BSA

WORKSHOP MANUAL

for

750 c.c. MODEL A75

ROCKET 3

Service Department Telephone **021-772-2381**

B.S.A. MOTOR CYCLES LTD. **ARMOURY ROAD**

BIRMINGHAM 11

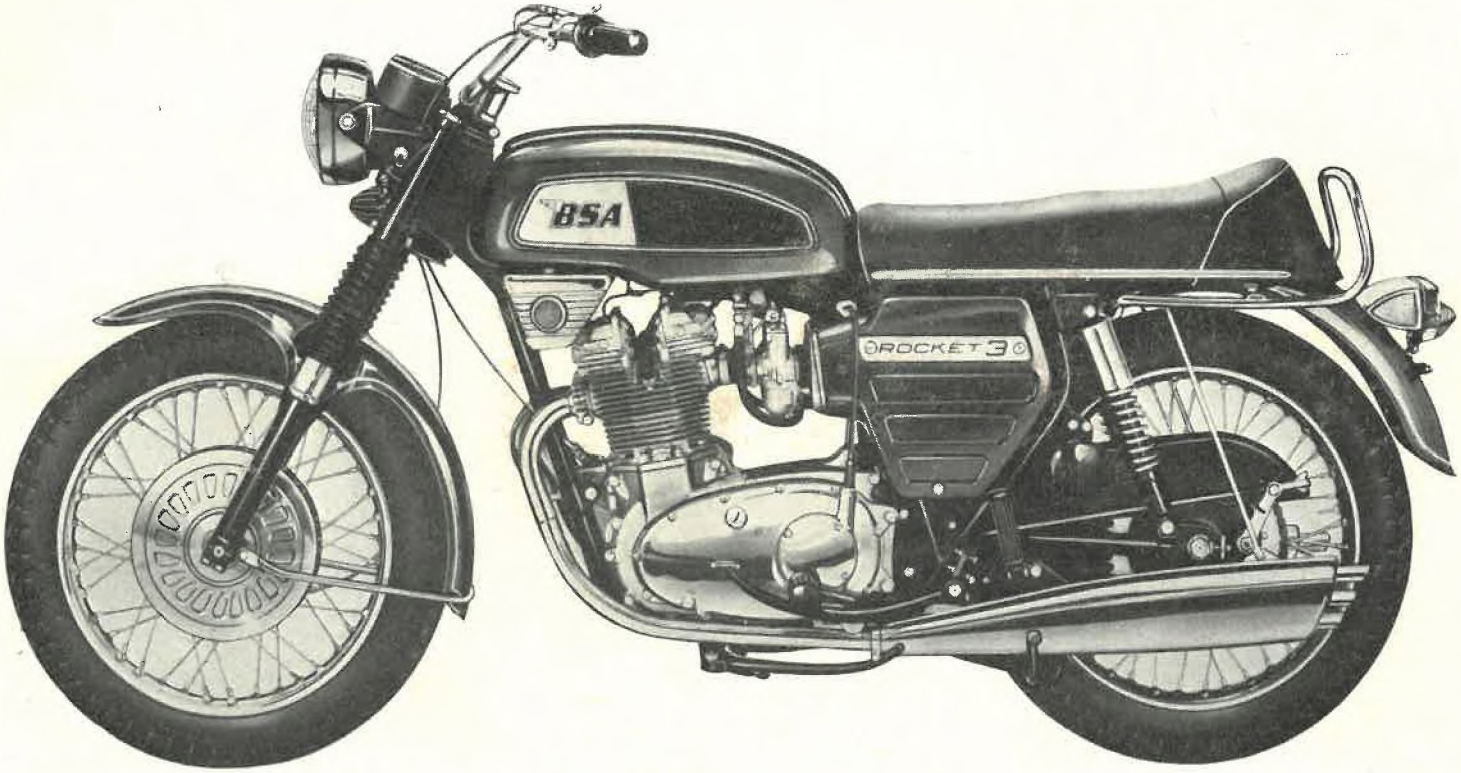
00-4167-December 1968

Printed in England at B.S.A. Press

Please Note!

Replacement parts or accessories must be of B.S.A. origin or as approved by B.S.A. Motor Cycles Ltd.

In this respect your attention is drawn to the Terms and Conditions of B.S.A. Guarantee.



BSA 750 c.c. ROCKET 3

INTRODUCTION

This manual has been compiled to provide comprehensive service information for the B.S.A. owner and for the workshop fitter wishing to carry out basic maintenance or major repair work. It is written in great detail, nevertheless, because of the specialised skills or equipment required to carry out some of the repair work described, the inexperienced owner is strongly advised to consult his B.S.A. dealer whenever he is in doubt as to his own ability to carry out a satisfactory job.

All the information given in this manual is correct at the time of publication but, since in the course of the constant development of B.S.A. motor-cycles, changes in specifications are inevitable, anyone finding the information given in this book to be at variance with the machine in his possession is advised to contact the Service Department. In such cases we will provide up-to-date information.

The manual is sub-divided into sections dealing with major assemblies and these are again broken down into the individual operations required for maintenance or repair. It is hoped that by this arrangement the manual will be useful as a quick work of reference even to the skilled mechanic.

ENGINE AND FRAME NUMBER

The engine number is stamped on the left-hand side of the crankcase immediately below the cylinder base.

The frame number is stamped on the left-hand side of the frame, on the front engine mounting lug.

Both the engine and frame numbers, together with prefix and suffix letters must be quoted in full in any correspondence relating to the machine or any enquiry regarding this manual, to either the dealer or the Service Department.

FACTORY SERVICE ARRANGEMENTS

(UNITED KINGDOM)

REPLACEMENT PARTS

B.S.A. replacement parts are distributed through a national network of B.S.A. dealers, each of whom holds a stock of fast moving parts. Approximately 200 of these dealers have been selected for appointment as specialist B.S.A. replacement part stockists and each of these stockists holds a comprehensive stock of B.S.A. replacements. List of appointed stockists are available on request, and their names are printed in every B.S.A. Parts Catalogue.

GUARANTEE CLAIMS

In the interests of all concerned it is best that any owner of a new motor-cycle wishing to claim assistance under the guarantee should do so through the dealer from whom his machine was purchased. All B.S.A. dealers are familiar with the procedure designed by B.S.A. to give quick service to any owner of a B.S.A. motor-cycle who may find himself in difficulty.

REPAIRS

Most appointed B.S.A. dealers are able to carry out even major repair work, and owners are asked to make all repair arrangements through their chosen dealer.

In the great majority of cases local repair will be possible and this will avoid the expense, inconvenience and the possibility of the machine being damaged in transit to or from the works for repair.

Should your B.S.A. dealer decide that Service Department attention is required he will know best how to make suitable arrangements with the factory. It is important to remember that no machine can be accepted at the works without a prior appointment. This appointment can be made either by letter or by telephone.

Labour time will be greatly reduced if proprietary articles such as legshields, safety bars, carriers or fibre-glass fairings are removed before handing the machine over for repair. Accessories such as mirrors or badges should always be removed before entrusting a machine to an independent carrier.

TECHNICAL ADVICE

B.S.A. Service Department staff have long experience in dealing with technical problems of all kinds and will be pleased to help in the event of difficulty. The correct address of the Service Department is as follows:—

B.S.A. MOTOR CYCLES LIMITED,
SERVICE DEPARTMENT,
ARMOURY ROAD,
BIRMINGHAM 11.

Telephone No. 021–772 2381

In all communications the full engine and frame numbers with all prefix or suffix letters and figures must be quoted.

SERVICE ARRANGEMENTS OVERSEAS

In most markets of the world B.S.A. has an appointed distributor to whom all service enquires should be addressed.

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PROPRIETARY PARTS

Equipment not of our manufacture which is fitted to our motor-cycles is of the highest quality and is guaranteed by the manufacturers and not by us. Any complaints or repairs should be sent to the manufacturer concerned or their accredited agents who will give every possible assistance. The following are the manufacturers concerned:—

CARBURETTERS	Amal Limited, Holdford Road, Witton, BIRMINGHAM 6.
CHAINS	Renold Chains Limited, Wythenshawe, MANCHESTER.
ELECTRICAL EQUIPMENT	Joseph Lucas Limited, Gt. Hampton Street, BIRMINGHAM 18.
REAR DAMPERS	Girling Limited, Birmingham Road, WEST BROMWICH, Staffs.
SPARK PLUGS	Champion Sparking Plug Company Limited, Feltham, MIDDLESEX.
SPEEDOMETERS	Smith's Motor Accessories Limited, Cricklewood Works, LONDON N.W.2.
TYRES	Dunlop Company Limited, Fort Dunlop, BIRMINGHAM 24.

U.S.A. SERVICE ARRANGEMENTS

REPLACEMENT PARTS

B.S.A. replacement parts are available through a national network of B.S.A. dealers covering the entire United States.

These B.S.A. motor-cycle dealers are listed under "Motorcycles" in the yellow pages of your local telephone directory.

All requests for parts must be made through franchised B.S.A. dealers, they are not sold direct to B.S.A. owners by the two factory branches.

GUARANTEE CLAIMS

In the interest of all concerned the owner of a new motor-cycle wishing to claim assistance under the guarantee must do so through the dealer from whom his machine was purchased.

REPAIRS

B.S.A. dealers are capable of servicing and repairing B.S.A. motor-cycles, ask your dealer to help when repairs are needed.

Labour time will be greatly reduced if proprietary articles, such as legshields, crash bars, carriers or fibre-glass fairings, are removed before handing the machine over for repair. Accessories such as mirrors or badges should always be removed before entrusting a machine to an independent carrier.

TECHNICAL ADVICE

The B.S.A. Service Department staff the two U.S.A. factory branches have long experience in dealing with technical questions of all kinds and will be pleased to help in the event of difficulty.

The factory branch addresses are shown below:—

EASTERN: B.S.A. INCORPORATED,
639 Passaic Avenue,
Nutley, New Jersey 07110.

WESTERN: B.S.A. MOTORCYCLES — WESTERN,
2745 E. Huntington Drive,
Duarte,
CALIFORNIA 91010.

In all communications the full engine and frame numbers with all prefix and suffix letters and figures must be quoted as well as the year and model of the motor-cycle in question.

REMOVING THE MOTOR-CYCLE FROM THE CASE

NOTE:—Check that the packing case is RIGHT SIDE UP before dismantling. The TOP has stencilled markings on it, the bottom does not.

(1) Prise off the top boards with a suitable pry-bar.

(2) Take out the top packing from around the machine.

(3) Remove the left-hand side of the case and remove all the loose parcels. Check that you have all the loose parts before discarding the wrappings. Retain the TEST CARD in case you find it necessary to report any loss of parts or damage during transit. The machine can now be removed from its case.

(4) The ignition keys and steering lock keys will be found in parcel No. 2.

INSTALLING THE FRONT WHEEL

(1) Put the machine on the centre stand and place a suitable support under the engine.

(2) Place the front fender between the fork legs and fit the stays.

(3) Fit the nave plate and brake plate to the front wheel and remove spindle clamps from the fork ends.

(4) Fit the wheel between the forks and replace clamps.

(5) The support can now be removed from under the engine.

INSTALLING THE HANDLEBAR, ATTACHING THE CABLES

(1) Place the handlebar in position and secure with nuts and washers on the clamp pins.

(2) Fit front brake lever and throttle twist grip complete with cables.

(3) Attach the clutch and air control cables to their respective levers.

(4) Attach the cut-out switch with the clip found in parcel No. 2.

FITTING SEAT AND HANDRAIL

(1) Hook the front of the seat on to the frame member and secure at the rear with two nuts and washers.

(2) Fit handrail and secure with nuts, washers and bolts.

INSTALLING THE FOOTPEGS, KICKSTART AND GEAR PEDAL

(1) Refit the right-hand footrest and replace rubbers on both left- and right-hand.

(2) Mount the pillion footpegs with nuts, washers and rubbers.

(3) Fit gearchange pedal with bolt and rubber.

(4) Fit kickstart pedal with rubber and tighten nut on the cotter pin securely.

INSTALLING REAR NUMBER PLATE BRACKET

Refit the rear number plate bracket with its two nuts, bolts and washers.

SPARK PLUGS AND TOOLS

(1) Take out and discard the plastic plugs from the spark plug holes, fit the new spark plugs and attach the plug lead connectors which are numbered 1, 2 and 3 from the timing-side. The plugs supplied with the machine are best suited to all round operating conditions and should not be changed without the advice of a plug specialist.

(2) The tools, instruction manual and other literature can now be placed in the toolbox behind the left-hand sidecover.

BATTERY

Batteries are supplied in dry-charged condition. Do not fill unless it is known that the machine is to be sold within a few days.

To Fill and Charge the Battery

All plates in this battery have been charged fully and dried completely by special process. The tape across the vent holes prevents the ingress of moisture or air and insures perfect condition of the plates during transportation and storage. This tape must only be removed immediately before the battery is brought into service. Dilute sulphuric solution S.G. 1·260 can be prepared by slowly pouring 1 part of concentrated sulphuric acid into 3 parts of distilled water (by volume) or of S.G. 1·210 by adding 1 part of concentrated sulphuric acid to 4 parts of distilled water (by volume).

A glass, earthenware or lead vessel should be used and the mixture well stirred. Allow to cool to the temperature of the surrounding atmosphere before using.

IMPORTANT:—On dry-charged batteries the filling of each cell with acid must be completed in one operation and levels restored after standing by syphoning off excess acid.

FILL EACH CELL WITH PURE DILUTE SULPHURIC ACID TO THE COLOURED LINE AT ONE OPERATION. The temperature of the acid and battery should be between 60°F. and 80°F. (see below).

	TEMPERATE Climates ordinarily below 90°F. (32·2°C.) Shade temperature	TROPICAL Climates frequently above 90°F. (32·2°C.) Shade temperature
Specific gravity for filling new cells	1·260 (at 60°F.)	1·210 (at 60°F.)
Specific gravity at completion of charge to be adjusted if necessary, to be between	1·270 and 1·290 (at 60°F.)	1·210 and 1·230 (at 60°F.)

(1) Batteries which have been stored at lower temperature than 60°F. should have their temperatures raised before filling by allowing the battery to stand in a warm room until it attains room temperature.

(2) Batteries used under these conditions are up to 90% charged, but if time permits a freshening charge of 3 hours at the normal re-charge rate would be beneficial. If the acid level rises after this freshening charge restore levels by syphoning off excess acid.

NOTE:—Re-charge rate 1·0 ampere.

IMPORTANT:—On no account should the battery be topped-up to the separator guard, but only to the coloured line.

FINAL CHECK

It is the duty of the dealer to see that every nut, bolt and screw is tight and correctly installed before the motor-cycle leaves his shop. You will be responsible if the customer returns and complains of rattles, missing nuts or fractures caused by vibration. It should be noted that 90% of all vibration problems can be traced to loose engine mountings. Do not take it for granted that the factory has done everything right. CHECK EVERYTHING YOURSELF.

STARTING THE MOTOR-CYCLE

Fill the oil tank, primary drive and gearbox with correct grades of oil (see pages A.7, A.10 and A.11).

While the engine is running take off the oil tank filler cap and check that the oil is circulating correctly through the return pipe. After replacing the oil tank cap the machine will be complete and ready for use.

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VALVES

Seat angle (inclusive)	90°	
Head diameter (inlet)	1·528″—1·534″	(38·81—38·96 mm.)
Head diameter (exhaust)	1·309″—1·315″	(33·24—33·4 mm.)
Stem diameter (inlet)	0·3095″—0·3100″	(7·86—7·874 mm.)
Stem diameter (exhaust)	0·3090″—0·3095″	(7·84—7·861 mm.)

VALVE GUIDES

Material		
Bore diameter (inlet and exhaust)	0·3122″—0·3129″	(7·93—7·947 mm.)
Outside diameter (inlet and exhaust)	0·5005″—0·5010″	(12·71—12·725 mm.)
Interference fit in head	0·001″—0·003″	(·0254—·0762 mm.)
Length	1⅞″	(47·625 mm.)

VALVE SPRINGS

Free length (inner)	1·468″	(37·28 mm.)
Free length (outer)	1·600″	(40·64 mm.)
Fitted length (inner)	1·181″	(30·0 mm.)
Fitted length (outer)	1·229″	(31·2 mm.)

PISTON

Material	"Lo-Ex" aluminium	
Compression ratio	9 : 1	
Clearance (bottom of skirt)	0·0018″—0·0033″	(·0457—·0838 mm.)
Clearance (top of skirt) (*both measured on major axis*).	0·0045″—0·0056″	(·114—·142 mm.)
Gudgeon pin hole diameter	0·6883″—0.6885″	(17·48—17·59 mm.)

PISTON RINGS

Material—compression (top and centre)	Cast-iron (tapered)	
Material—scraper	Chrome-plated steel	
Width—compression (top and centre)	0·0625″	(1·587 mm.)
Scraper	"Apex"	
Depth	0·091″—0·107″	(2·31—2·71 mm.)
Clearance in groove	0·0015″—0·0035″	(·038—·088 mm.)
Fitted gap (minimum)	0·009″	(·228 mm.)
Fitted gap (maximum)	0·013″	(·33 mm.)

GUDGEON PIN

Material	EN.32B	
Fit in small-end (clearance)	0·0011″—0·0005″	(·028—·012 mm.)
Diameter	·6883″—·6885″	(17·48—17·59 mm.)
Length	2·235″—2·250″	(56·76—57·15 mm.)

CONNECTING RODS

Length between centres	5·749″—5·751″	(146·02—146·07 mm.)
Big-end bearing type	Vandervell VP.6	
Rod side clearance	0·008″—0·014″	(·203—·355 mm.)
Bearing diametrical clearance	·0005″—·002″	(·0127—·05 mm.)
Small-end bore diameter	0·6890″—0·6894″	(17·5—17·511 mm.)
Finished width of cap	0·903″—0·905″	(22·93—22·98 mm.)

CRANKSHAFT

Type	One-piece forged three-throw crank	
Main bearing (drive-side)	Hoffman MS.11 (ball)	
Journal diameter	1·1245″—1·1248″	(31·56—31·57 mm.)
Outer diameter	2·812″	(71·42 mm.)
Width	0·812″	(20·6 mm.)
Centre main bearings	Vandevell VP.3	
Journal diameter	1·9170″—1·9175″	(49·69—48·7 mm.)
Bearing diametrical clearance	0·0005″—0·002″	(·0127—·0508 mm.)
Main bearing (gear-side)	Hoffman R.125 (roller)	
Inner diameter	0·9840″—0·9843″	(24·993—25·00 mm.)
Outer diameter	2·047″	(51·99 mm.)
Width	**0·590″**	**(14·986 mm.)**
Crankpin diameter	1·6235″—1·6240″	(41·23—41·25 mm.)
Minimum regrind (big-end)	—0·010″	(—·254 mm.)
Second regrind (big-end)	—0·020″	(—·508 mm.)
Third regrind (big-end)	—0·030″	(—·762 mm.)
Maximum regrind (big-end)	—0·040″	(—1·016 mm.)
Minimum regrind (centre main bearings)	—0·010″	(—·254 mm.)
Second regrind (centre main bearings)	—0·020″	(—·508 mm.)
Third regrind (centre main bearings)	—0·030″	(—·762 mm.)
Maximum regrind (centre main bearings)	—0·040″	(—1·016 mm.)
Crank throw	1·375″	(34·925 mm.)

TIMING GEAR

Crankshaft pinion:		
Number of teeth	25	
Fit on shaft	—0·0005″	(·0127 mm.)
	+0·0005″	
Camshaft pinion:		
Number of teeth	50	
Interference fit	—0·0000″—0·001″	(·0254 mm.)
Idler pinion:		
Number of teeth	47	
Idler pinion spindle size	0·6870″—0·6875″	(17·449—17·462 mm.)
Idler pinion hole size	0·8745″—0·8755″	(22·212—22·237 mm.)
Type of bearing	Torrington B.1110 (needle roller)	

TAPPET CLEARANCE (Cold)

Inlet	0·006″	(·1524 mm.)
Exhaust	0·008″	(·2032 mm.)

IGNITION TIMING

Piston position (B.T.D.C.) full advanced	0·375″	(9·525 mm.)
Crankshaft position (B.T.D.C.) full advanced	38°	
Contact breaker (gap setting)	0·015″	(·381 mm.)

CAMSHAFT

Journal diameter—left (inlet and exhaust)	1·0605″—1·0615″	(26·936—26·962 mm.)
Journal diameter—right (inlet and exhaust)	1·0605″—1·0615″	(26·936—26·962 mm.)
Journal diameter—centre (inlet and exhaust)	1·0605″—1·0615″	(26·936—26·962 mm.)
End float	·007″—·012″	(·1778—·304 mm.)
Cam lift (inlet)	·329″	(8·33 mm.)
Base circle diameter	·406″	(10·3 mm.)

VALVE TIMING

Tappets set to 0·020″ (·508 mm.) for checking purposes only:—

Inlet opens	50° B.T.D.C.
Inlet closes	64° A.B.D.C.
Exhaust opens	67° B.B.D.C.
Exhaust closes	47° A.T.D.C.

OIL PUMP

Pump body material	Cast-iron	
Pump type	Double-gear	
Pump non-return valve spring (free length)	1·500″	(38·1 mm.)
Pump non-return valve ball size	0·437″ diamter	(11·1 mm.) diamter
Oil pressure relief valve spring (free length)	1·500″	(38·1 mm.)
Blow off pressure (oil at 80°C.)	70—90 lb./sq. in.	(4·9—6·3 kg./sq. cm.)

SPROCKETS

Engine sprocket	28 teeth
Clutch sprocket	50 teeth
Final drive sprocket	19 teeth

CYLINDER BARREL

Material	Aluminium with Austenitic iron liner	
Bore size (standard)	2·6368″—2·6363″	(66·21—66·19 mm.)
Maximum oversize	2·6768″—2·6763″	(67·99—67·98 mm.)
Tappet bore size	0·3120″—0·3125″	(7·9248—7·9375 mm.)

