015″	2·835″—2·834″	2·836″—2·835″
Compression ratio Std.	7 to 1	7 to 1	7·5
Compression ratio Sports	8 to 1	8 to 1	8·5
Piston skirt diameter Top	2·5933″—2·5925″	2·8341″—2·8334″	2·8295″—2·8287″
Piston ring gap	·006″	·006″	·006″
Gudgeon pin diameter	ALL	·7499—·7497	ALL
Gudgeon pin rod diameter	,,	·7505—·7500	,,
Crankshaft diameter (crankpin)	,,	1·62575—1·62525	,,
Crankshaft diameter (centre bearing)	,,	1·62675—1·62625	,,
Crankshaft bearings (2 off)	$3\times1\frac{3}{8}\times\frac{11}{16}$	$3\times1\frac{3}{8}\times\frac{11}{16}$	$3\times1\frac{3}{8}\times\frac{11}{16}$
Camshaft bushes	ALL	0·8125″—0·8135″	ALL
Rocker bushes	,,	0·500″—0·501″	,,
Intermediate shaft diameter	,,	0·7485″—0·7490″	,,
Intermediate bush diameter	,,	0·7495″—0·7502″	,,
Cam follower spindle diameter	,,	0·373″—0·374″	,,

GEAR BOX RATIOS, 1957 and 1958 MODELS

Engine	*Sprocket size*	*First gear*	*Second gear*	*Third gear*	*Fourth gear (top)*
	19 teeth	15·48	10·26	7·83	5·80
	20 teeth	14·71	9·75	7·43	5·51
(A)	21 teeth	14·01	9·29	7·08	5·25
(B)	22 teeth	13·37	8·86	6·76	5·01
	23 teeth	12·78	8·47	6·46	4·79

(A) Standard 500cc Engine sprocket.
(B) Standard 600cc Engine sprocket.

Gear box internal ratios

First gear	*Second gear*	*Third gear*	*Fourth gear (top)*
2·67 to 1	1·77 to 1	1·35 to 1	1 to 1

Sprocket sizes

Clutch..	42 teeth
Gear box	16 teeth
Rear wheel	42 teeth

1959-1962 Models

Gear Ratios

Engine	*Sprocket size*	*First gear*	*Second gear*	*Third gear*	*Fourth gear (top)*
(C)	19 teeth	14·85	9·86	7·07	5·80
	20 teeth	14·11	9·37	6·73	5·51
(A)	21 teeth	13·42	8·93	6·41	5·25
	22 teeth	12·81	8·52	6·11	5·01
(B)	23 teeth	12·23	8·15	5·85	4·79

(A) Standard 500cc Engine Sprocket.
(B) Standard 650cc Engine Sprocket.
(C) S/C Engine Sprocket 500cc.
(A) S/C Engine Sprocket 650cc.

Gear ratios Models CS and CSR

First gear	*Second gear*	*Third gear*	*Fourth gear (top)*
11·51 to 1	7·65 to 1	5·49 to 1	4·5 to 1

Sprockets

Location	*Number of teeth*
Clutch	42
*Gear Box	16 or 17
Rear wheel	42

*17 teeth used on CSR models.

Gear box ratios (internal)

First gear	*Second gear*	*Third gear*	*Fourth gear (top)*
2·56 to 1	1·70 to 1	1·22 to 1	1 to 1

Chain sizes

Front (all models)	½" by ·305"
Rear (all models)..	⅜" by ⅜"