TAPPETS

Material	High tensile steel with Stellite tip	
Tip radius	1·125″	(28·575 mm.)
Tappet diameter	0·3110″—0·3115″	(7·899—7·912 mm.)
Clearance in tappet blocks	0·0005″—0·0015″	(·0127—·0381 mm.)

CYLINDER HEAD

Material	DTD.424 aluminium alloy	
Inlet port size	$1\frac{7}{16}$″	(36·5 mm.)
Exhaust port size	1-7/32″	(30·9 mm.)
Valve seatings	Cast-iron (cast-in)	

INLET MANIFOLD

Carburetter port size	$1\frac{1}{16}$″	(26·98 mm.)
Cylinder head port size	$1\frac{1}{16}$″	(26·98 mm.)

CARBURETTER

Type	Concentric: R.626/14; R.626/16; L.626/15	
Main jet	150	
Pilot jet	622/107	
Needle jet size	·106″	(2·692 mm.)
Needle position	2	
Nominal choke size	27 mm.	
Throttle valve	3	
Air cleaner type	Zig-zag felt	

CLUTCH

Type	Borg and Beck: single dry-plate	
Overall thickness of friction plate	0·262″	(6·654 mm.)
Diaphram spring (maximum release load)	1,000 lb. (approx.)	(453·6 kg.)

PRIMARY CHAIN

Triplex ·375″ pitch × 82 links

GEARBOX

	Top	*3rd*	*2nd*	*1st*
Internal ratios	1 : 1	1·192 : 1	1·690 : 1	2·437 : 1
Overall ratios	4·87 : 1	5·83 : 1	8·3 : 1	11·95 : 1

GEAR DETAIL

Mainshaft top gear:		
Bush diameter (fitted)	0·8145″—0·8155″	(20·688—20·713 mm.)
Bush length	2-7/32″	(56·35 mm.)
Working clearance	0·0042″—0·0057″	(·1066—·1447 mm.)
Layshaft first gear:		
Bush diameter (fitted)	0·8135″—0·8145″	(20·662—20·688 mm.)
Working clearance	0·0025″—0·0040″	(·0635—·1016 mm.)

GEARBOX SHAFTS

Mainshaft—left end diameter	0·8098″—0·8103″	(20·568—20·581 mm.)
Mainshaft—right end diameter	0·7494″—0·7498″	(19·034—19·044 mm.)
Length	10-21/64″	(262·33 mm.)
Layshaft—left end diameter	0·6870″—0·6875″	(17·449—17·462 mm.)
Layshaft—right end diameter	0·6870″—0·6875″	(17·449—17·462 mm.)
Length	6-31/64″	(164·7 mm.)

KICKSTART RATCHET

Pinion diameter (inner)	0·6205″—0·6215″	(15·76—15·786 mm.)
Running clearance	0·0015″—0·0035″	(·0381—·0889 mm.)
Bore diameter (inner cover)	0·623″—0·624″	(15·824—15·849 mm.)
Pinion diameter (outer)	0·747″—0·748″	(18·973—18·999 mm.)
Running clearance	0·003″—0·005″	(·0762—·127 mm.)
Bush bore diameter	0·751″—0·752″	(19·075—19·10 mm.)
Ratchet spring free length	½″	(12·7 mm.)

GEAR SELECTOR QUADRANT

Plunger diameter	0·4315″—0·4320″	(10·96—10·97 mm.)
Housing diameter	0·4325″—0·4330″	(10·98—10·99 mm.)
Working clearance	0·0005″—0·0015″	(·0127—·0381 mm.)

CAM PLATE PLUNGER

Plunger diameter	0·4355″—0·4365″	(11·061—11·087 mm.)
Housing diameter	0·4370″—0·4380″	(11·099—11·125 mm.)
Working clearance	0·0005″—0·0025″	(·0127—·0635 mm.)
Spring free length	2·65″	(67·46 mm.)

FRAME AND FITTINGS

STEERING HEAD

Number of steel balls	40	
Size of balls	¼″	(6·35 mm.)

SWINGING ARM FORK

Bush type	Glacier WB.1624	
Housing diameter	1·0012″—1·0000″	(25·43—25·4 mm.)
Spindle diameter	0·810″—0·811″	(20·574—20·599 mm.)
Spacer tube diameter (inner)	0·812″—0·817″	(20·624—20·651 mm.)
Spacer tube diameter (outer)	0·9972″—0·9984″	(25·328—25·359 mm.)
Spacer tube clearance (swinging arm spindle)	0·001″—0·007″	(·0254—·1778 mm.)
Clearance in bush	·0016″—·0040″	(·0306—·1016 mm.)
Bush diameter (inner)	1·0000″—1·0012″	(25·4—25·43 mm.)
Bush diameter (outer)	1⅛″ nominal	(28·5 mm.)

REAR SHOCK ABSORBERS

Type	Coil spring, hydraulically damped	
Springs:		
Fitted length	9·4″	(238·76 mm.)
Spring rate	110 lb./in.	
Colour identification	Red/white	

FRONT FORKS

Type	Coil spring, hydraulically damped	
Springs:		
Free length	9·75″	(247·6 mm.)
Spring rate	32·5 lb./in.	
Number of coils	17	
Colour identification	Yellow/green	

FORK BUSHES

Material	Sintered bronze	
Outer diameter (top)	1·498″—1·499″	(38·49—38·074 mm.)
Outer diameter (bottom)	1·4935″—1·4945″	(35·648—35·674 mm.)
Inner diameter (top)	1·3065″—1·3075″	(33·185—33·21 mm.)
Inner diameter (bottom)	1·2485″—1·2495″	(31·7—31·73 mm.)
Working clearance (top)	0·0035″—0·0050″	(·0889—·127 mm.)
Working clearance (bottom)	0·0035″—0·0065″	(·0889—·1651 mm.)
Length (top)	1″	(25·4 mm.)
Length (bottom)	0·870″—0·875″	(22·098—22·225 mm.)
Shaft diameter	1·3025″—1·3030″	(25·463—25·476 mm.)
Sliding tube diameter	1·498″—1·500″	(38·049—38·1 mm.)

WHEELS, BRAKES AND TYRES

WHEELS

Rim size and type (front)	WM2–19	
Rim size and type (rear)	WM3–19	
Spoke sizes:		
Front (inner) timing-side (10)	8/10G×4-11/16″	(·160″×·128″×4·687″)
Front (outer) timing-side (10)	8/10G×4-11/16″	(·160″×·128″×4·687″)
Front (outer) drive-side (20)	8/10G×5⅝″	(·160″×·128″×5·625″)
Rear—timing-side (20)	10G×8⅜″	(·128″×8·375″)
Rear—drive-side (20)	10G×8″	(·128″×8·00″)

WHEEL BEARINGS

Front (left- and right-hand)	20×47×14 mm. ball journal	
Rear (left- and right-hand)	20×47×14 mm. ball journal	
Spindle diameter (front)	0·7868″—0·7873″	(19·98—19·997 mm.)
Spindle diameter (rear)	0·7867″—0·7862″	(19·98—19·984 mm.)

REAR WHEEL SPROCKET

Number of teeth	52	
Chain size	⅝″×⅜″×108 pitch	(15·875×9·525 mm.)

BRAKES (Floating Shoes)

Diameter (front)	8″	(203·2 mm.)
Diameter (rear)	7″	(177·8 mm.)
Width (front)	1⅝″	(41·275 mm.)
Width (rear)	1¼″	(31·7 mm.)
Lining thickness (front)	$\frac{3}{16}$″	(4·7 mm.)
Lining thickness (rear)	$\frac{3}{16}$″	(4·7 mm.)
Lining area (front)	12·8″ sq./in.	(82·5 sq./cm.)
Lining area (rear)	7·875 sq./in.	(50·7 sq./cm.)

WHEELS, BRAKES AND TYRES

TYRES

Size (front)	3·25×19 (K70)	(82·55×482·0 mm.)
Size (rear)	4·10×19 (K81)	(101·1×482·0 mm.)
Pressure (front)	24 lb. sq./in.	(1·687 kgm./sq. cm.)
Pressure (rear)	28 lb./sq. in.	(1·969 kgm./sq. cm.)

ELECTRICAL EQUIPMENT (12 volt)

Alternator type	Lucas RM.20 (encapsulated)	
Zener Diode	Lucas ZD.715	
Rectifier	Lucas 2DS.506	
Coils	SIBA No. 32000	
Contact breaker	Lucas 7CA	
Battery	Lucas PUZ5A	
Horns (2)	Clearhooter P.201 (right-hand) Clearhooter P.101 (left-hand)	
Headlamp glass diameter	7″	
Bulbs:	*Number*	*Type*
Headlight (12 volt)	446	50/40 watt
Stop/tail light (12 volt)	380	21/6 watt
Pilot light (12 volt)	989	6 watt
Main beam warning light (24 volt)	13829	3 watt
Oil pressure warning light (24 volt)	13829	3 watt

SPARK PLUGS

Type	Champion N4	
Gap setting	·020″	(·508 mm.)
Thread size	14 mm. diameter × ·75″ reach	(19·0 mm.)

CAPACITIES

Fuel tank	5 U.S. gallons	(19 litres)
Oil tank	6 U.S. pints	(3 litres)
Oil cooler	⅝ U.S. pint	(250 c.c.)
Primary chaincase	¾ U.S. pint (nominal).	(290 c.c.)
Gearbox	2½ U.S. pints	(1,150 c.c.)
Front forks (each leg)	⅜ U.S. pint	(190 c.c.)

BASIC DIMENSIONS

Wheelbase	56¾″	(144·0 cm.)
Overall length	88″	(223·5 cm.)
Handlebar width	32·5″	(82·5 cm.)
Seat height	32″	(81·2 cm.)
Ground clearance (unladen)	7″	(17·8 cm.)

WEIGHTS (approximate)

On front wheel	206 lbs.	(93·44 kg.)
On rear wheel	275 lbs.	(124·75 kg.)
Machine (unladen)	470 lbs.	(213·19 kg.)
Engine gearbox unit	180 lbs.	(81·64 kg.)
Centre of gravity (front wheel)	32·1″	(14·56 mm.)
Wheel centres	56·25″	(25·5 mm.)

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ROUTINE MAINTENANCE

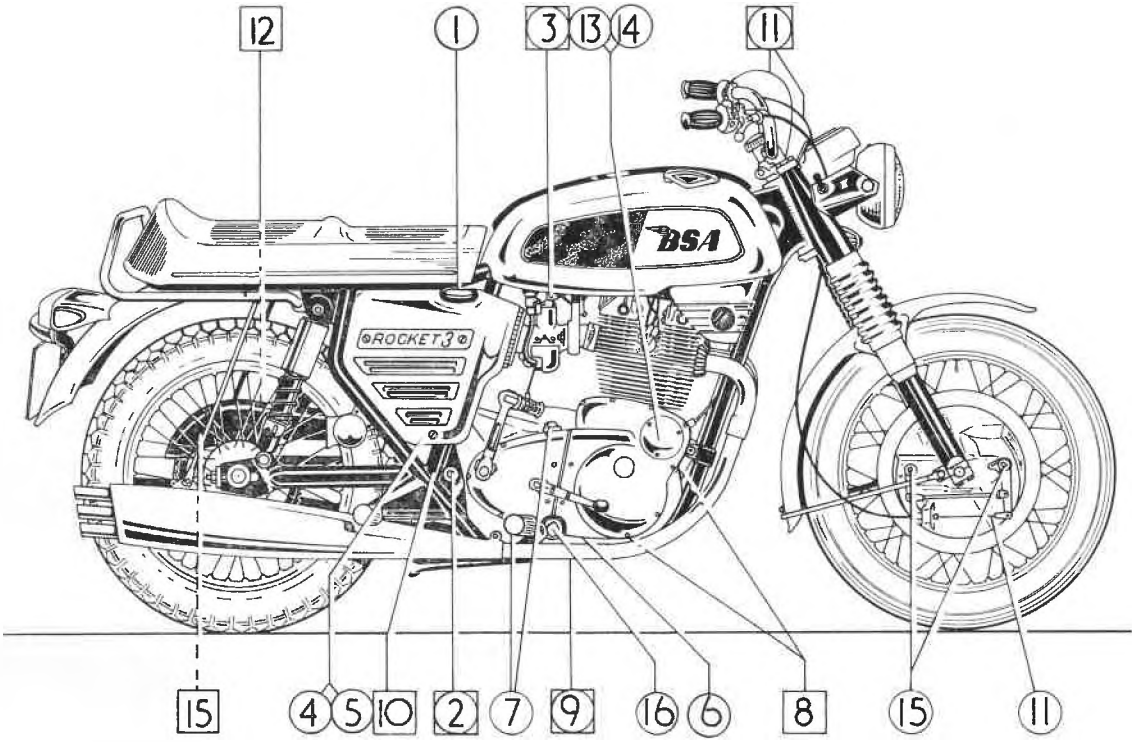

FIG. A.1. *Key lubrication points.*

(Numbers in circles refer to the right-hand side of machine, numbers in squares refer to left-hand side of machine).

REF. NO.	
	Weekly or every 250 miles (400 km.)
1	Check oil level in tank.
3	Oil carburetter linkage.
	Every 2,000 miles (3,200 km.)
13	Lubricate contact breaker cam.
14	Lubricate auto-advance unit.
7	Check oil level in gearbox.
8	Check oil level in primary case.
11	Lubricate exposed cables and joints.
10	Grease brake pedal pivot.
12	Lubricate rear chain.
2	Grease swinging arm pivot.

REF. NO.	
	Every 4,000 miles (6,400 km.)
4, 1	Drain and refill the oil tank.
5	Clean oil tank filter.
6	Clean crankcase sump filter.
16	Replace full-flow, oil filter.
7	Drain and refill the gearbox.
8	Drain and refill the primary case.
15	Grease brake cam spindles.
9	Grease central stand (2).

Fig. A.2.

RECOMMENDED LUBRICANTS

Assembly	MOBIL	B.P.	CASTROL	ESSO	SHELL	REGENT
Engine and Primary Chaincase	Super	Visco-Static 20/50	XL	Motor Oil 20W/50	X100 20W/50	Havoline
Gearbox	Mobilube GX.90	Gear Oil 90 E.P.	Hypoy 90 E.P.	Gear Oil 90 E.P.	Spirax 90 E.P.	Multigear 90 E.P.
Front Forks	Super	Visco-Static 10W/40	Castrolite	Motor Oil 10W/30	Motor Oil 10W/40	Havoline 10W/30
Wheel Bearings	Mobil-grease	Ener-grease	Castrolease	Multi-purpose	Retinax	Marfak
Swinging Arm Steering Head	MP or Special	L2	M	H	A	All Purpose

The choice of lubricant is to a certain extent dependent on the application of the machine and the climate in which it is to be used. The chart above gives recommended lubricants for use in temperate climates. In countries where climate conditions are extreme, obviously some variation in grade will be found necessary to provide adequate lubrication. Remember that the higher the temperature, the higher S.A.E. grade number required.

Routine Lubrication

So that the machine will provide trouble-free running and remain in good condition, lubrication must be regularly carried out. The above list of items requiring regular attention will also service as a useful guide to the periods of time before servicing (see page A.2). Where necessary, the method of carrying out each operation is detailed on following pages.

ENGINE LUBRICATION

The lubrication system is of the dry-sump type, *i.e.*, the oil is fed by gravity from a tank to the double-gear type pump contained inside the crankcase at the bottom between the gearbox and the crankshaft. One set of gears in the pump draws oil from the tank through a gauze filter and delivers it under pressure past a non-return valve to the two centre main bearings.

The oil then flows through drillings in the crankshaft to the big end bearings. Excess oil is then thrown off by centrifugal force on to the cylinder walls, the underside of the pistons (to lubricate the gudgeon pins) and is collected in various wells to lubricate the camshaft and gears. From the two centre main bearings part of the oil goes via small pipes up to timed feeds for tappet and cam lubrication.

If the pump pressure is above the intended maximum a release valve in the base of the left-hand crankcase opens to pass the excess oil direct to the bottom of the crankcase.

After lubricating the various internal parts of the engine the oil drains down into the sump, fastened to the underside of the crankcase. From here the second, and larger set of gears in the pump, draws oil and pumps it back to the tank via rockers and oil cooler at a greater rate than the feed-side thus ensuring that the sump is not flooded; hence the term "dry sump." The return pipe is tapped just before it gets to the oil cooler, and oil flows down a pipe to the ends of the rocker spindles.

The oil then flows along the hollow rocker spindles, from the spindles the oil lubricates the rockers and ball pins. It then drains down into the crankcase via small drain holes through the cylinder head and barrel.

Changing the Oil and Cleaning the Filters

The oil in new or reconditioned engines should be changed at 250, 500, and 1,000 mile intervals during the running-in period and thereafter as stated on page A.2.

It is always advisable to drain when the oil is warm as it flows more readily.

Draining the Oil Tank

The right-hand sidecover is retained by three special screws.

Take off the sidecover, to expose the oil tank, and unscrew the large hexagon drain plug which incorporates the tank filter. Use a piece of stiff card as a chute to allow the oil to drain freely into a suitable receptacle, lean the machine towards the right-hand side to drain off any remaining oil in the tank.

Wash out the tank and filter plug with clean kerosene, making sure that none remains in the tank.

Replace the filter using a new sealing washer if necessary.

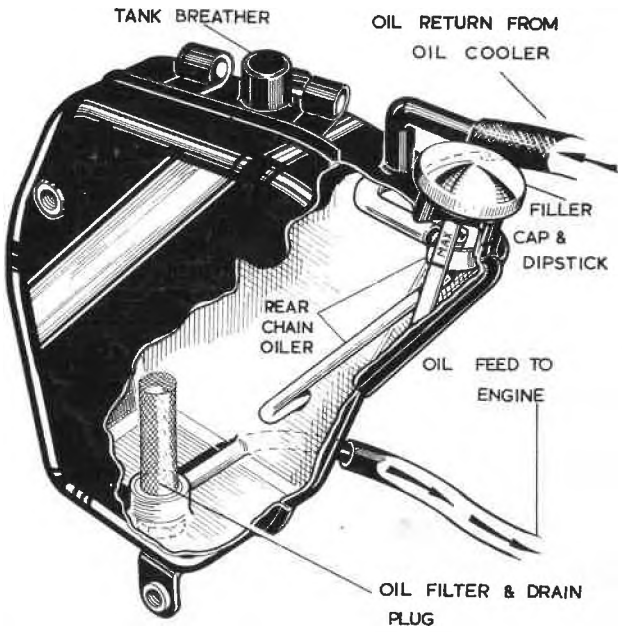

FIG. A.3. *Oil tank.*

Draining the Oil Cooler

Because the oil pipe connectors are uppermost, it will not be possible to drain the oil cooler until it is first removed. Two decorative panels conceal the oil cooler at the front and are each held by one bolt at the rear and two bolts at their front edge. Unless the oil cooler is to be detached from its support cradle, the panels need not be disturbed.

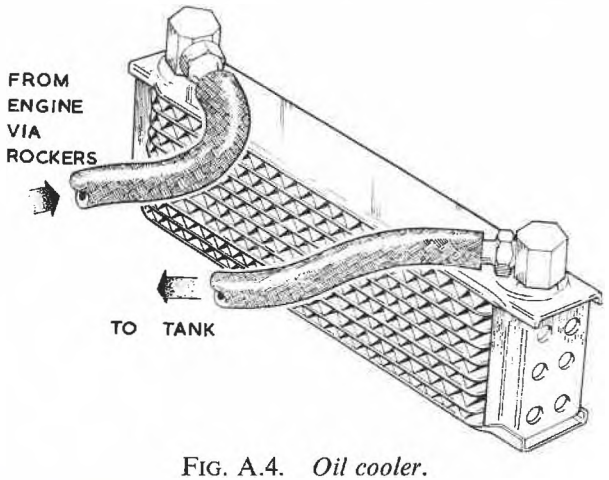

FIG. A.4. *Oil cooler.*

Loosen the oil pipe clips and pull the pipes off the connector stubs. Do not attempt to unscrew tha large hexagon connectors from the oil cooler. To ensure that the oil pipes are replaced on the correct connector stubs, it is recommended that one of the pipes and its corresponding stub is suitably marked.

For instructions on removing oil cooler see page B.8.

The Oil Filters

The oil in the lubrication system passes through three filters which must each be cleaned or replaced if necessary whenever the oil is changed.

The oil tank filter is made of gauze and is attached to the tank drain plug. Wash the filter thoroughly in clean kerosene but before replacing, ensure that it is perfectly dry and that the sealing washer is intact.

The full-flow **crankcase filter** is contained within the lower rear end of the crankcase and can be withdrawn on removal of its large retaining cap, situated to the left of the timing cover. It is most important that this filter is renewed every 4,000 miles (6,000 km.) and no attempt should be made to clean it. Before replacing the cap, make sure that the tension spring is correctly located in the cap recess and that the sealing washer is fit for further use.

The **crankcase sump filter** is integral with the sump plate which is held to the underside of the crankcase by four nuts. Remove the unit so that it can be washed in kerosene and dried before replacing. Check that the gasket is in good condition to maintain an oil-tight joint, renewing if necessary.

Opportunity should be taken whilst the sump plate is removed, to check that the sump suction pipe is not blocked. If the return flow of oil to the tank is restricted, the crankcase may become flooded.

Refilling

Replenish the tank with one of the engine oils recommended on page A.5. The tank capacity of approximately 6½ U.S. pints and "normal" and "low" levels are indicated on the dipstick. Avoid over-filling the tank, otherwise the air space above the oil which is needed for normal "breathing", will be reduced, causing oil to be blown out of the breather pipe.

NOTE:—If the crankcase sump filter was removed for cleaning, half a pint of clean engine oil must be added to the crankcase before starting the engine. This oil can either be inserted through the ignition timing plug aperture at the crankcase front or added to the rocker box. If the latter is chosen, then the oil must be given ample time to drain into the crankcase sump. Obviously it will be necessary to allow sufficient space in the oil tank to receive the additional quantity of oil.

Run the engine for a few moments then check the oil level indicated on the tank dipstick, adding sufficient oil to restore the level to the "normal" mark on the dipstick. This procedure must be carried out because a quantity of oil will be retained by the oil cooler.

Non-return Valve

The non-return valve is the smaller of the two valves and is situated in the oilway between the pump and engine bearings. Its purpose is to prevent oil flowing down from the tank to the crankcase during intervals when the engine is stationary. This valve is pre-set for correct operation during manufacture and should not require attention until the engine is dismantled for overhaul.

OIL PRESSURE CONTROL VALVE

FIG. A.5. *Oil pressure control valve.*

The oil pressure control valve is mounted within the rear of the crankcase behind the primary chaincase and is retained by a large domed hexagon nut. Like the non-return valve, it should not need attention until such time as the engine is dismantled for overhaul.

The length of spring in both valves can be checked (see page GD.4) and if there is corrosion, replace the spring after cleaning the valve body (see Fig. A.5).

To remove the pressure release valve simply unscrew the large hexagon and to dismantle, unscrew the smaller hexagon. Do not attempt to remove the gauze filter and ensure that the fibre washers are fit for further use.

LOW OIL PRESSURE

When the engine revolutions reach 1,000 revs per minute the oil pressure must be between 70 and 90 lb. per square inch.

If the oil pressure is lower than 70 lb. per square inch it becomes dangerous since insufficient oil is likely to be delivered to the engine. The possible causes of low pressure being:—

(1) Insufficient oil in the tank. Check the level and return after replenishing. If the return is correct, it will show as a mixture of oil and air issuing from the return pipe.

(2) Tank and sump filters partly blocked preventing the free passage of oil.

(3) Badly worn oil pump or badly worn big-end bearing shells.

(4) Oil pipes incorrectly connected at the tank when the pump would be drawing air through the return pipe.

SYPHONING

This, one of the commonest troubles, happens when the non-return ball valve is sticking off its seating. It can also be caused by a badly worn pump.

Indications of syphoning are clouds of smoke from the exhaust when the engine is first started after standing overnight.

To service the non-return valve (see page A.7).

OIL PIPES

All oil pipes are a push-fit on the unions and are retained by screw-type clips.

NOTE:—The feed pipe goes to small pipe on the crankcase and the return from the big pipe (see Fig. A.2).

DISMANTLING AND REASSEMBLING THE OIL PUMP

Having removed the pump from the engine (see page B.24) it is advisable to have a very clean working area on which parts can be laid out for inspection.

Take out the two screws which pass through the pump body and screw into the back plate. The pump can then be taken apart revealing the four gears.

Wash all parts thoroughly in gasoline and allow to dry before examining. Look for foreign matter jammed in the gear teeth and deep score marks in the pump body. These will be evident if the oil changing has been neglected. Figure A.6 shows slight score marks which could be ignored but the metal embedded in the gear tooth must be removed.

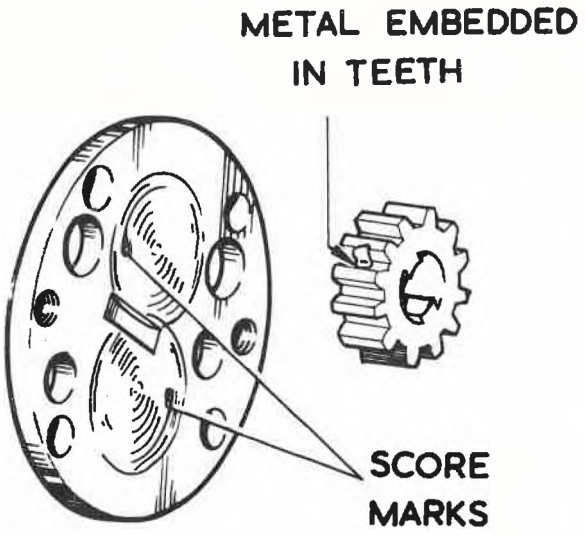

FIG. A.6. *Score marks.*

REBUILDING THE PUMP

Absolute cleanliness is essential when rebuilding the pump.

Insert the return driving gear and spindle into the housing end cap, then place the driven return gear and its spindle.

Slide the main housing over these, fit the driving feed gear on to the splined shaft and the driven feed gear on to the plain spindle, **apply clean oil,** and refit the base plate.

Check the pump for freedom of movement. The pump housing and end plates should line up perfectly as the whole assembly is located on dowels (see Fig. A.7 for help on reassembly).

CONTACT BREAKER LUBRICATION

The contact breaker is situated on the outer timing cover and it is essential that no engine oil gets into the contact breaker housing. To prevent this, there is an oil seal pressed into the inner timing cover behind the auto-advance unit.

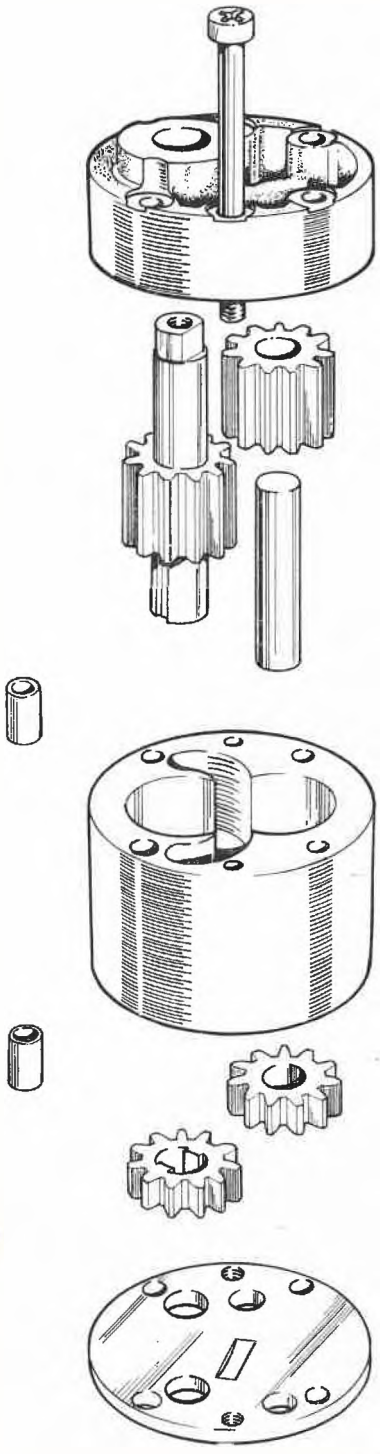

FIG. A.7. *Oil pump exploded.*

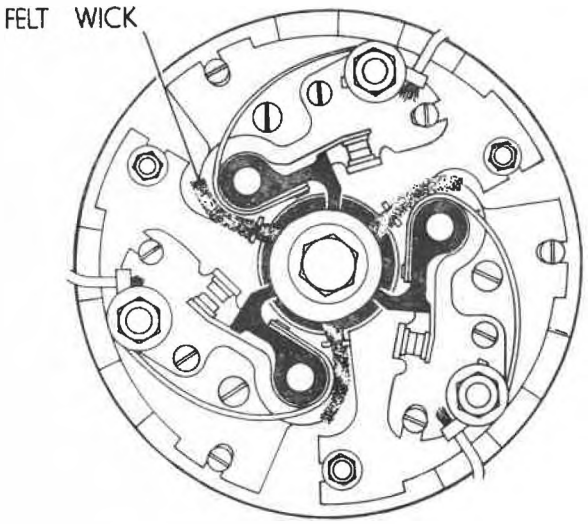

FIG. A.8. *Felt wick.*

Lubrication of the contact breaker cam and the auto-advance unit pivot points, however is necessary.

The cam is lubricated from greased felt wicks which should have a small amount of high-melting point grease.

Retinax "A" or equivalent, every 2,000 miles (see Fig. A.8).

To lubricate the auto-advance unit it is necessary to remove the contact breaker plate. First place a mark across the place and the housing so that it can be replaced in exactly the same position, then take out the three contact plate screws and lift off the plate.

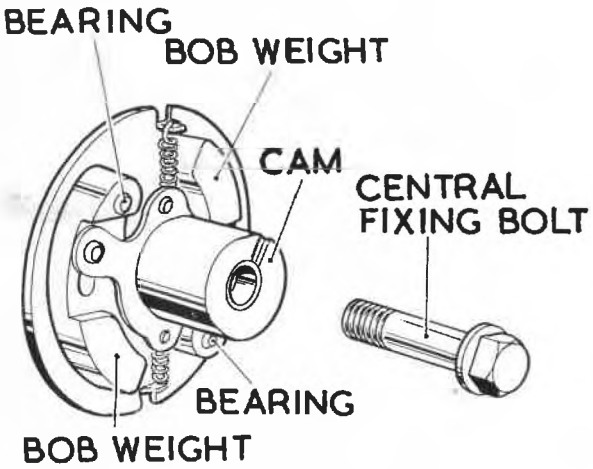

FIG. A.9. *Auto-advance.*

The pivot points of the auto-advance unit should be lightly oiled where indicated in Fig. A.9, again at 2,000 miles intervals. After lubricating replace the plate to the marker but if timing is lost follow instructions on page B.51.

NOTE:—The auto-advance cam spindle is coated with a special lubricant and no other form of lubricant should be applied.

GEARBOX LUBRICATION

The gearbox having its own oilbath is independent of the engine for lubrication but, for the same reason, the level of oil must be checked and any loss due to leakage made good.

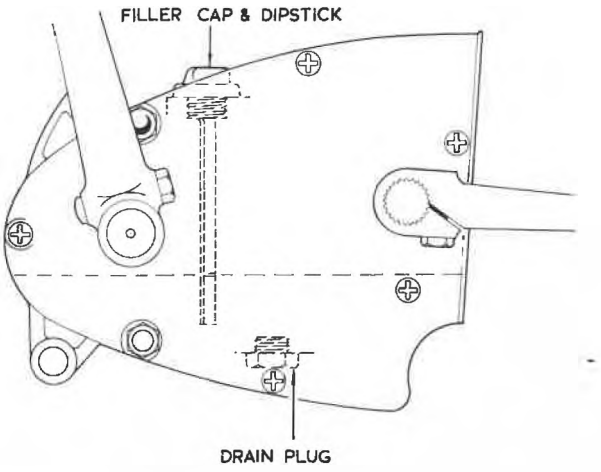

FIG. A.10. *Gearbox lubrication.*

The lower set of gears runs in the oilbath and oil being squeezed from or thrown off these gears by centrifugal force lubricates the rest of the gears, bearing and bushes.

To drain the gearbox, take out the filler cap and dipstick on top of the gearbox, then take out the drain plug underneath, draining the oil into a suitable receptacle (see Fig. A.10).

After draining the oil replace the drain plug making sure the rubber O-ring is in good condition. Now refill with approximately 2½ U.S. pints of one of the recommended oils, and check the level with the dipstick.

Recommended grades are quoted on page A.5, capacities on page GD.9, and checking frequency on page A.2.

PRIMARY CHAINCASE LUBRICATION

Oil to the primary chaincase is fed from the engine, thus eliminating the necessity of checking oil level in the chaincase. The oil passes through the drive-side main bearing and is picked up on the bottom run of the primary chain, it is then thrown off the clutch sprocket into a small well at the top of the case. From there the oil then drips down through a tube back on to the bottom run of the chain, so providing the chain with a continuous flow of oil.

If the chaincase is to be taken off then the oil must be drained, it should also be drained at every engine oil change.

To drain remove plug (*A*) and inspection cap (*B*). Plug (*C*) conceals the primary chain tensioner adjuster sleeve.

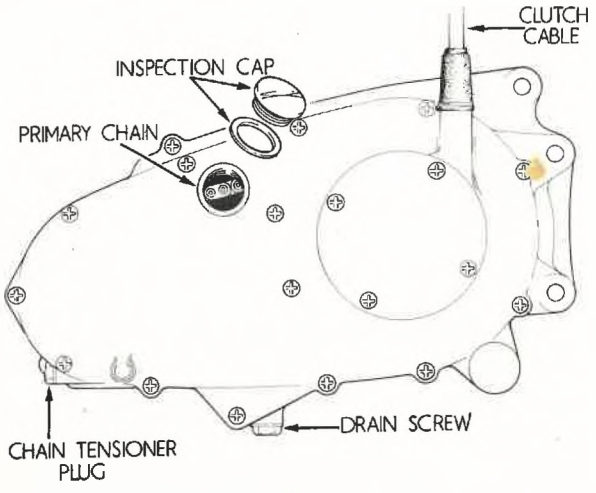

FIG. A.11. *Primary chaincase.*

STEERING HEAD

The steering head bearing are packed with grease on assembly and only require repacking at intervals quoted on page A.2.

Removal and replacement of the steering head is dealt with on pages E.3—4 in the Fork Section.

When the balls are removed they should be cleaned by placing in a clean rag, then rolling the rag between the palms of the hands, changing the position on the rag as necessary.

After cleaning examine carefully for pitting and corrosion, and examine the cups and cones for pocketing and cracks.

If there is evidence of damage, it is wise to replace all the bearings, cones and cups.

The fresh grease will hold the balls in position during assembly, but make sure that there is the correct number as quoted on page E.3 and that the grease is as quoted on page A.5.

FRONT FORKS

The oil contained in the forks not only lubricates the bearing bushes, but also acts as the damping medium. It is for this latter reason essential that the amount of oil in each fork leg is exactly the same.

Oil leakage midway up the forks usually indicates that the oil seal has failed and requires replacement; this is dealt with on page E.7, covering dismantling and reassembly of the forks.

Correct period for changing the oil as quoted on page A.2 is every 10,000 miles (16,000 km.) but some owners may not cover this mileage in a year, in which case it is suggested that the oil be changed every 12 months.

To drain the oil, take out the small drain screws on the outside of the fork legs directly above the wheel spindle also remove the fork top caps (see Fig. A.12).

After allowing several minutes for the oil to drain, pump the forks up and down to expel any oil remaining, then replace the drain plugs taking care not to omit the fibre washers.

Refill with ⅜ U.S. pint (190 c.c.) of the correct grade of oil (see page A.5).

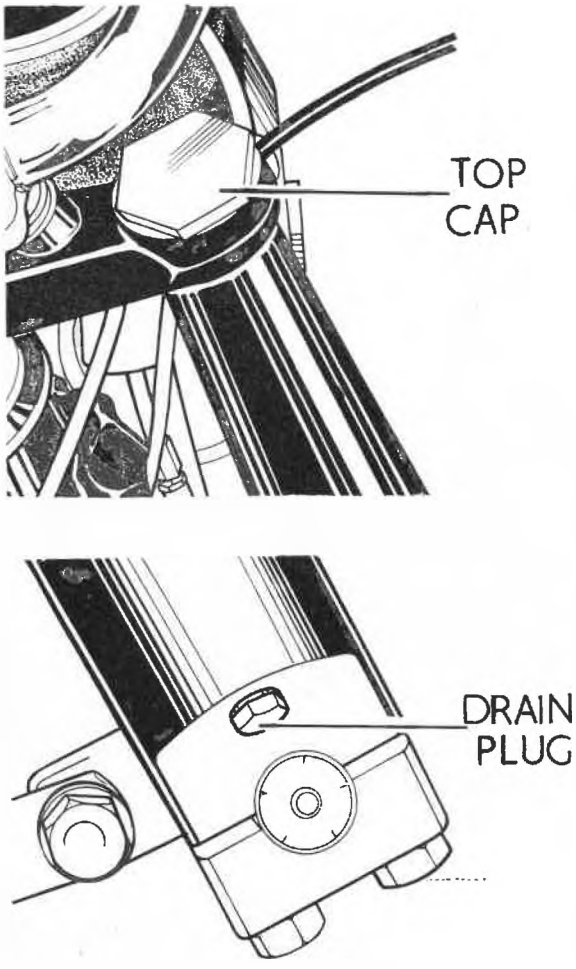

FIG. A.12. *Fork lubrication.*

WHEEL BEARINGS

The wheel bearings are packed with grease on assembly and only require repacking at the intervals quoted on page A.2.

The bearings should be removed as quoted on page F.3 dealing with wheels. After removal, wash thoroughly with clean kerosene and if possible, use an air line to blow any grit or kerosene remaining, out of the bearings.

Pack with the correct grade of grease as quoted on page A.5 after assembling the first bearing. Do not over-lubricate and do not handle brake shoes with greasy hands.

LUBRICATION NIPPLES

There are a number of points to be lubricated by means of a grease gun and nipples as indicated on page A.2. They comprise both front and rear brake cam spindles (15) and centre stand (9). Give one stroke of the grease gun to each of these points at the period indicated on page A.2. No more than one stroke of the gun should be used at point (15) as excess grease is liable to get on the brake linings.

REAR BRAKE PEDAL LUBRICATION

The back brake pedal spindle is lubricated by means of a grease nipple mounted underneath the pedals pivot lug on the frame. This should be greased every 2,000 miles or sooner if the pivot is found to be getting dry.

CABLES

Exposed sections of inner cables should be lubricated periodically (see page A.2). This can be done either by greasing or applying the oilcan.

The most satisfactory way however, is to induce a flow between the inner and outer casing by forming some sort of reservoir to hold the oil, and leaving the cable for several hours (see Fig. A.13).

All cables are greased on manufacture, with a molybdenum-based grease which forms a semi-permanent lubricant. They will give long service before needing attention.

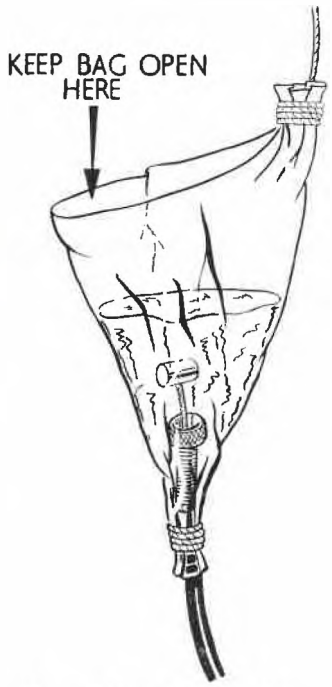

FIG. A.13. *Oiling cable.*

SPEEDOMETER CABLES

It is necessary to lubricate speedometer and tachometer cables, particularly to prevent premature failure of the inner wire. Care is however necessary to avoid over-zealous greasing, which may result in lubricant getting into the instrument head.

As the speedometer and tachometer instrument heads are enclosed in the rubber binnacle behind the headlamp, it will be necessary to remove the latter to gain access to the cable nipples. These must then be unscrewed and the cable pulled out of its register, the inner cable can then be withdrawn for cleaning and greasing. Apply grease sparingly to the inner wire, and none at all within 6″ of the instrument head.