Chain length

Front	500 Twin	67 links	Rear	All Models	97 links
,,	650 Twin	68 links			

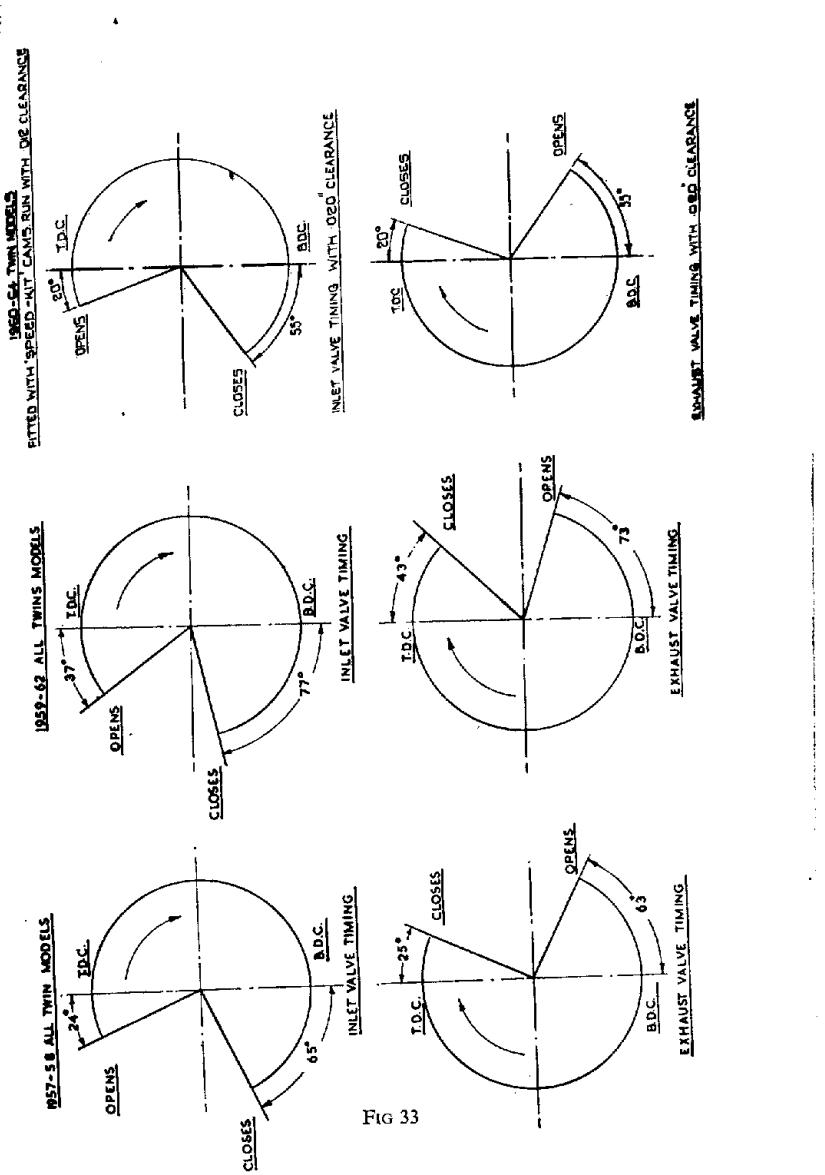
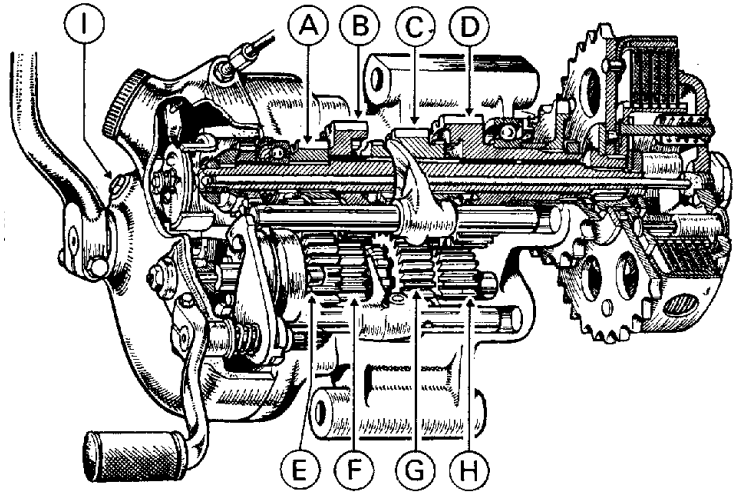


FIG 33

BURMAN GEAR BOX 1955/56



A LOW GEAR ON MAINSHAFT
B THIRD GEAR ON MAINSHAFT
C SECOND GEAR ON MAINSHAFT
D MAIN DRIVING GEAR
E LOW GEAR ON LAYSHAFT
F THIRD GEAR ON LAYSHAFT
G SECOND GEAR ON LAYSHAFT
H SMALL PINION ON LAYSHAFT
I OIL LEVEL PLUG

Section through gearbox showing gears and clutch with actuating mechanism

To remove kickstarter case cover for exposure of kickstarter gear change and internal clutch actuating mechanism. Remove oil drain plug and drain off oil contents of the gear box.

Remove the large oil filler plug and slack off the clutch cable adjuster sufficiently to permit the cable end to be detached from the slotted end of the internal clutch operating lever which is exposed by the removal of filler cap.

Unscrew the clutch cable adjuster until it is free from the kickstarter case cover and withdraw the cable nipple through the adjuster hole.

Remove the nut and small spiral spring securing small gear indicator disc from the cam barrel spindle.