FIG. A.14. *Speedometer cable lubrication.*

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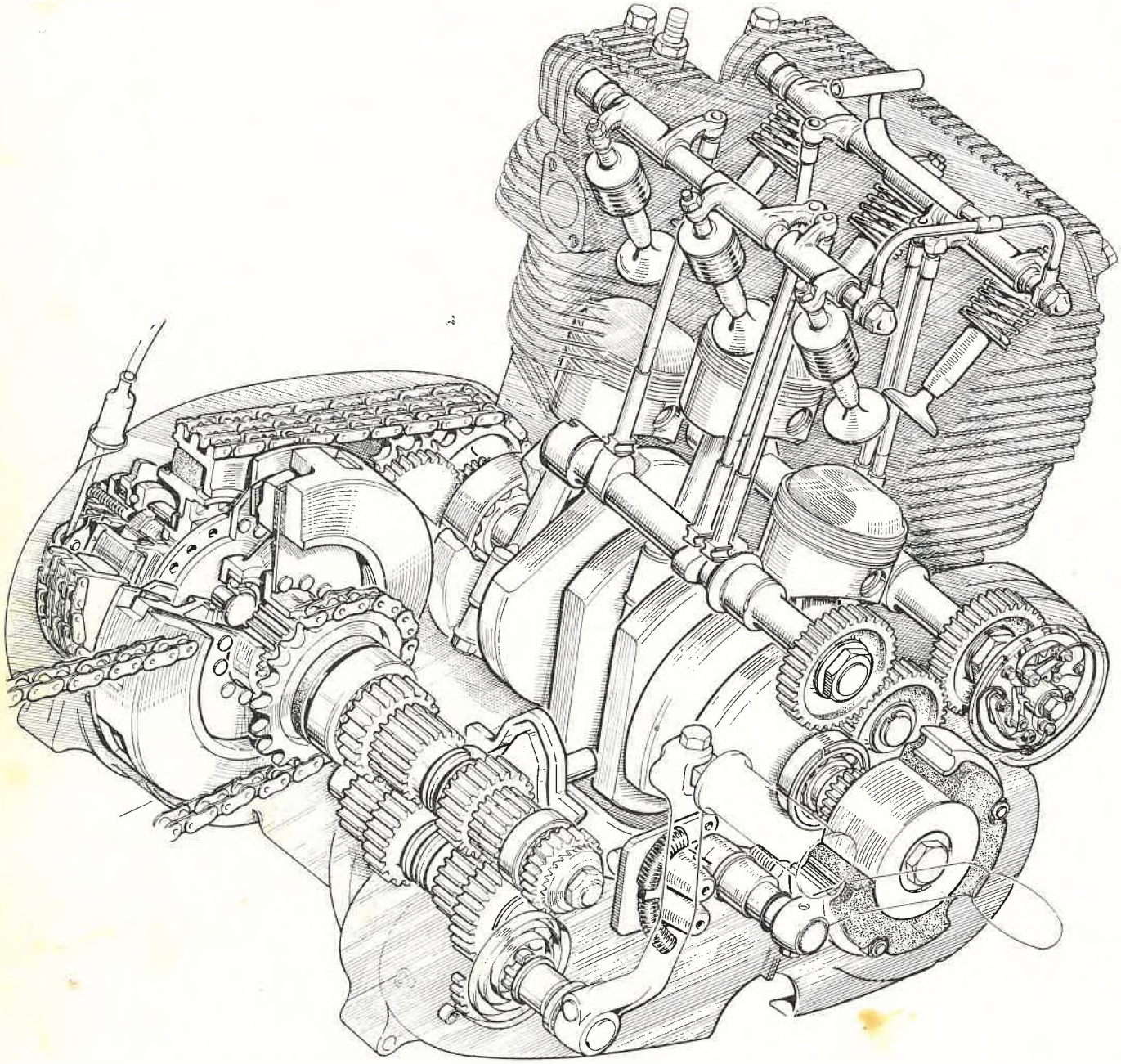
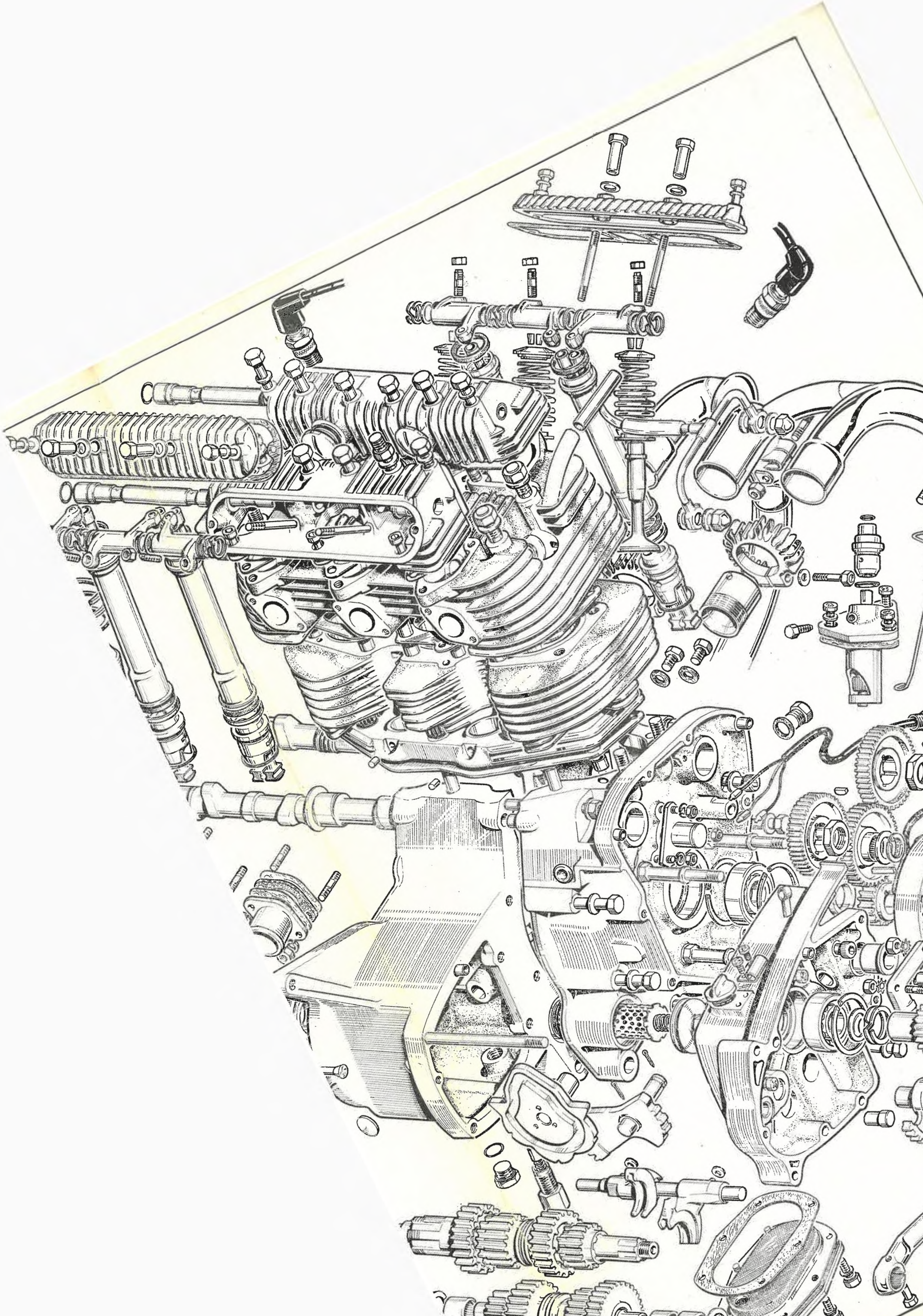


FIG. B.1. *Engine and gearbox arrangement.*

Fig. B.1a.

Engine Exploded.



DESCRIPTION

Of unit construction the engine has a triple cylinder barrel of aluminium, with three Austenetic iron liners, mounted on an aluminium crankcase made from three sections bolted and machined together.

The gearbox is an integral part of the centre crankcase portion which also houses the oil pump.

The primary drive cases are bolted to the left-hand or drive-side crankcase. There is also a clutch housing which bolts between the gearbox and inner primary case.

The aluminium alloy cylinder head has high duty cast-iron valve seat inserts cast-in, on top of the head are the two rocker boxes, these are bolted to the head.

"Lo-Ex" aluminium pistons having two compression rings, both of which are tapered, and one scraper ring are used on H-section connecting rods made from RR.56 Hiduminium alloy. The two one-piece camshafts operate in three bearing surfaces each, two in the right-hand crankcase and one in the left-hand crankcase.

The alternator consists of a rotor mounted on the right-hand side of the crankshaft and a six-coil stator mounted on three pillar bolts.

The crankshaft is of one piece forged three-throw type with no flywheel.

The double gear oil pump is driven off the left-hand end of the crankshaft via a gear train. The pump supplies oil to the crankshaft, cylinder, pistons and timing gears.

The gearbox has its own independent oil bath, but the primary chaincase is dependent on the engine oil for its lubrication.

Power is transmitted from the engine through the engine sprocket and triple primary chain to the clutch sprocket which has a built-in shock absorber, then via the Borg and Beck clutch to the four-speed constant mesh gearbox and final drive sprocket.

Three Amal concentric carburetters are fitted to an inlet manifold which in turn is connected to the cylinder head by three rubber hoses and three adaptor stubs.

DECARBONISING

Description

Decarbonising or "top overhaul" as it is sometimes called means the removal of carbon deposit on the top of the piston, on valve heads, around the combustion chamber and inlet and exhaust ports. It also means that while the upper portion of the engine is dismantled for this purpose the opportunity is taken to examine the various parts of the engine for general "wear and tear", hence the term "top overhaul."

Carbon, which is the result of the combustion taking place in the engine when running, is not harmful providing it is removed at the right time, that is before the deposit is too heavy and therefore likely to cause pre-ignition and, other symptoms which may impair performance.

The usual symptoms, indicating the need for decarbonising are, a tendency to "pink" (metallic knocking sound when under load), a general falling off of power noticeable mainly on hills, a tendency for the engine to run hotter than usual and an increase in petrol consumption.

Decarbonising should not be carried out unnecessarily, it should only be done when the engine really needs it.

PREPARING TO DECARBONISE

Before commencing the work it is advisable to have the following equipment available:—

Spanners from $\frac{7}{16}$" across flats to $\frac{5}{8}$" across flats.
Phillips screwdriver.
Set of scrapers.
Set of feeler gauges.
Supply of fine emery cloth.
Jointing compound or cement.
Grinding paste.
Clean engine oil.
Top overhaul gasket set.
Valve springs (set).
Kerosene.
And rag for cleaning.

Perfect cleanliness is essential to ensure success in any service task, so before starting the job make sure that you have a clean bench or working area in which to operate and room to place parts as they are removed.

REMOVING THE PETROL TANK

Turn off the petrol supply at the taps and disconnect the fuel pipes from the taps.

Take out the four "Phillips" screws securing the padded styling strip. Removal of this will reveal the tank fixing nut and washer, unscrew this and remove the tank.

REMOVING THE OIL COOLER

To provide the necessary clearance for withdrawal of the cylinder head, the oil cooler must also be removed.

Two decorative panels conceal the oil cooler at the front and are each held by one bolt at the rear and by two bolts at their front edge. Unless the oil cooler is to be detached from its support cradle, the panels need not be disturbed.

Loosen the oil pipe clips and pull the pipes off the connector stubs. Do not attempt to unscrew the large hexagon connectors from the oil cooler. To ensure that the oil pipes are replaced on the correct connector stubs, it is recommended that one of the pipes and its corresponding stubs are suitably marked.

Undo two nuts and bolts securing the oil cooler cradle to the frame top tube lugs and withdraw the assembly. It will be seen that the bolts pass through two rubber bushes, fitted each side of the frame lugs.

After removal of the covers the oil cooler can, if necessary, be withdrawn from the cradle. Note that eight small rubber packing pieces are fitted between the cradle straps and each corner of the oil cooler to insulate the assembly from vibration.

REMOVING CARBURETTERS

So that the carburetter settings and synchronisation of the throttle levers will not be disturbed, it has been made conveniently possible to remove all these carburetters, air cleaner and control linkage complete with the large adaptor or inlet manifold.

First detach the throttle cable from the main operating lever and remove the air cable from the control lever on the handlebars.

Loosen the clips holding the adaptor rubber hoses to the cylinder head stubs and carefully withdraw the assembly. Unless in need of replacement, the petrol pipes can remain on the carburetters.

REMOVING EXHAUST MANIFOLD

Release the bolts in the finned collars that hold the exhaust manifold on to the cylinder head adaptor stubs. Loosen the exhaust pipe pinch bolts at each end of the manifold and allow the exhaust pipes to drop slightly. The manifold can now be pulled away from the adaptor stubs.

Avoid unscrewing the adaptor stubs unnecessarily. Excessive damage to the threads in the cylinder head may be caused by engine vibration if they should become loose.

ROCKER BOX REMOVAL

To remove the engine steady brackets, unscrew the two nuts securing the brackets to the top of the inlet rocker box and remove the single nut and bolt from the frame lug behind the engine, the steady brackets can now be removed.

Each rocker box is retained by two small end bolts, three nuts from the underside of the cylinder head and by four of the head fixing bolts.

Unscrew the two domed nuts securing the rocker oil feed unions to the ends of the rocker spindles and tie the pipe up out of the way. Note that copper sealing washers are fitted each side of the unions. It is advisable when reassembling, to renew these washers so that a good seal is maintained. Alternatively, the old washers can be annealed to soften them.

Before attempting to remove the rocker boxes it is recommended that the valve rocker adjusters are loosened completely, this is done to relieve the cylinder head studs from any undue strain from valve spring pressure.

Access is gained to the adjusters by removal of the long finned covers each being retained by two sleeve nuts and two bolts.

The three nuts and small end bolts should be removed first then, to avoid distorting the cylinder head, all the head fixing bolts must be unscrewed a little at a time in the sequence shown in Fig. B.2.

Having removed the fixing bolts and nuts, the rocker boxes can be lifted off complete with their spindles and rocker arms.

VALVE ROCKER ASSEMBLY

The rocker box assemblies need not be dismantled unless they are known to be faulty.

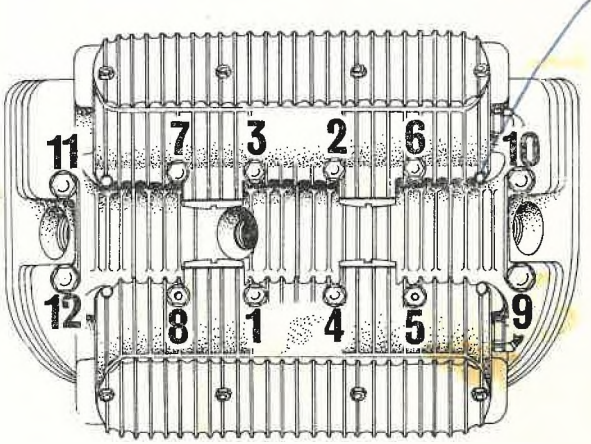


FIG. B.2. *Head fixing bolts.*

The rocker spindles are simply pressed into the rocker box housing, and to remove, tap the shaft out from the threaded end leaving the rockers in position. To avoid damaging the end of the spindle a blunt centre punch should be used as a drift.

Make a careful note of the position of the springs and thrust washers, and remove the rockers from between the shaft pillars.

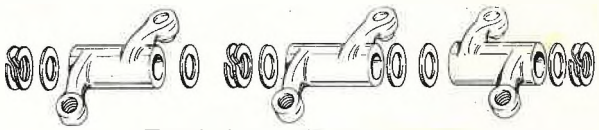


FIG. B.3. *Valve rocker assembly.*

From left to right the assembly should be:—

spring washer
thrust washer
left-hand rocker
thrust washer
dividing pillar
spring washer
thrust washer
centre rocker
thrust washer
dividing pillar
thrust washer
right-hand rocker
thrust washer
spring washer

Spring washers are always fitted next to the shaft pillars, they must never be fitted next to the rockers.

CYLINDER HEAD REMOVAL

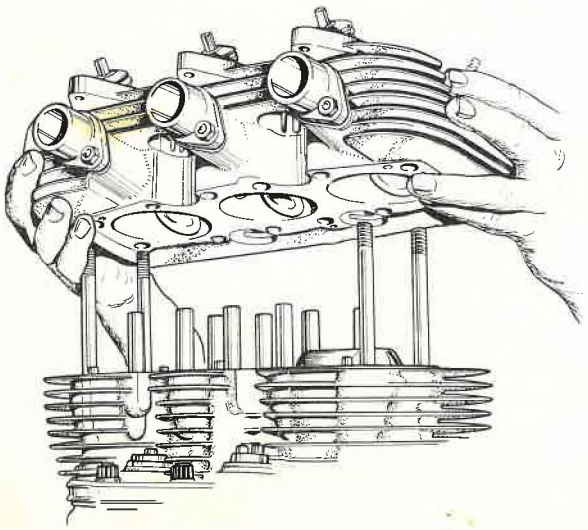


FIG. B.4. *Cylinder head removal.*

Disconnect the high-tension leads and unscrew the spark plugs.

After removing the remaining cylinder head bolts, lift the head squarely off its studs and place to one side. The push rod tubes and push rods can be left in the cylinder barrel until a later stage.

VALVE SPRINGS

Using a suitable valve spring compressor, compress each spring until the split collets can be removed. If the tool is given a sharp blow with a hammer on the spring side after the spring has been compressed a little, it will release the collets from the tapered hole in the valve cap.

When the collets are out, and the compressor removed, the valve springs and top collars can be lifted from the valve stems. Swill in clean kerosene. Each valve should be marked or placed on a numbered board for correct re-assembly in the cylinder head.

The springs may have settled through long use and they should therefore be checked in accordance with the dimensions quoted on page GD.2.

If the springs have settled more than $\frac{1}{16}$" (1.587 mm) or there are signs of cracking, they should be replaced.

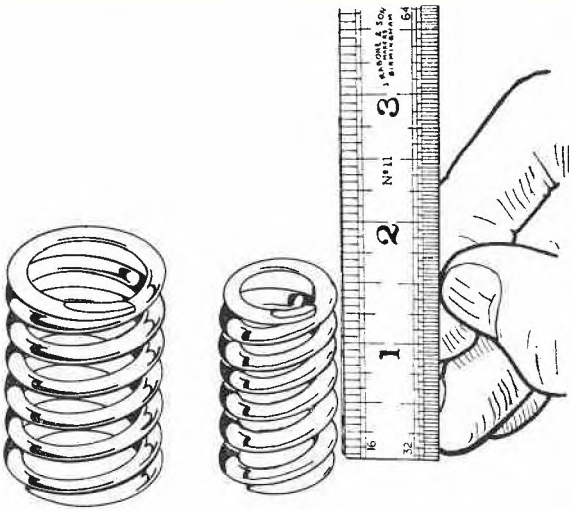


FIG. B.5. *Checking the springs.*

PUSH RODS

Examine the push rod end cups and ball ends to see if they are chipped , scarred, worn or loose, and check the rods by rolling on a flat surface, such as a piece of glass, to see if they are bent, this should be done with the cup end just off the edge of the glass. If any of these faults are evident the rod should be replaced.

VALVES AND GUIDES

Check the valves in the guides, there should be no excessive play or evidence of carbon build-up on that section of the stem which operates in

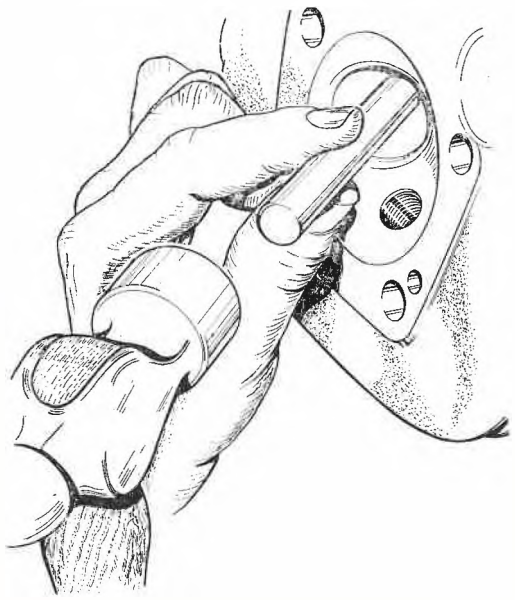


FIG. B.6. *Driving out a valve guide.*

the guide. Carbon deposits can be removed by careful scraping and very light use of fine emery cloth. If there are signs of scoring on the stem indicating seizure, both the valve and guide should be replaced.

An old guide can be pressed out with service tool No. 61–6063 (see Fig. B.6), but the aluminium head should first be heated by immersing in hot water. The new guide can be pressed in with service tool No. 61–6063 while the head is still warm.

Valve heads can be refaced on a valve refacer

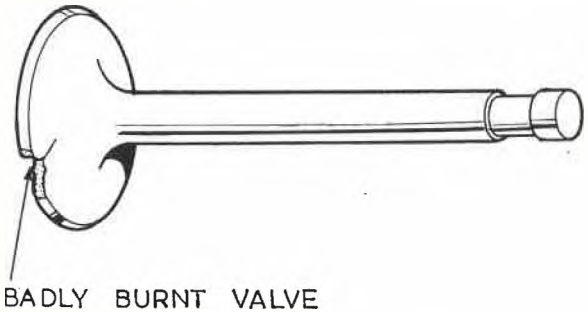


FIG. B.7. *Burnt valve.*

but if pitting is deep or the valve head is burnt, then a new valve must be fitted and ground-in.

When a new valve guide has been fitted, or if a new valve is necessary, the valve seat in the head must be re-cut at the correct angle of 45°.

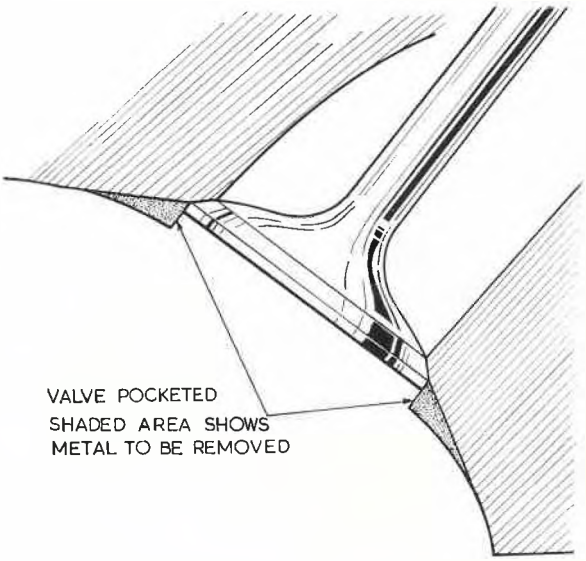


FIG. B.8. *Pocketed valve.*

Sometimes when the engine has been decarbonised many times, valves become "pocketed" that is the head and seat is below the surface of the combustion chamber so impairing the efficiency of the valve and affecting the gas flow. When this happens it is necessary to remove the pocket using a special blender tool before re-cutting the seat and grinding-in the valve.

The valve seats can be re-cut with pilot No. 60–1838 and cutter Nos. 60–1832 exhaust, 60–1833 inlet.

VALVE GRINDING

During decarbonisation, all valves must be ground-in, each to its own seat, whether new or old. This operation is only carried out after all the carbon deposit has been removed from the combustion chamber.

Removal of carbon from the head, inlet and exhaust ports, can only be done with scrapers or rotary files but whichever method is used great care must be taken to avoid damage to the valve seats due to the tools slipping across the seats. For final "polishing" the careful use of fine emery wetted by kerosene is recommended.

Having removed the carbon, smear a small quantity of fine grinding paste over the face of the valve and return it to its seat.

Hold the head of the valve with tool No. 61–5035 and rotate the valve backwards and forwards maintaining steady pressure.

Every few strokes raise the valve and turn to a new position.

Take the valve out, clean off the paste and examine both face and seat, continuing the grinding until both show a uniform matt finish all round. After grinding remove all traces of grinding paste and smear the valve stem with clean engine oil before reassembling the valve to the head.

Prolonged grinding does NOT produce the same results as re-cutting and must be avoided at all costs.

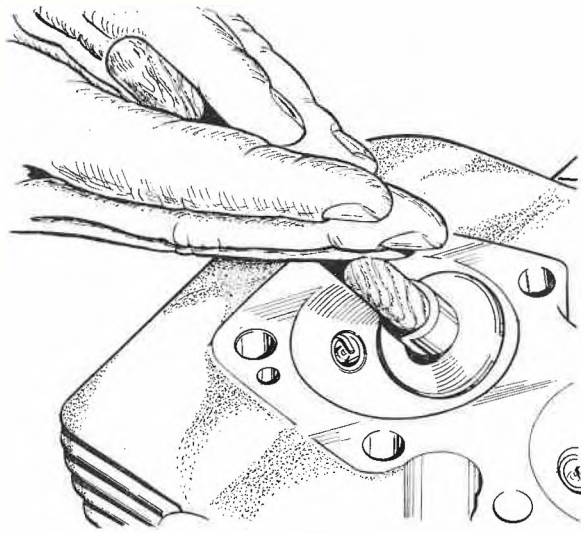


FIG. B.9. *Grinding-in valve.*

CYLINDER BARREL

In the ordinary course of events it should rarely be necessary to remove the cylinder barrel, since top overhaul, already described, usually suffices to keep the engine in first-class working condition for thousands of miles. Unless the condition of the engine indicates that the pistons, rings or cylinder bores require attention the cylinder barrel should not be disturbed.

If the bores are worn this can sometimes be detected by placing the fingers on top of the piston and pushing backwards and forwards in the direction of rotation. Symptoms indicating faulty piston rings might include heavy oil consumption, and poor compression (but only if the valves are in good order, otherwise they are much more likely to be the cause).

Excessive piston slap when warm may indicate a worn bore or severe damage through seizure.

Worn bores can be measured with cylinder bore dial gauges, by moving the pistons to the

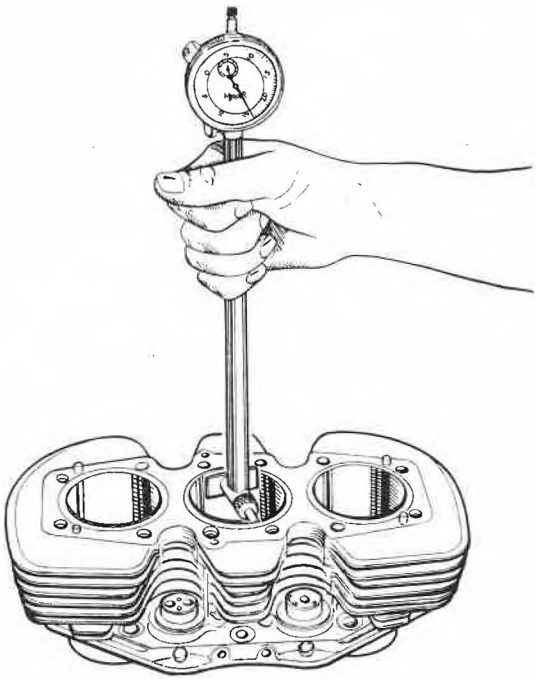


Fig. B.10. *Checking bore size.*

bottom of the bores thus exposing them for examination (see Fig. B.10).

If the barrel is not being removed bring the pistons to the top of the bores, cover the push rod towers with rag and proceed to remove the carbon from the piston crowns using a suitable scraper such as a stick of tinsmiths solder flattened at one end to form a scraper.

Always leave a ring of carbon round the edge of the piston crown and do not remove the ring of carbon at the top of the cylinder bore (see Fig. B.11).

After cleaning the two outer pistons rotate the engine to lower the outer two pistons and raise the middle one. Wipe away all loose carbon from the cylinder walls.

Scrape the carbon off the centre piston and again revolve the engine and clean the centre cylinder wall.

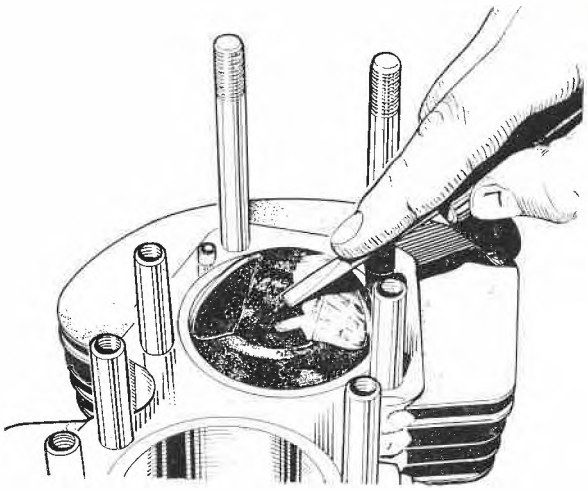


Fig. B.11. *Removing carbon.*

The cylinder barrel and head joint faces must also be cleaned and great care taken not to damage the faces by scoring with the scraper. Such score marks would result in gas leakage, loss of compression and even burning of the cylinder head face.

REMOVING THE BARREL

The tappets are loosely located from the underside of the tappet blocks so, to prevent them falling through into the engine when removing the cylinder barrel, wrap a piece of insulating tape around the top of each tappet stem.

The cylinder barrel is securely held at its base by 10 $\frac{3}{8}$" diameter nuts which must each be loosened a little at a time in the sequence shown in Fig. B.12, this is to relieve the barrel from any distortion.

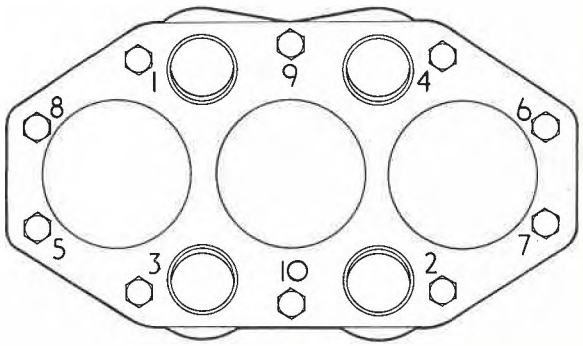


FIG. B.12. *Cylinder barrel nuts.*

Gently lift the barrel upwards and steady the pistons as they emerge from the bores so that they will not be damaged on the crankcase mouth. As soon as the barrel has been removed, cover the crankcase mouth with a clean rag to prevent entry of any foreign matter.

The tappets can now be withdrawn from the blocks and stored in their order of removal. It is most important that the tappets are replaced in their original position; failure to observe this may result in subsequent excessive tappet and cam wear.

CYLINDER BORES

Examine each cylinder bore carefully for excessive wear, usually being indicated by a deep ridge around top of each bore. The cylinder

barrel will also require attention if there is any deep scoring as this will cause loss of compression and excessive oil consumption.

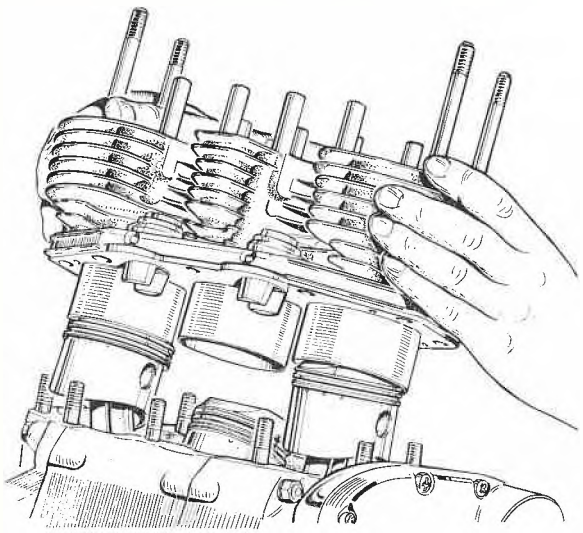


FIG. B.13. *Cylinder barrel removal.*

The point of maximum wear in the bores is usually the top 1″ in the direction of rotation. Bore wear anti-rotation and at the base of the cylinder is usually negligible. If the original base size is unknown the amount of wear can therefore be considered as the difference between the base measurement and the point of maximum dimension shown by the dial (see Fig. B.10, page B.12).

If wear exceeds ·005″ (·127 mm.) at the top (rotation) then a rebore with new pistons is indicated.

The cylinder barrel is fitted with cast-iron liners enabling +·010″, +·020″, +·030″ and +·040″ rebores to be carried out for use with oversize pistons and rings. The liners should stand ·002″—·007″ proud of the top face of the cylinder barrel.

TAPPET BLOCKS

The tappet guide blocks are pressed into the cylinder base flange and should not need replacement. If it becomes necessary to renew these, the dowels will have to be drilled out, the cylinder block must be heated, before pressing out the original tappet guide blocks and refitting the new ones. New dowels will then have to be fitted. Immersion in boiling water is normally the most satisfactory method of heating aluminium components.

REMOVING THE PISTONS

To remove the piston from its connecting rod it is first necessary to remove one of the gudgeon pin circlips. This is best accomplished with a pointed instrument such as the tang end of a file suitably ground to enter the slot in the piston.

If the piston is worn the pin will come out easily, otherwise it may be necessary to heat the piston with rags dipped in hot water and wrung out.

Then supporting the piston, tap out the gudgeon pin using a light hammer and punch.

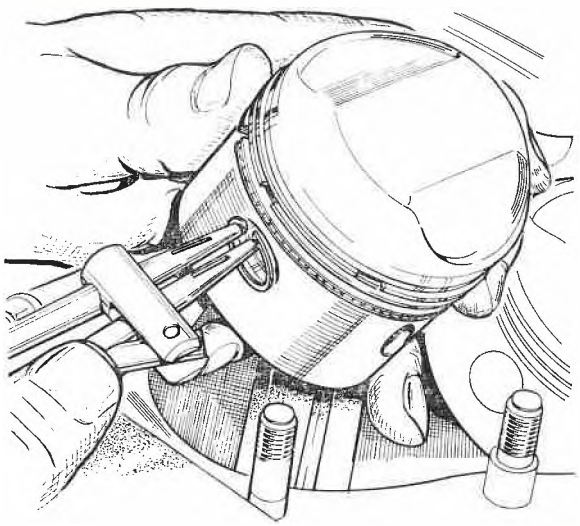


FIG. B.14. *Removing circlips.*

When the piston is free, mark the inside of the piston skirt, so that it can be replaced the correct way round and on the same connecting rod.

PISTON RINGS

If the rings are stuck in their grooves they will need to be carefully prised free and removed from the piston. All carbon should be carefully scraped from the grooves and the back of the rings. An old broken ring is useful for cleaning the grooves in the piston.

The outside face of each piston ring should possess a smooth metallic surface and any signs of discolouration means that the rings are in need of replacement.

The rings should also retain a certain amount of "springiness" so that when released from the barrel the ends of each ring should lie at least $\frac{3}{16}$" apart. When removing a ring from the piston, care is necessary to permit only a minimum amount of movement as they are very brittle and can be broken easily.

To check the piston ring gaps, place each ring in the least worn part of the cylinder wall (usually at the bottom) and locate it with the top of the piston to ensure it is square in the bore.

Measure the gap between the ends of the ring with a feeler gauge. The correct gap when new is between ·009" and ·013"; although an increase of a few thousandths of an inch is permissible, any large increase to say, ·025" indicates the need for a replacement ring.

It is advisable to check the gap of a new ring before fitting, and if the gap is less than ·009" then the ends of the ring must be carefully filed to the correct limit.

To check the ring groove in the piston place a new ring on end in the groove and roll it round the piston, at the same time rocking it from side to side. If the play is excessive the piston will have to be replaced (see Fig. B.15).

FIG. B.15. *Checking for worn piston ring grooves.*

REPLACING THE RINGS

Reassembly is in the reverse order to that for dismantling, that is the scraper ring is replaced first. Both centre and top compression rings are tapered this being indicated by the word "top" marked on one face which must always be uppermost on the piston. If the rings were to be fitted upside down, oil consumption would become excessive and a great deal of compression would be lost.

The ring gaps must always be equally spaced about the piston, that is at 120° apart, to restrict gas leakage through the gaps to the absolute minimum.

SMALL-END WEAR

Even after considerable mileage, wear in the small-end should normally be very slight, but if excessive it can cause an unpleasant high-pitched

tapping sound. The gudgeon pin should be a good sliding fit in the rod, though if there is considerable up and down movement the rod must be replaced.

REASSEMBLY AFTER DECARBONISING

Scrupulous cleanliness must be maintained when reassembling, and each compenent should be smeared with fresh oil before being refitted.

Having ground-in and replaced the valves and springs in the cylinder head taking great care to correctly fit the tapered cotters, replace the pistons on the connecting rods so that they are the same way round as previously. Always use new gudgeon pin circlips and see that they are pressed well down into their grooves.

If the circlips come adrift or one is omitted the cylinder barrel will soon be damaged and will require replacement.

Assemble the tappets into the tappet guide blocks, each one fitted to the hole that it came from. To prevent them from falling through wrap a piece of tape around the top of each tappet stem.

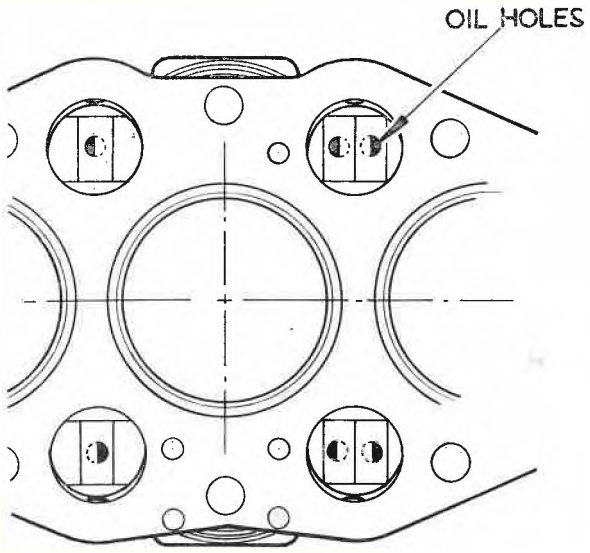


FIG. B.16. *Oil holes tappets.*

It is most important that the oil holes in the tappet stems line up with the holes in the blocks as indicated in Fig. B.16.

Now using piston slippers No. 61–6031 compress the rings of each piston so that they are just free to move. Rotate the engine until the top of the middle piston is at the top of its stroke (see Fig. B.17). Now place crankcase baffles in place, service tool Nos. 60–2211 (front), 60–2212 (rear).

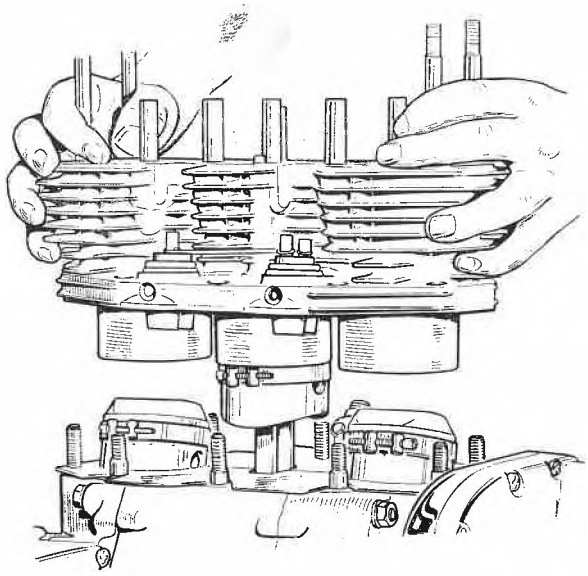


FIG. B.17. *Piston ring slippers.*

REPLACING THE BARREL

Gently lower the cylinder barrel complete with new base gasket over the middle piston. The piston ring slipper will be displaced as the piston enters the bore and can then be removed. Rotate the engine sufficient to allow the two outside pistons to enter the bore then remove the slippers. Gently lower the cylinder barrel on to the crankcase and tighten the 10 fixing nuts a bit at a time to the correct torque load quoted on page J.1, for tightening sequence refer to Fig. B.12, page B.13.

Remove the tape temporarily placed around the tops of each tappet stem and fit the push

rod tubes over the tappet blocks. Ensure that the rubber sealing rings at both ends of the tubes are in good condition before refitting.

REPLACING THE HEAD

Replace new cylinder head gasket on the cylinder head studs with the ribs downwards and lower the head squarely over the studs. Refit the four outer stud nuts loosely.

Insert the push rods into their tubes, single ones being on the drive-side. It is most important that the push rods line up evenly, as indicated in Fig. B.18.

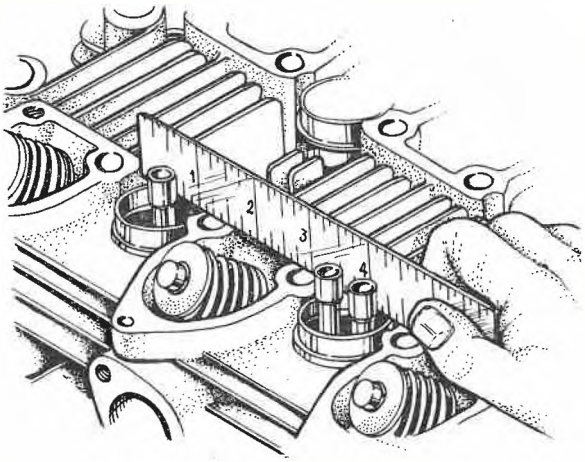


FIG. B.18. *Push rods.*

REPLACING ROCKER BOXES

Before refitting rocker boxes new gaskets must be fitted with gasket cement or compound on one side only. Replace the rocker boxes, taking care to locate the tops of the push rod tubes correctly.

Remove the circular inspection caps so that the upper ends of the push rods can be fitted under their corresponding rocker arms.

Fit the remaining eight cylinder head bolts through the rocker boxes and tighten all the bolts evenly in the sequence shown in Fig. B.19, to the torque settings quoted on page J.1. Note that the longer bolts are fitted on the outside, the rear ones being special bolts that take the engine steady stays. The rocker box end bolts and the six Allen screws on the inside of the rocker boxes can now also be tightened.

Replace the push rod inspection covers but, until the valve clearances have been reset, do not fit the long finned covers.

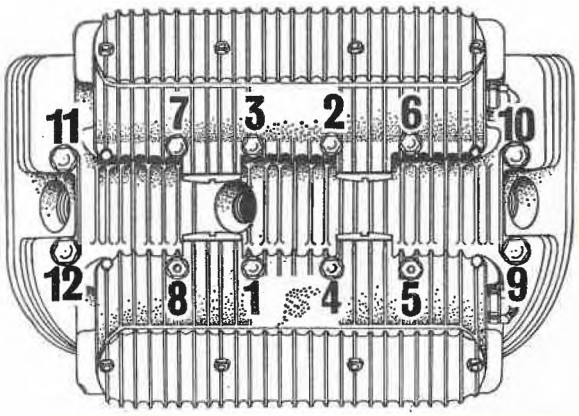


FIG. B.19. *Cylinder head bolts.*

VALVE CLEARANCE

The clearance between the top of each valve stem and the rocker adjusting pin can be most accurately set when the engine is cold.

With the sparking plugs removed compression will be eased, so enabling the engine to be rotated with ease by means of the kickstart pedal. It may be found easier if top gear is engaged and the rear wheel used to rotate the engine.

Set each piston in turn to top dead centre on its compression stroke, when both the inlet and exhaust valves are closed and using a feeler gauge, check that the clearances are as follows: inlet ·006", exhaust ·008". If a clearance requires adjustment, slacken the locknut, and using the special key supplied in the toolkit, turn the adjuster pin one way or the other, until the correct

gauge will just pass through between the valve stem and adjuster pin. Whilst holding the pin in its new position, retighten the locknut. Check the clearance again to make sure that the setting has not altered whilst tightening the locknut.

Repeat this operation on all three cylinders and finally replace spark plugs and valve inspection covers using new gaskets if necessary.

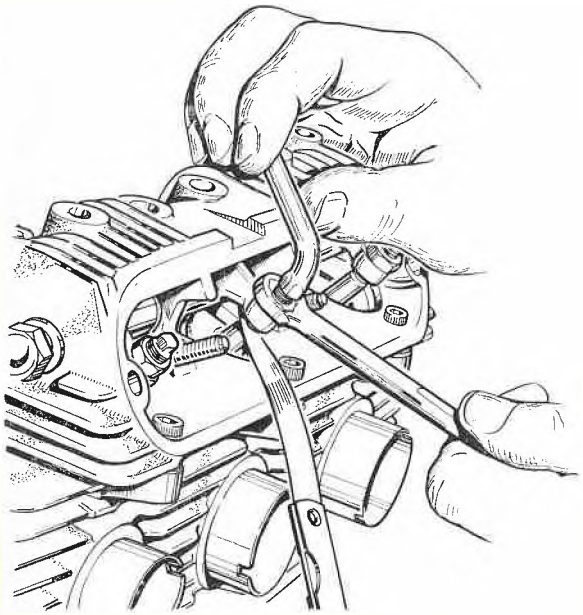


FIG. B.20. *Measuring valve clearances.*

REPLACING CARBURETTERS

Replacement of the carburetters is the reverse of removal but care should be taken to ensure that no leaks occur past the rubber connections.

Reconnect the throttle cable to the main throttle lever and check for correct operation. It may be found necessary to re-adjust the carburetter setting as detailed on page C.7.

REPLACING OIL COOLER

Replacement of the oil cooler is the reverse of removal but care must be taken to connect the oil pipes to the correct stubs. The correct way for fitting the pipes is as follows: left-hand stub goes to oil tank. Right-hand stub has pipe coming from the engine via rocker feed. The pipes are secured to the stubs by clips.

Refit the engine steady stays and secure with nuts, to the special cylinder head bolts. Screw in the spark plugs and attach the appropriate high-tension leads. These are numbered 1, 2 and 3, to indicate which plug they should be attached. Number 1 lead goes to the timing-side plug.

Locate the petrol tank over the frame top tube, taking care not to disturb the rubber mounting pads, and tighten down the central fixing nut. Reconnect the fuel pipes to the taps, and finally replace the protective strip over the petrol tank.

REMOVING ENGINE UNIT

During the process of engine unit removal, keep careful watch for any nuts or bolts which are found to be loose or have worn considerably. Such parts are no longer safe and must be renewed. Examine the wiring for places where the insulation may have rubbed through, and protect with a few turns of good insulating tape. Never neglect a bare wire; it can cause an electrical short-circuit which may start a fire.

The procedure for removing the engine unit is as follows:

(*a*) First remove the petrol tank, the procedure for which is detailed on page B.8.

(*b*) Drain the oil tank and system as described on page A.6. This operation will also involve removal of the oil cooler described on page B.8. Uncouple the rocker oil feed pipes, then disconnect the supply and pipes from beneath the crankcase at the rear.

(*c*) Take off the carburetters and exhaust manifold, described on page B.8.

FOOTRESTS

Both footrests are located by two small dowels which fit between the back of the footrest and the rear engine plates. They are then secured by a single set-screw for each footrest. To take off the right-hand footrest unscrew the bolt and pull the footrest off its location pegs. Both screws have right-hand threads. The left-hand footrest should be left on its plate.

CHAINGUARD

To remove the chainguard, unscrew the single nut and bolt securing the guard to the swinging arm at the front, whilst the rear is held by the lower fixing nut of the suspension unit.

REAR CHAIN

After removing the chainguard disconnect the rear chain by removing the spring link and run the chain off the gearbox sprocket. Disconnect the generator leads at the couplings and remove the contact breaker leads also from their couplings. Remove high-tension leads and unscrew spark plugs. To aid correct assembly, the high-tension leads are numbered 1, 2 and 3.