Next remove the five cheese head screws by which the kickstarter case cover is secured to the gear box end plate.

Withdraw the cover about $\frac{1}{2}$", holding the kickstarter pedal firmly while doing so.

Now swing the kickstarter crank round until it can be tied to the foot change lever. This prevents the kickstarter return spring unwinding and facilitates re-assembly.

The entire cover can now be removed.

Re-assemble in exactly reverse order, taking care to avoid damage to the paper joint gasket.

Note: The position of the various cheesehead screws securing the kickstarter case cover are as follows:

In the top position, screw measuring $3\frac{1}{8}$" under head.
In the bottom position, screw measuring $2\frac{7}{8}$" under head.
In the rear position, screw measuring $\frac{7}{8}$" under head.
In the front position, top screw measuring $1\frac{1}{8}$" under head.
In the front position, bottom screw measuring $1\frac{3}{8}$" under head.

To remove gear box end plate for examination of gears. Remove kickstarter case cover as already described.

Remove split pin securing both gear striker shaft pins and withdraw the pins and also the cam barrel in which they operate together, with the spring loaded conical ended plunger which engages depressions on the underside of the cam barrel.

Remove the mainshaft end nut and draw off the kickstarter ratchet driver, pinion, spring and bush upon which the pinion is mounted.

Remove the three cheesehead screws by which the end plate is secured to the gear box shell and the end plate is then free to be withdrawn leaving the gears and gear striker shafts *in situ*.

Take care to avoid losing the steel ball fitted in the end of the mainshaft and interposed between the clutch actuating lever and the clutch thrust rod.

To re-assemble. If gears have been disturbed insert them in their proper order with slider shafts in correct location and apply end plate with paper joint gasket in position.

Re-fit the three cheesehead screws and firmly tighten down with a stout screwdriver.

Then insert conical ended plunger and spring and apply the gear selection cam barrel with any one of the depressions on its underside engaging with the conical end of the spring loaded plunger.

Next insert the selector shaft pins and secure each in position with its split pin.

Complete the assembly in reverse order of dismantling ascertaining, before applying the kickstarter case cover, that the ball is inserted in the end of the mainshaft.

Fill to correct level with one of the recommended oils and lastly re-fit the gear indicator disc and adjust its position to give correct indication of gears.

Clutch operating mechanism adjustment. To enable the clutch to function satisfactorily $\frac{1}{8}$" to $\frac{3}{16}$" free movement of the operating cable is essential. This is checked by lifting the outer casing of the clutch cable at the position where it enters the screwed adjuster on the kickstarter case cover. If the adjustment is correct it should be possible to freely move the casing up and down with the fingers $\frac{1}{8}$" to $\frac{3}{16}$".

If the free movement is excessive causing clutch drag or noisy gear changing, adjustment should be made as follows.

Release the clutch cable adjuster lock nut and then screw in the adjuster as far as it will go to ensure that the operating lever is in its normal position.

Now turn to the opposite side of the cycle and remove the domed clutch cover secured by eight screws.

Then using the sparking plug box key supplied in tool kit, loosen lock nut on the pressure plate.

Then with a screwdriver, gently screw in the thrust cap until contact with the thrust rod can be felt, after which unscrew exactly one half turn and then securely retighten the lock nut taking care to observe that the screwed thrust cap does not also turn while doing so.

Replace the clutch cover and then make the final adjustment by unscrewing the cable adjuster until the recommended free movement of the casing is obtained, after which retighten the cable adjuster lock nut.

As a result of wear of the clutch friction plate inserts after prolonged use, the plates tend to close up towards each other. This will have the effect of reducing the free movement in the operating mechanism referred to above.

Clutch slip resulting from lack of free movement will rapidly ruin the inserts and may generate sufficient heat to soften the clutch springs. Therefore should clutch slip develop, an immediate check of free movement must be made.

In this case after slacking off the cable adjuster, unscrew the cup a turn or two and then gently screw in until contact with the thrust rod is felt, after which as already detailed, it should be unscrewed exactly one half turn before retightening the lock nut.

Lastly adjust the cable for the specified free movement.

To remove a clutch control cable. Remove the oil filler cap from the kickstarter case cover.

Screw right home the clutch cable adjuster that is located in the top of the kickstarter case cover.

Disengage, from the operating lever, the clutch cable inner wire by operating through the oil filler cap opening.

Completely unscrew the clutch cable adjuster.

Disengage, from the handlebar operating control lever, the clutch inner wire.

Pull cable, by its lower end, till removed from the machine, easing it through the frame cable clips while doing so.