CLUTCH CABLE

Disconnect the clutch cable from the actuating mechanism in the primary chaincase. To do this the cable adjusters must be completely slackened off then remove the large inspection cover (which is held by four screws) to reveal the clutch actuating mechanism. The cable can now be pulled from the lever toggle.

Unscrew the rev-counter drive cable nut and withdraw the cable from its housing on the front of the crankcase. Detach the large plastic tube from the engine breather stub situated at the rear of the inner primary chaincase, it is simply a push-fit on the stub.

To allow more clearance for engine removal it is recommended that the rear brake pedal and the kickstart pedal are removed. To remove brake pedal unscrew the pinch bolt and prise the pedal from the spline. To remove the kick-start pedal remove the nut and washer from the cotter pin and using a suitable drift, drive the cotter from the crank and pull off.

MOUNTING BOLTS

The engine/gearbox unit is now held at the rear by two triangular plates, bolted to the frame tubes. Release the five fixing nuts and bolts from the right-hand mounting plate, unscrew the swinging arm spindle nut and take off the plate. It will not be necessary to remove the left-hand mounting plate. There are spacers between the plate and the frame.

A second fixing point is located below the crankcase, comprising one long bolt through the crankcase base and frame lugs. Remove the nut and washer from the left-hand side and drive the bolt out. A spacer is fitted between the frame lug and the crankcase on the left-hand side and its position should be noted.

The third attachment point is at the frame front down tubes, the fixing bolt being fitted with a spacer tube at the left-hand side of the engine lug. The nut is on the left-hand side, when removed, the bolt should be driven out with great care as the engine may shift its position suddenly.

Raise the engine slightly and carefully withdraw from the left-hand side. The unit weighs approximately 180 lbs., so the help of a friend may be found beneficial whilst actually lifting the unit out of the frame.

If lifting tackle is available this can be used in conjunction with service tool No. 61–6002 which consists of a plate and eye bolt. This attachment when bolted to the top of the engine enables the engine to be lifted in and out of the frame without great difficulty.

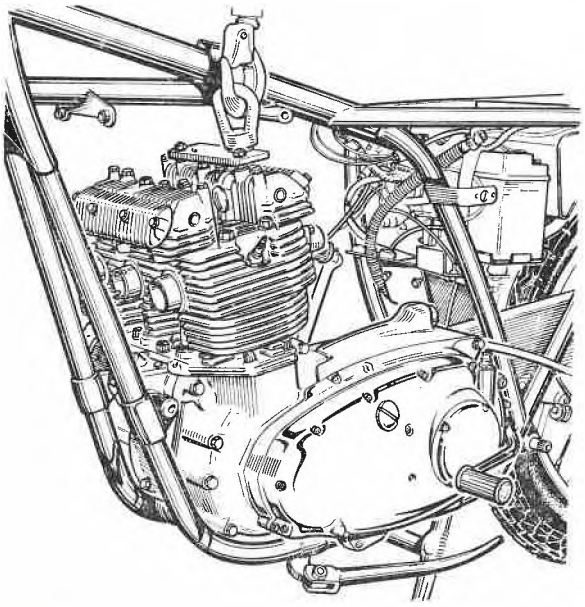


FIG. B.21. *Engine removal.*

To remove the engine shield is simply a matter of unhooking it from the rear frame cross tube, the front is released with the removal of the bottom engine bolt. The shield fixing holes are slotted to enable easy removal in normal circumstances.

REPLACING THE ENGINE UNIT

Having completed the overhaul of the engine/gearbox unit, the task of replacing the engine unit is the reverse of removal. When actually lifting the engine into the frame from the left-hand side, the front should be lifted slightly higher than the back, giving clearance to the front engine lug over the frame lug. Here again help from a friend or the lifting attachment may be found beneficial.

When fitting the mounting bolts it may be found necessary to juggle the engine about to position it to receive the bolts. Do not omit the packing pieces which fit on the left-hand side of the front engine mounting lug, the bottom lug and the left-hand rear mounting plate complete with footrest, the spacers fit between the mounting plate and the swinging arm plate.

Replace all the nuts and washers and make sure that they are absolutely tight.

Connect the rocker feed oil pipes to the union at the end of each rocker box.

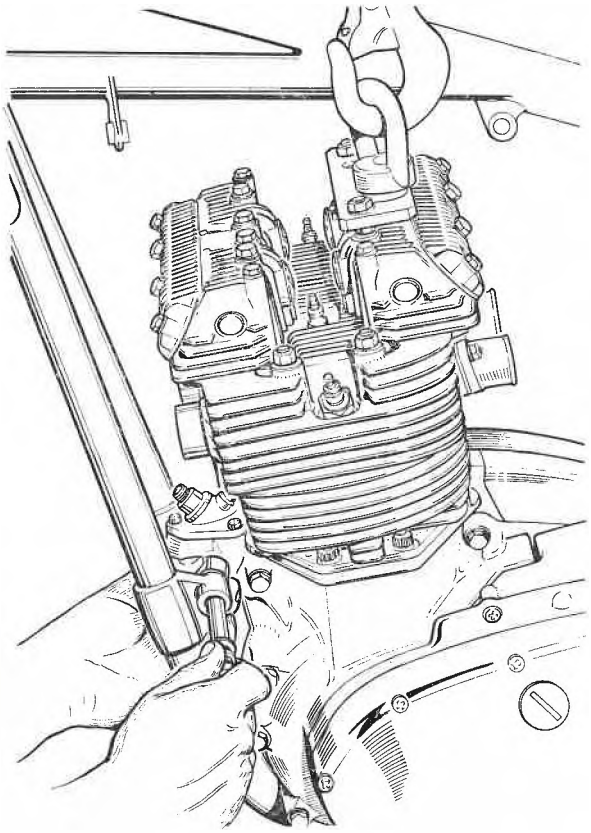


FIG. B.22. *Positioning engine.*

Replace the oil feed and scavenge pipes to their unions on the crankcase underneath the gearbox, the big bore pipe (scavenge) goes to the stepped-down union and the small pipe (feed) goes to the small straight diameter union. Do not forget to tighten the clips.

Feed the clutch cable through the frame clips, (or replace it) pass the nipple through the ad-

juster in the primary chaincase and reconnect to the lever toggles. Adjust the cable as necessary.

Reconnect the generator leads ensuring that they are correctly matched, the leads run from the back of the timing case at the top and are positioned under a clip on top of the gearbox. Now reconnect the contact breaker leads to their corresponding colours this cable runs from the front of the timing cover and travels underneath the engine and up behind the air cleaner.

Replace the rear chain with the closed end of the connector link spring facing the direction of chain travel, (facing forward on top run of chain) and refit the chainguard in the reverse order of removal.

At this stage the oil warning switch lead can be connected on to the switch positioned beneath the crankcase, adjacent to the oil pipe unions. The engine shield can now be fitted, hook the back of the shield over the frame cross-tube and swing it up until the slotted bracket fits behind the nuts and washers of the bottom engine bolt which in turn should be fully tightened securing the plate plus the engine bottom lug.

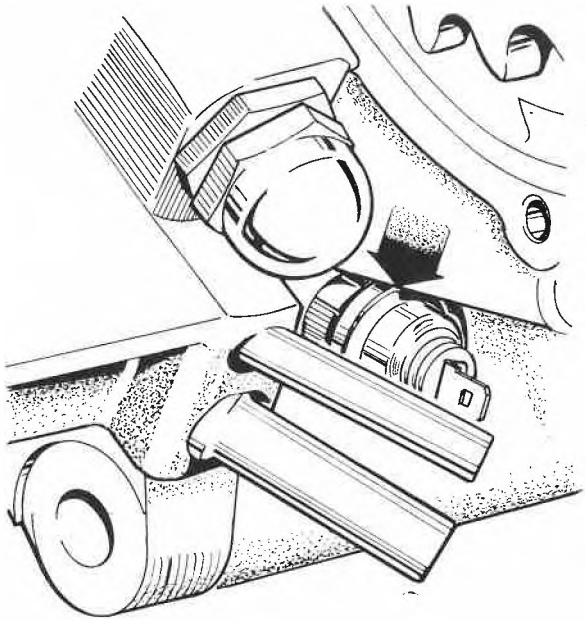


FIG. B.24. *Oil warning light switch.*

Replace the carburetters as described on page B.18.

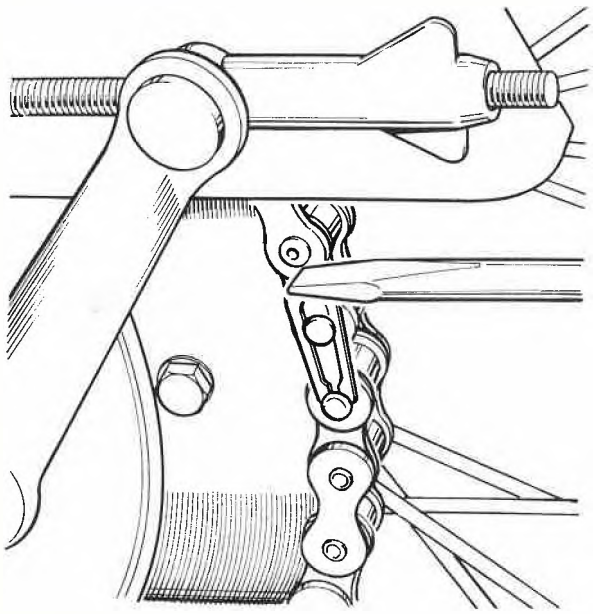


FIG. B.23. *Chain link.*

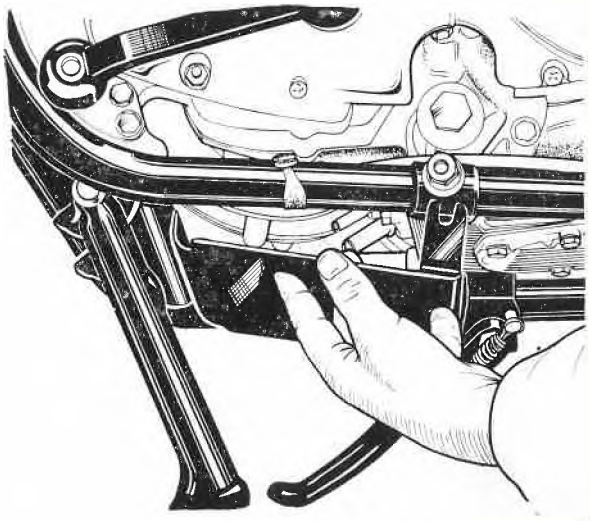


FIG. B 25. *Engine shield.*

Replacement of the exhaust system is the reverse of removal, remembering to correctly tighten the finned clips otherwise an unpleasant exhaust blow may be evident.

Finally replace the brake pedal on its splines and tighten the clamp bolt, adjust brake if necessary (see Fig. D.18, page D.13).

Replace kickstart pedal inserting cotter pin from the back of the crank tapping it home and tighten up with the nut and washer.

Refill the oil tank, and gearbox.

NOTE:—Before starting the engine ½-pint of the recommended engine oil should be added to the sump this can be effected through the timing plug aperture in the right-hand crankcase section.

TRANSMISSION

Power from the engine is transmitted through the engine sprocket and primary drive chain to the clutch chainwheel, thence via the Borg and Beck single dry-plate clutch to the shock absorber unit and the gearbox mainshaft, through the gearbox to the final drive sprocket, the rear chain and rear wheel.

The shock absober unit as its name implies is necessary to smooth out the drive as the power impulses fluctuate.

The clutch not only provides a means of stopping and starting the machine without stopping the engine, but also provides a means of changing from one gear ratio to another smoothly.

Thus it will be evident that the satisfactory functioning of one part of the system is very often dependent on another part. In other words if one part is worn or faulty it can very often prevent parts from working properly.

The dismantling and reassembly of the primary drive can be carried out if necessary without removing the engine unit, but will be treated in this case as though the engine unit were on the bench.

PRIMARY DRIVE COVER

Before commencing work on the primary drive, drain out the oil as detailed in the Lubrication Section.

Remove the clutch inspection cover, which is held by four screws, to expose the clutch actuating mechanism. Unscrew both the locknut and the large adjuster nut from the end of the pull-rod, using a screwdriver to prevent the latter turning.

The actuating plate assembly is retained by two anti-vibration spring plates which need not be disturbed unless in need of replacement.

To ease removal of the cover, it is recommended that the primary chain tensioner is first completely slackened off.

Take out the 14 screws and pull away the outer cover, the cover fixing screws are of different lengths and a note should be made of their respective locations in order to facilitate correct replacement.

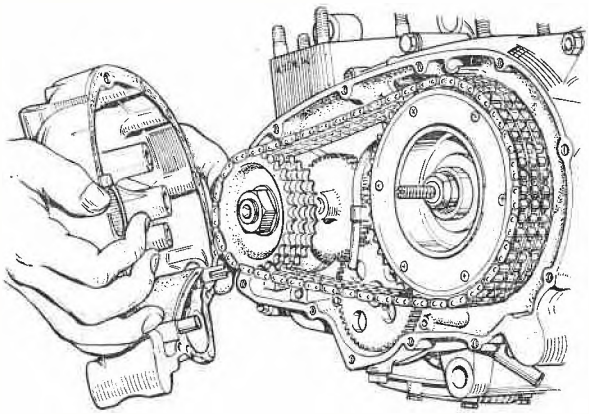


FIG. B.26. *Primary drive cover.*

CLUTCH DISMANTLING

The Triplex primary chain has no connecting links and can therefore only be removed complete with the engine sprocket and clutch chainwheel. Knock back the tag on the lockwasher securing the engine sprocket nut and unscrew, removing lockwasher also. Unscrew the clutch centre nut and note that it contains a small rubber oil seal, the spacer and thrust bearing can now also be withdrawn.

Pull away both the engine sprocket and clutch chainwheel off their splined shafts, complete with the primary chain. It may be found necessary to first free the sprockets from their shafts, using service tool No. 61–6046 and shock absorber hub extractor No. 60–1862.

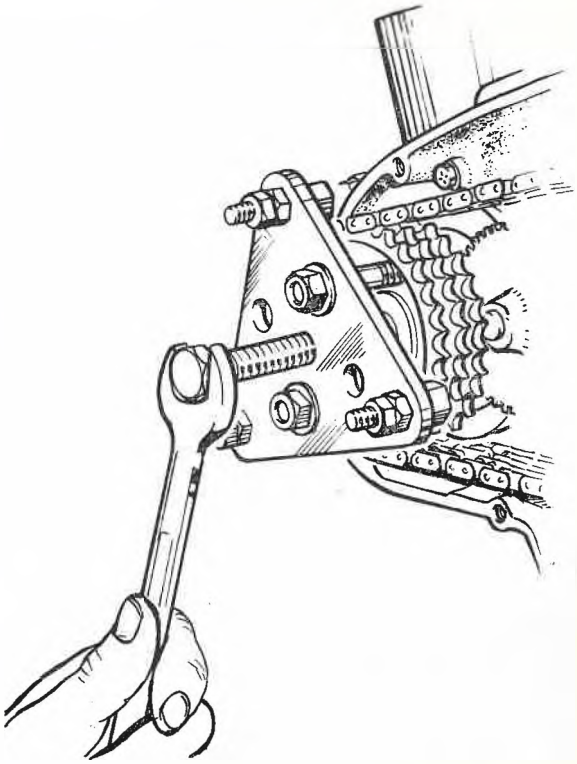


FIG. B.28.
Using extractor (engine sprocket).

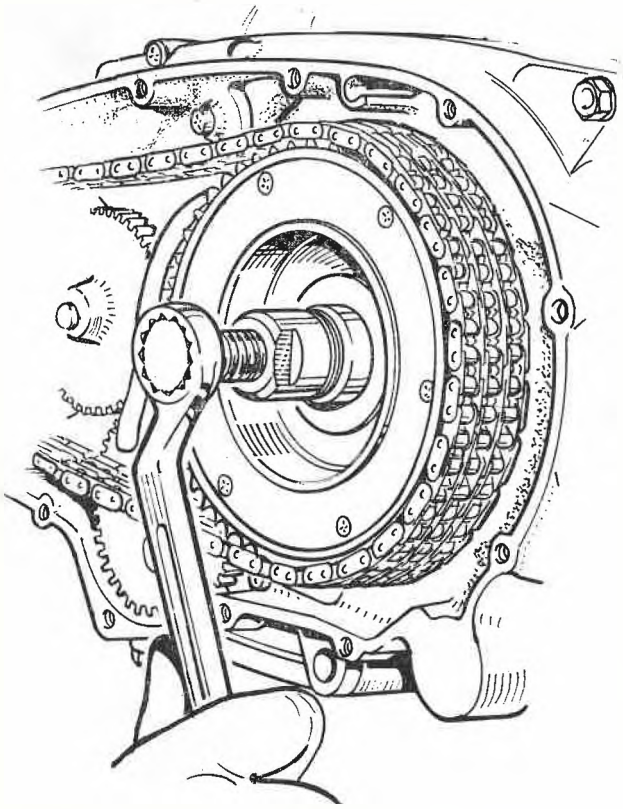


FIG. B.27.
Using extractor (shock absorber hub).

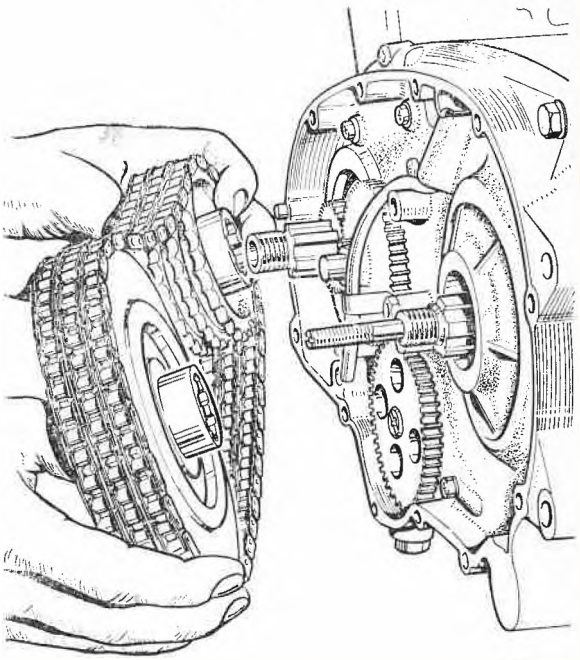


FIG. B.29.
Removing chain and chainwheels.

SHOCK ABSORBER

To inspect the shock absorber rubbers which are inside the clutch chainwheel, take out the six countersunk screws from the circular plate and prise off.

The rubbers should be quite firm and sound, if there is any tendency for the rubbers to disintegrate they should be replaced. To remove, prise out the rubbers. When refitting do not use oil or grease, if lubricant is required it is better to use a liquid soap. (See notes on shock absorber, page B.27, column 2, paragraph 5).

INNER CASE AND CLUTCH REMOVAL

Take out the eight screws, two bolts and screw through the breather duct cover securing the inner case, these are of various lengths so a note must be made of their respective positions for correct reassembly.

Pull off the inner chaincase to reveal the clutch. See that the large rubber O-ring in the oil pump aperture is not damaged or displaced. Check also that the oil seal for the clutch is still serviceable, then take off the clutch shaft spacer.

The clutch can now be taken off its splines.

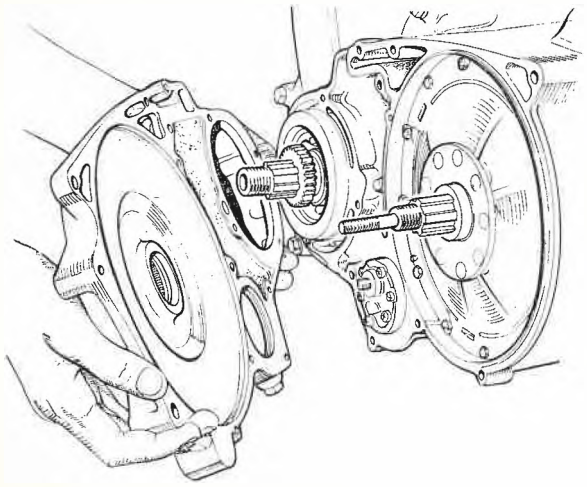


FIG. B.30. *Inner clutch case removal.*

OIL PUMP REMOVAL

The oil pump should be removed as a unit. There are six screws through the face of the pump, four of these secure the pump to the crankcase, the other slightly smaller screws hold the pump together. Remove the four larger screws. Before removing the pump replace the drive pinion.

If any resistance is present when trying to extract the pump from its housing, it is because the rubber seals have stuck to the surface of the pump two levers can be used as in Fig.B. 31.

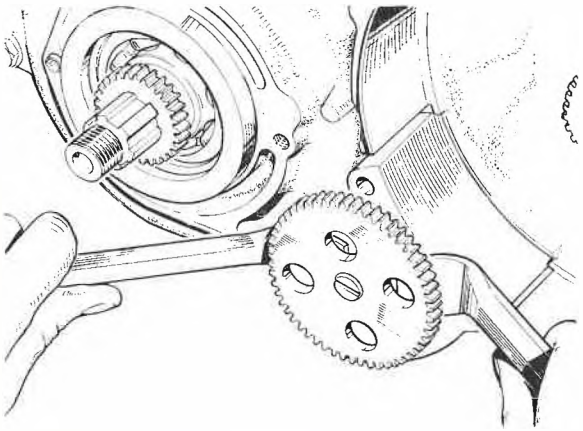


FIG. B.31. *Removing oil pump.*

Before stripping the clutch, mark the cover, drive ring, and pressure plate to ensure reassembly in the same position.

Bend back the tabs on the 12 screws holding the cover in position, and release the screws half a turn at a time, each in order round the cover until the spring pressure is released, when they may be removed completely. Do not remove any screws altogether until the spring load is

released in this manner, or distortion of the cover may take place. Ensure that the three dowels are in position in the drive ring and do not fall out when the cover is removed.

Lift out the cast-iron pressure plate complete with its bearings. Before removing the driving plate make sure the hands are completely free of grease or oil. No trace of lubricant should be allowed on the driven plate facings.

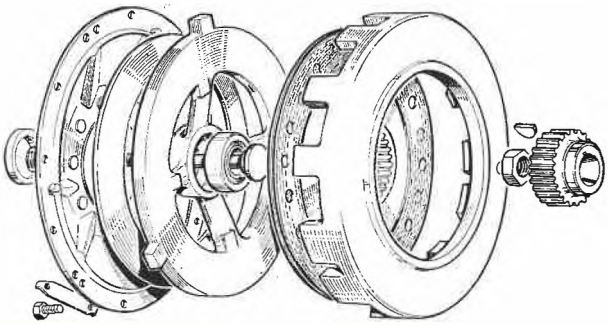


FIG. B.32. *Clutch exploded.*

INSPECTING THE CLUTCH

The driven plate rivets should be below the surface of the facings. No attempt should be made to punch down rivets which are flush with the surface, as this can cause distortion of the driven plate and subsequent drag. Facings which show signs of oil contamination cannot be cleared but must be replaced. Make sure that all the rivets are tight and that the splines are a smooth sliding fit on the clutch hub splines. If any doubt exists, renew the driven plate or the clutch hub. Do not attempt to renew the facings unless workshop facilities include a means of checking and correcting driven plate distortion.

Examine the drive ring and pressure plate for heat cracks and scoring, if either exists, renew the parts involved.

Examine the bearing in the centre of the pressure plate for wear. The bearing if necessary should be replaced. Do not attempt to remove the oil seals or re-lubricate an old bearing as there is risk of lubricant contaminating the facings.

Check that the slots in the drive ring and the lugs on the pressure plate are not burred. Slight irregularities may be removed with a smooth file, but if the parts are a loose fit, clutch balance may be affected.

The diaphragm spring should be examined for signs of over-heating, if the clutch has been slipping, the diaphragm may have become weakened, in this case it should be replaced.

GEARBOX OR FINAL DRIVE SPROCKET

To gain access to the final drive sprocket it will be necessary to remove the small clutch hub and the clutch housing.

Remove the nut retaining the clutch hub to the gearbox mainshaft and extract the hub with service tool No. 60–1860, be careful not to lose the Woodruff key when the hub is withdrawn.

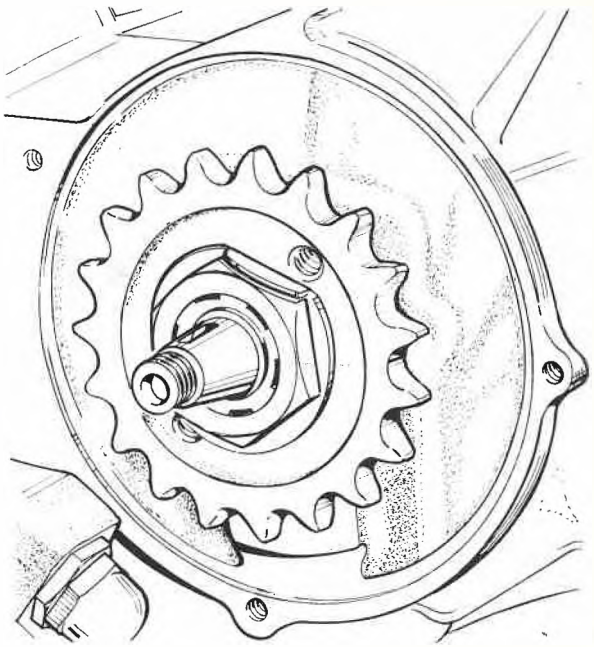


FIG. B.33. *Final drive sprocket.*

Take out the three screws holding the clutch housing to the crankcase, the breather duct cover can be left in place. On removal of the case, check the oil seal and replace if necessary.

To remove the final drive sprocket, bend back the tab washer, place a length of chain round the sprocket and clamp in a vice or with a suitable bolt and unscrew the sprocket nut with service tool No. 61–6061, the nut has a right-hand thread.

When the nut and tab washer are removed the sprocket can be pulled off its splines. If there has been an oil leakage from the back of the sprocket it indicates that the gearbox oil seal requires renewal. To do this take out the three countersunk screws from the oil seal retainer and remove. The oil seal can then be driven out of the retainer with a suitable punch.

Replacement is the reverse of removal but make sure the open side of the seal faces towards the gearbox, also if the sprocket boss has worn, the sprocket should be replaced as well.

Fitting a new seal on its own would be useless as the old sprocket would ruin the new seal.

Before fitting the sprocket smear a thin coating of Loctite plastic gasket on the sleeve gear splines, this will prevent oil from leaking between the sprocket and sleeve gear. If the sprocket boss is smooth and not scored it can of course, be replaced but it must be lightly oiled to avoid damaging the seal as the sprocket is pressed home. Reassembly is in the reverse order but do not omit to turn the tab washer over the nut after tightening to torque setting quoted on page J.1.

CLUTCH OPERATION

As already indicated, the clutch being part of the transmission system transmits power to the rear wheel, and by separating the driven plate from the drive ring, this connection is broken. This is done by pulling the left-hand handlebar lever towards the rider, the force imposed is transmitted via the clutch cable to the clutch lever in the primary case. The clutch lever revolves on a bearing. In between the lever and the thrust plate there are three ¼″ diameter steel ball bearings located in semi-spherical ramps. When the lever is actuated the balls roll up the ramps forcing the two plates apart, thus operating the clutch pull rod, which pulls the pressure plate outwards so compressing the diaphragm spring and freeing the driven plate (see Fig. B.34).

To ensure the smooth operation of the clutch it is essential that the driven friction plate and pressure plate run true. Adjustment for the cable is provided at the handlebar lever and at the adjuster at the primary case.

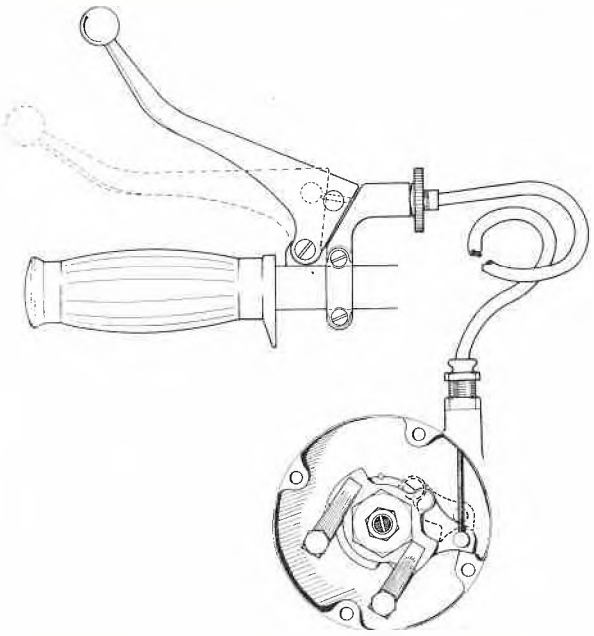


FIG. B.34. *Clutch operation.*

REASSEMBLING THE PRIMARY DRIVE

Replace the clutch housing with its three screws and check the oil seal in the centre, replace if necessary.

If the small splined clutch hub has worn, through the oil seal running on it, it should be replaced.

To replace clutch hub fit the Woodruff key in its slot in the shaft and press home the hub and tighten the nut to torque settings on page J.1.

The following instructions on rebuilding the clutch must be strictly adhered to:

Firstly place the drive ring on the bench with the friction surface uppermost, using scrupulously clean hands, place the driven plate in position with the splines extending downwards.

If necessary press a new bearing into the centre of the pressure plate. Apply a light smear of high-melting point grease to the sides of the three pressure plate lugs, make sure that no grease is allowed on to the friction surface.

Slide the pressure plate lugs into position between the slots of the drive ring, making sure that the locating marks previously made are lined up.

Apply another smear of grease to the machined ridge on the pressure plate and place the diaphragm spring in position on the ridge with the outer edge of the spring upwards. Also grease lightly the ridge on the inside of the cover and place the cover in position aligning the locating marks and engaging the three ribs of the cover around the diaphragm spring.

Using new locking plates, run in the twelve screws until they are finger-tight (making sure that the dowels are between and not beneath the tab plates). Now insert service tool No. 61–6042 from the rear of the clutch, this is to centralise the clutch plates before tightening the twelve screws. This tool locates on the inside diameter of the driven plate splines, the bearing in the pressure plate and finally in the pull rod bore, so centralising the whole assembly.

Now tighten the twelve screws by one half-turn at a time working round the clutch until the cover meets the drive ring. The screws should be tightened and the tabs turned up securely to lock them. Remove the centralising tool and insert the clutch pull rod, before mounting the clutch on the machine, smear the driven plate splines lightly with high-melting point grease, and slide the clutch on to the mainshaft and clutch hub.

Before refitting the inner primary chaincase check the following: that the two rubber O-rings for the oil pump seal are not split or perished if they are, they must be replaced. Check the needle bearing by inserting the shock absorber hub and trying it for up and down movement, if any is evident replace the bearing. The oil seal also should be replaced if it is worn, and check the oil seal sleeve because if this is scored or has a groove in it replacement is necessary.

Fit the sleeve on the mainshaft and apply jointing compound on both faces of the chaincase then using a new gasket, replace inner cover tightening the screws evenly to avoid distortion.

The twelve shock absorber rubbers should be fitted as in Fig. B.35, and the outer plate being secured by six countersunk head screws, which should have a small amount of "Loctite" grade A.V. applied before fitting.

On later models the six countersunk headed screws have been replaced with six hexagon headed bolts and three tab washers, also a new plate is fitted without countersunk holes. When replacing these bolts make sure that the tab washers are turned up against the flats of the bolt heads.

If, on removal of the countersunk screws in the earlier shock absorber, they are found to be loose, this means that the Loctite has not cured properly and it is advisable to obtain the later modification. This consists of the plate No. 57–4004, the bolts and tab washers No. 57–3940 and No. 57–3941 respectively.

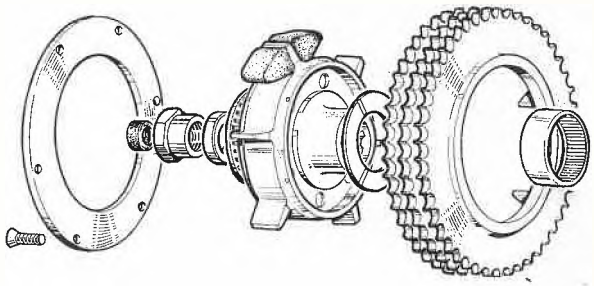


FIG. B.35. *Shock absorber.*

Replace the oil pump using a new gasket smeared with grease and tighten the four fixing screws. Care is necessary when inserting the pump not to damage the O-rings.

Replace the idler gear and crankshaft pinion, lightly oiling idler gear spindle before assembly.

Fit the thrust washer on the back of the shock absorber hub and place the primary chain about the hub and engine sprocket, the engine sprocket must be fitted with the projection towards the crankcase.

Now lift them up together and replace them on their splines in one operation.

Screw the nut and tab washer on to the engine shaft and tighten to the torque wrench figures quoted on page J.1. Bend the tab washer on the nut after tightening.

Replace nut and spacer on clutch shaft and tighten. Replace oil seal if necessary.

Finally slip the thrust bearing over the shock absorber spigot and applying jointing compound to both faces of the chaincase, replace the outer primary case using new gaskets, do not forget to fit the gaskets between the centre fixing bolts.

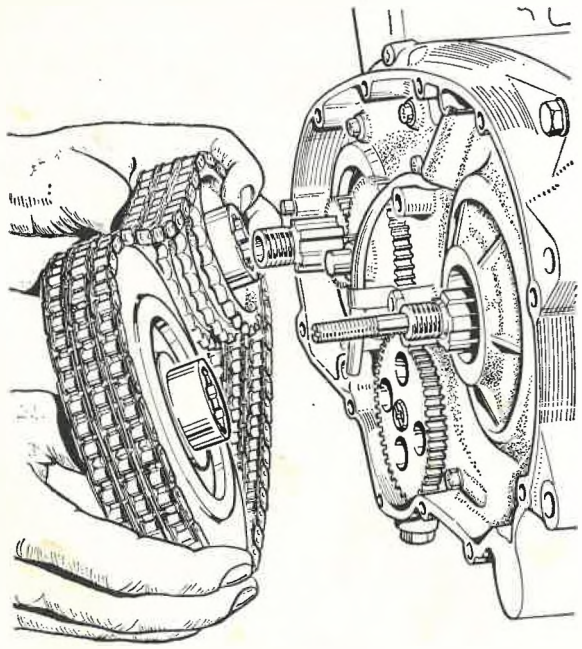


FIG. B.36. *Fitting primary drive.*

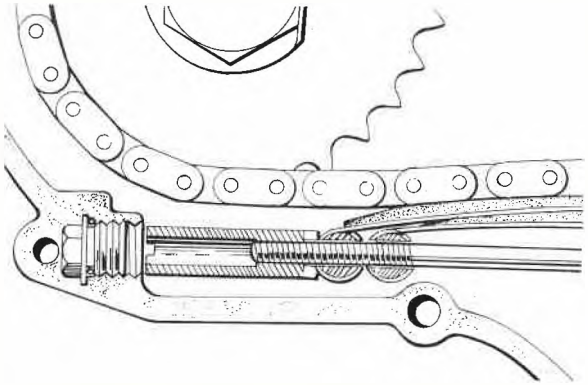


FIG. B.37. *Primary chain adjustment.*

The chain tensioner should not need attention unless it is known to be faulty.

Bring a cylinder on to its compression stroke and hold it there with the kickstarter pedal. This removes the slackness from the bottom run of the chain. By retaining the pedal in this position the top run of the chain can be adjusted to approximately $\frac{3}{16}$" total up and down movement by applying a screwdriver to the sleeve nut.

The clutch actuating mechanism should not need attention, unless known to be faulty. If so the following instructions on removal and replacement must be observed.

Bend back the tab washer from the two bolts retaining the springs clips and remove both, tab washer, springs and spacers, then remove the clutch lever this will release the three ball bearings. The thrust plate can now be removed.

All the parts should be cleaned and inspected before replacing, if any pitting or cracking is evident in the steel balls they should be replaced. Check the clutch lever bearing and replace if necessary.

To replace, push the thrust plate into its register in the primary case, locating its position on the dowel, smear the spherical ramps with grease and stick the three balls into their respective positions in the deepest part of the ramps, the grease will hold them there. Now fit the clutch lever (complete with bearing) over the balls with the cable trunnion at approximately

3 o'clock. Replace spring clips using new tab washer. Screw the large adjuster nut on to the pull rod with service tool No. 61-6051 inserted through the oil seal to protect it from the thread on the pull rod. Then turn the lever one way or the other until the steel balls are in their lowest positions in the ramps.

Now using a ·005″ feeler gauge between the bearing and large adjuster nut replace the small locknut and tighten. There is a slot in the end of the pull rod to prevent it turning when tightening the locknut.

Finally check the clutch for correct operation.

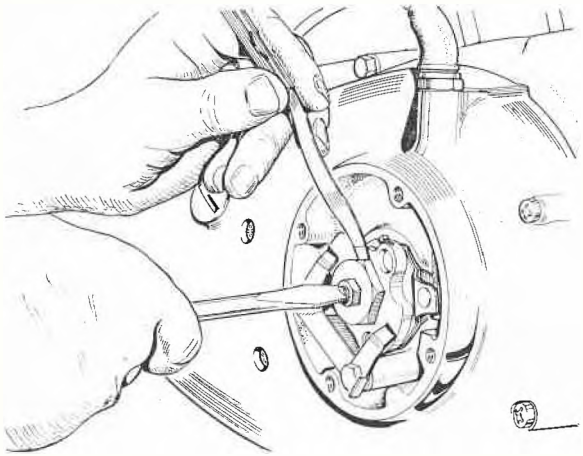


FIG. B.38. *Clutch adjustment.*

THE CONTACT BREAKER

The contact breaker assembly is contained in a circular compartment in the outer timing cover on the right-hand side of the machine, access is gained by removing the chrome cover held in position by three screws.

The assembly comprises the contact breaker back plate on which are mounted three smaller adjustment plates with the three sets of contacts mounted on them.

Behind the contact plate is the automatic-advance and retard assembly comprising two bob-weights and springs and the contact breaker cam. This assembly is locked into the tapered hole in the exhaust camshaft by its central bolt.

Oil is prevented from reaching the assembly by an oil seal set in the back of the housing.

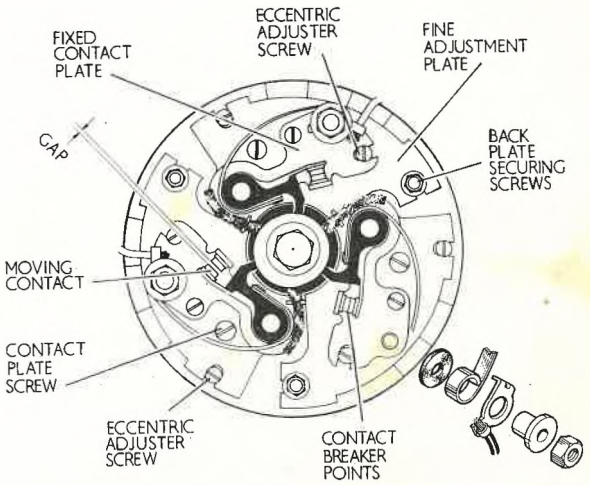


FIG. B.39. *Contact breaker unit.*

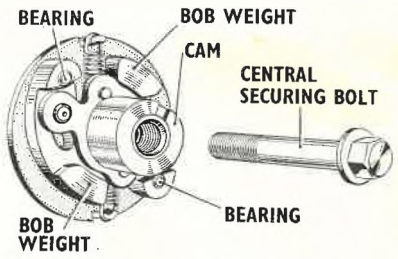


FIG. B.40. *Auto-advance mechanism.*

When the engine is first started the ignition is in the retard position because of the two springs which are holding the two bob-weights and the cam. This makes starting easier and prevents "kick-back" on the kickstart lever.

As the engine revolutions increase, centrifugal force carries the bob-weights outwards and this in turn progressively turns the cam and advances the ignition.

The small plates are for fine adjustment of the ignition timing, adjustment is by slotted holes and eccentric screw arrangement.

REMOVING CONTACT BREAKER

Before removing the three screws holding the contact plate, scribe a mark on the plate and housing to assist reassembly, otherwise it will be necessary to re-time the ignition. The plate can be removed, complete with contacts after the three pillar bolts are removed.

To remove the auto-advance unit and cam it is necessary to take out the centre bolt, the unit can then be forced from its taper with service tool No. 60–782.

This tool is screwed in until resistance is felt, further screwing will then release the assembly.

Do not however, remove the auto-advance unit unnecessarily as the timing will have to be re-set, this is detailed on pages B.51—B.54.

To change a set of points unscrew and remove the small screw inside the C-shaped spring, and remove the contact points set. To remove the fixed contact from the moveable contact, unscrew and remove the nut securing the C-shaped spring. Take off the lead and nylon insulating spacer, the moveable contact can now be removed.

Replacement of the contact points is the reverse of dismantling but care is needed to assemble the spring and lead pillar correctly, refer to Fig. B.39 for correct assembly.

New contact points are treated with a special preservative which must be wiped off with a clean rag moistened with gasoline, before the set is fitted to the plate.

After changing a set of contact points revolve the engine until the nylon heel is on the peak of the cam, slacken off the contact plate screw and turn the eccentric screw left- or right-hand to obtain the correct gap of ·015″ (·381 mm.).

Re-check the timing.

TIMING-SIDE COVER

To gain access to the timing gears and generator, it is necessary to remove the cover on what is known as the timing- or gear-side, that is, the right-hand side of the machine.

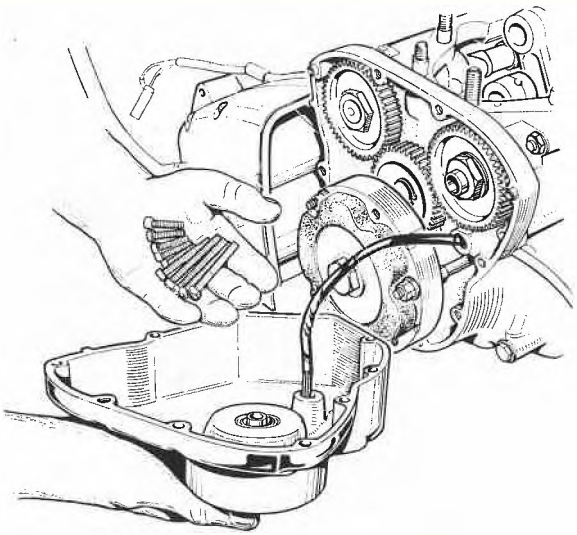


FIG. B.41. *Timing cover removal.*

To remove the cover it will first be necessary to remove the contact breaker assembly as detailed on this page.

Now take out the 10 screws in the outer cover noting their positions as they differ in length. Tap the case gently with a hide mallet to break the joint and remove case to reveal the timing gears and generator.

GENERATOR REMOVAL

Take off the three nuts and washers which are equally spaced around the stator. Pull the stator off its studs revealing the cable sleeve nut which is covered by a rubber grommet, unscrew the nut and pull the cable through.

To remove the rotor, bend back the locking tab from the large nut on the engine mainshaft

and unscrew. The rotor can now be removed leaving its key in place, this key also prevents the crankshaft timing pinion from turning.

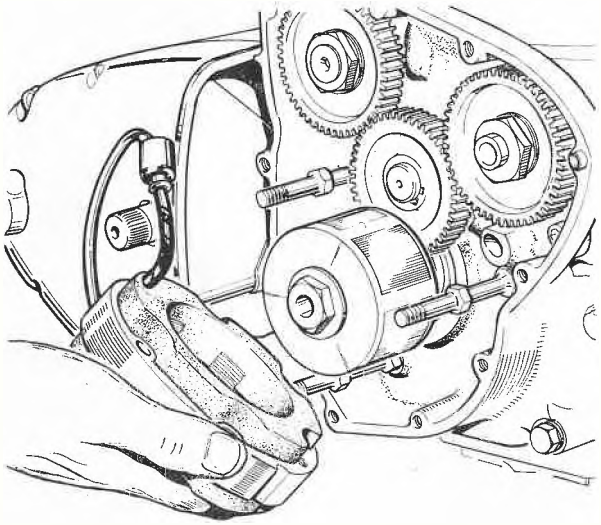


FIG. B.42. *Removing generator.*

TIMING GEARS

Careful examination of the timing gears will show that there are marks on the faces of the gears adjacent to the gear teeth.

These marks are to assist in the correct re-assembly and it is good practice to familiarise oneself with them before removing the gears (see Fig. B.43, and page B.51).

Take out the rotor fixing stud and pull the crankshaft pinion off using extractor tool No. 61–6019.

The idler gear or intermediate timing gear is retained on its shaft by a circlip, when removed the timing gear and thrust washer can be pulled off.

The spindle assembly for the idler gear need not be removed, unless it is known to be faulty. If it is faulty it should be replaced. The needle roller bearing in the idler gear can be pressed out as a new one is pressed in although these bearings will last a long time without need for replacement.

To unscrew the camshaft nuts it is necessary to leave the gears in position and lock the assembly with a bar through one of the conecting rods. Great care should be taken to avoid damaging the crankcase.

Having locked the assembly unscrew the two nuts which have left-hand threads and withdraw the camshaft pinion with extractor No. 60–2213.

Take out the Woodruff keys.

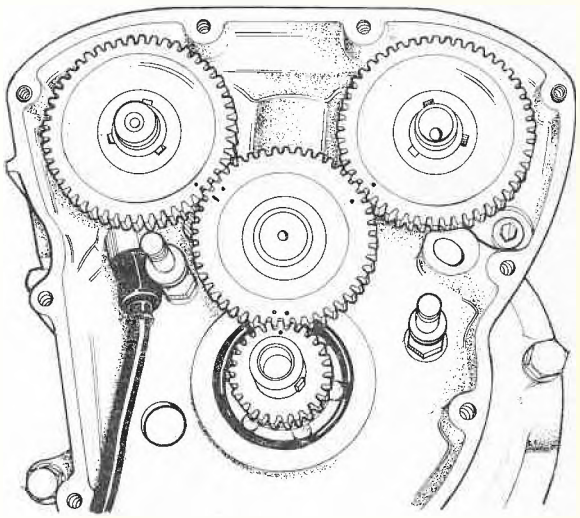


FIG. B.43. *Timing marks.*

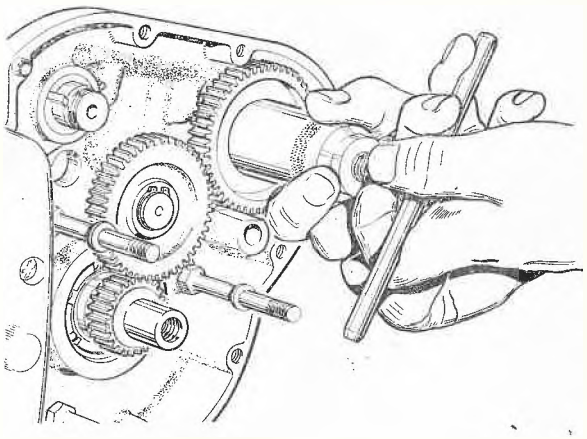


FIG. B.44. *Removing camshaft pinions.*

Replacement of the timing gear is simply the reversal of the above procedure except that care must be taken to match the timing marks as the idler pinion is inserted last into the case (see page B.50).

Tighten the rotor fixing nut and the three stator fixing nuts to the torque settings quoted on page J.1.

Replace the advance and retard mechanism loosely and replace the timing cover using a new gasket with jointing compound on both faces.

To re-set the timing refer to page B.51.

REV-COUNTER DRIVE

The rev-counter drive is situated at the front of the engine just above the front engine mounting. It consists of a housing, a spindle, and a gear which engages with a gear on the exhaust camshaft. To remove, unscrew the three screws and withdraw from the crankcase.

FIG. B.45. *Rev-counter drive.*

To dismantle take out the single hexagon-headed screw which locates in the spindle bearing housing.

The spindle can now be withdrawn from the housing.

There should be no need to replace any part and the only need for stripping is for cleaning and checking purposes. If any part is found to be worn then of course it must be replaced.

GEARBOX DISMANTLING

The gearbox need not be disturbed if the engine only is to be inspected but while the engine is out of the frame and stripped it is good practice to check the gearbox as well.

The gearbox can be stripped without interfering with the timing gear housing. If the gear cluster is to be removed then the clutch will have to be taken off first (see pages B.22—B.24).

Access is gained to both the kickstart and gearchange mechanism by removal of the gearbox outer cover. It will not be necessary to remove the kickstart pedal or gearchange pedal at this stage.

Take out the five Phillips-head screws the single domed nut and plain nut holding the outer cover to the inner cover. The screws are of varying lengths and a note must be made of

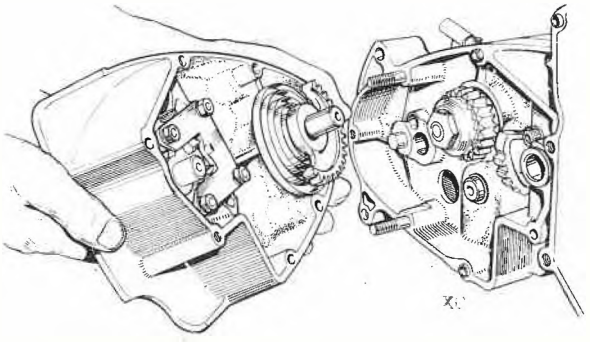


FIG. B.46. *Removing gearbox outer covers.*

their respective locations. Gently pull away the cover, complete with kickstart pedal assembly and the gearchange mechanism.

The kickstart quadrant (*A*) is simply a press-fit on to the splined spindle which also carries the pedal return spring (*B*). When fitting a new spring, first locate the inner hooked-end to the quadrant spindle, then "wind-up" the spring 1¼ turns in a clockwise direction to gain sufficient tension before slipping the eye over the small dowel (*C*)—see Fig. B.47.

The kickstart spindle oil seal is pressed into the cover recess and is protected by a plain metal cap. This is accessible on removal of the kick-start pedal.

The spring-loaded cam plate plungers (*E*) Fig. B.48 are retained by a V-shaped plate, held to the inner face of the cover by four nuts with shakeproof washers. On removal of the plate, the loosely located quadrant return spring (*F*) will also be released.

To remove the kickstart ratchet and pinion for inspection, unscrew the gearbox mainshaft nut, after first bending back the lockwasher tab. If these items are badly worn or damaged, replacements must be fitted. When a new pinion is to be fitted, it is recommended that the special spring is also renewed. For removal of the gears from the case the kickstart ratchet can be left on the mainshaft.

The inner cover is held to the gearbox housing by two countersunk-head screws and two bolts. Removal of these screws and bolts will allow the cover to be withdrawn complete with gear-change selector quadrant and mainshaft. Note that the layshaft has a thrust washer located on the inner face of the cover by means of a small peg. A similar washer is fitted at the opposite end of the shaft.

Unscrew the hexagon plug from the base of the gearbox housing. This contains a spring-loaded plunger that operates in the cam plate notches.

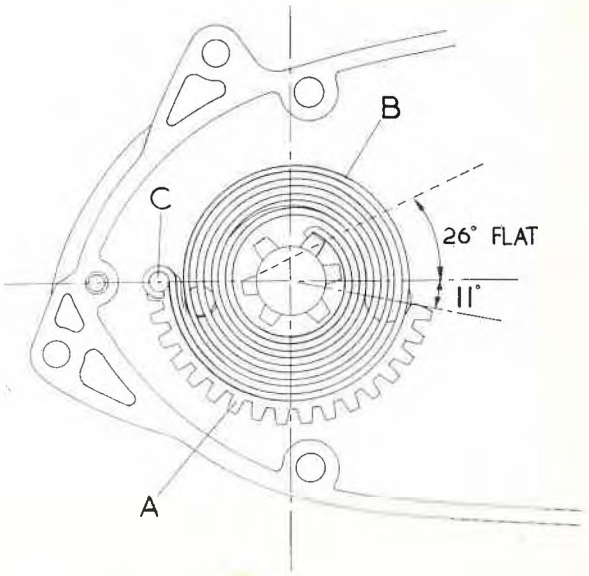


FIG. B.47. *Kickstart spring.*

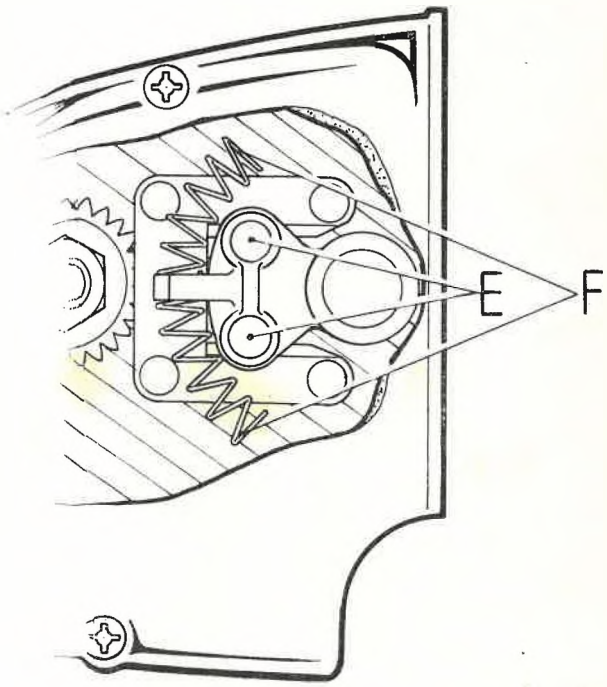


FIG. B.48. *Gear cam plate plungers.*

Pull out selector fork spindle and take off the large layshaft low gear. The sliding gears and their selector forks can then be withdrawn from the case. Take care not to lose the loosely located fork rollers as the assemblies are drawn away from the cam plate.

Pull out the layshaft with its fixed top gear and take out the gearchange cam plate. The spindle on the latter is a sliding fit into a boss on the housing wall.

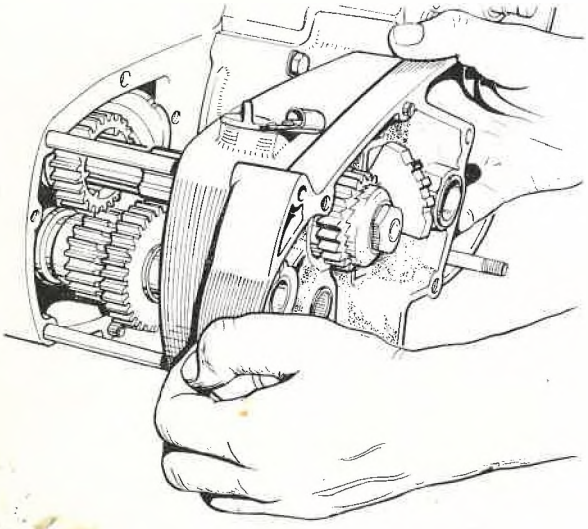


FIG. B.49. *Removing gears.*

All that will remain in the housing at this stage is the mainshaft high gear or sleeve pinion, which is attached to the final drive sprocket by a large nut and lockwasher.

When examining the gears, look for cracked, chipped, or scuffed teeth, which will show (if present) on the thrust faces of the teeth. In severe cases, the case-hardening of the gear teeth may even have broken through. Should it be necessary to renew the fixed gears of the shafts, a properly mounted hand press will be required to press the gears off the shafts.

Before reassembly of the gearbox ensure that all bearings, bushes and oil seals are checked and where necessary, renewed.

To remove the gearbox top gear bearing it is necessary to remove the final drive sprocket and oil seal housing as described on page B.25.

Drive the gear out of the bearing using a suitable drift. Warm up the crankcase locally to the bearing, with rags soaked in boiling water, then with the aid of service tool No. 61–6026 drive the bearing out from inside the gearbox housing. When replacing the bearing the case must be heated again, in fact when renewing any bearing or bush the case should be heated locally for removal and replacement.

The gear selector cam plate should be inspected for signs of wear in the roller tracks. Excessive wear will occur if the mainshaft bearing has worn badly. Check the fit of the cam plate spindle in its housing. Examine the cam plate gear wheel for excessive wear. Difficulty will be encountered in gear selection, causing susequent damage to the gears, if this gear is worn badly.

Ensure that the cam plate plunger works freely in the housing and that the moving parts are free from corrosion. To check if the spring has become inefficient, measure its length and compare it with the length quoted on page GD.7.

Examine the mainshaft high gear bush for wear by inserting the mainshaft into it and feeling the amount of play. It is advisable to take micrometer readings of the mainshaft and compare them with caliper readings of the bush. If the clearance is excessive, say ·005″ the bush should be renewed.

GEARBOX REASSEMBLY

Push the high gear into the bearing and replace final drive sprocket as detailed on page B.26.

Lubricate the cam plate spindle and offer it into the spindle housing within the gearbox. Assemble cam plate plunger and spring into the large hexagon plunger retaining nut and screw it into position underneath the gearbox, but do not forget the fibre washer. Set the cam plate

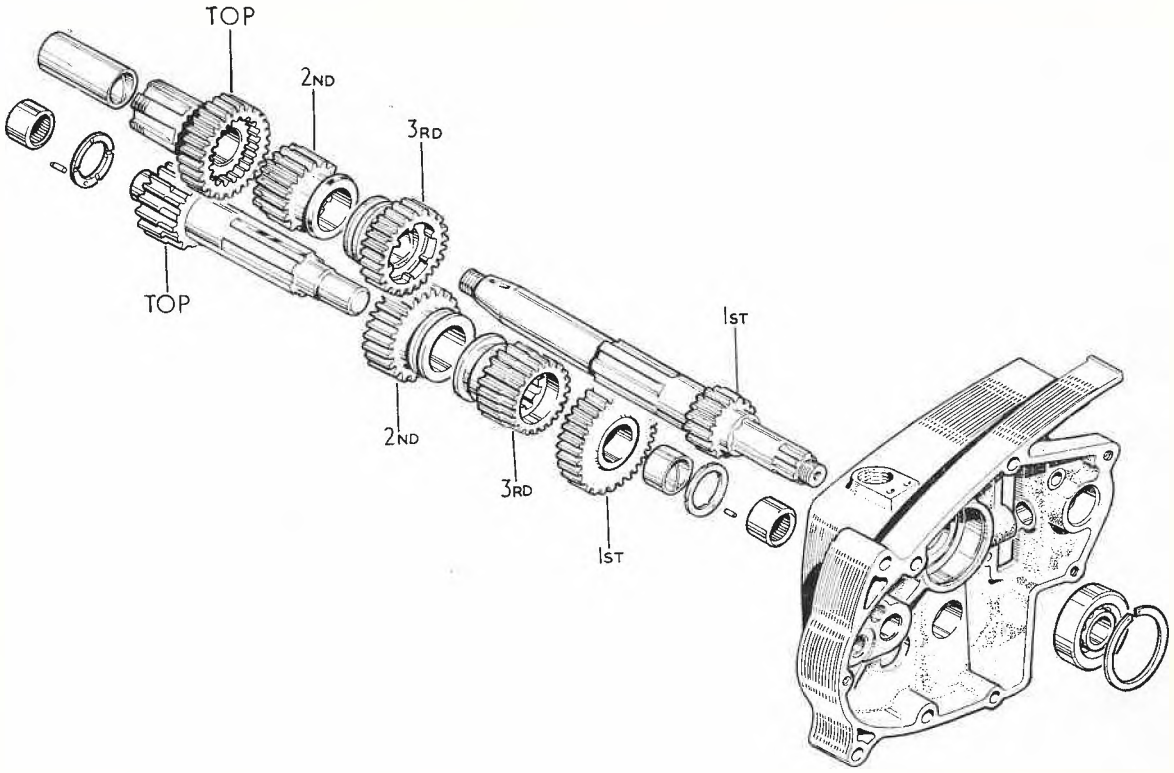


FIG. B.50. *Gear cluster exploded.*

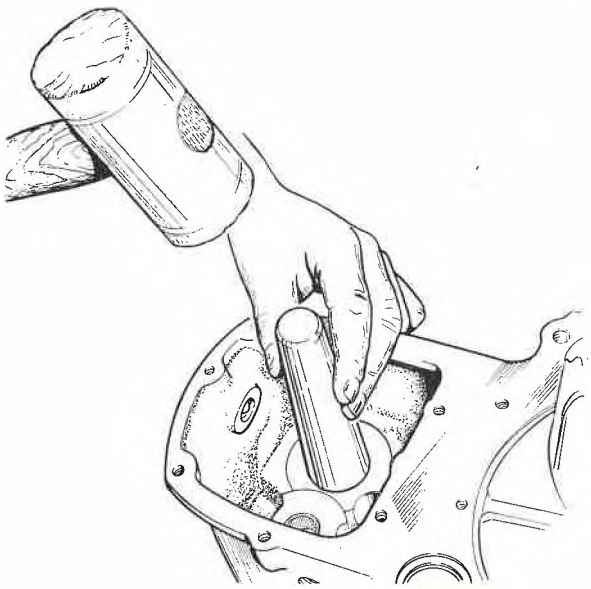


FIG. B.51. *Removing final drive gear bearing.*

with the plunger located to the top gear notch. Locate the bronze thrust washer over the inner needle roller bearing. The thrust washer can be held in position by smearing its rear surface with grease. Note that the grooved surface of the thrust washer is towards the layshaft.

Lubricate the mainshaft and layshaft captive gears, then assemble the mainshaft and layshaft gear clusters.

Place the cam plate rollers on to the selector forks, and hold them in position with grease. Position the selector forks in their respective grooves in the gears. (The fork with the smaller radius is for the mainshaft cluster.) The assembly is now ready to be offered into the gearbox housing. As the mainshaft and layshaft are being located in their respective bearings, the gears should be slid into position and aligned, so that the selector

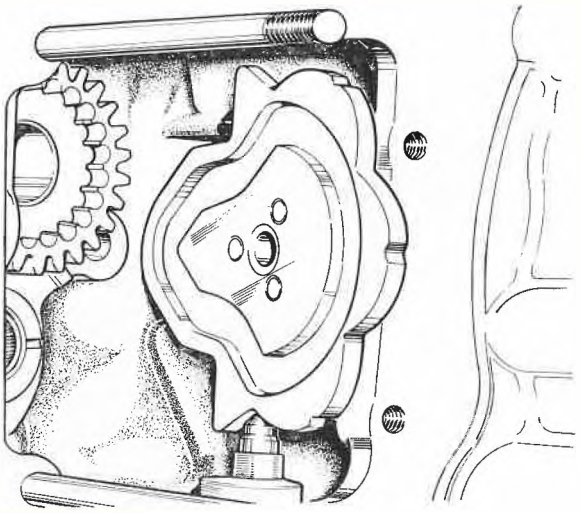


FIG. B.52. *Camplate position.*

fork rollers locate in the roller tracks in the cam plate, and the bores for the selector forks are approximately aligned. Smear the selector fork spindle with oil and slide it through the selector forks, shoulder end first, until it is fully engaged in the gearbox housing. The mainshaft selector fork will be noted to be in the innermost position.

Check the cam plate operating quadrant is moving freely in the inner cover and position the bronze layshaft thrust washer over the needle roller bearing in the inner cover. Again, use grease to hold the thrust washer in position during assembly.

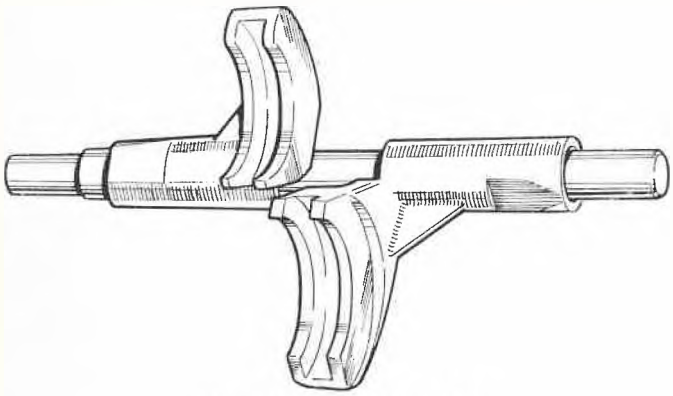


FIG. B.53. *Selector forks.*

Using a pressure oilcan, lubricate all the moving parts in the gearbox, then apply a fresh coat of jointing compound to the gearbox junction surface.

Ensure that the two location dowels are in position and offer the inner cover assembly to the gearbox. When the cover is approximately ¼" (6 mm.) away from the gearbox junction face, hold the cam plate quadrant down then release it fractionally and push the cover home. With the cover completely home there should be slight up and down movement in the quadrant also the top of the first tooth should be on the centre line of the mainshaft (see Fig. B.55).

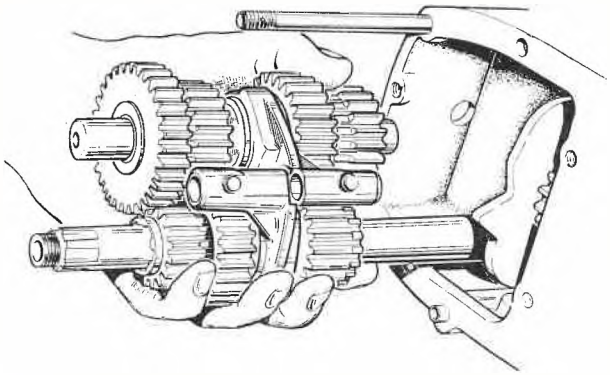


FIG. B.54. *Replacing cluster.*

Screw in the two Phillips screws and two bolts, then temporarily assemble the outer cover and gearchange lever and check that the gearchanging sequence is correct by simultaneously operating the gearchange pedal and turning the final drive sprocket. In the event of any problem of selection it must be assumed that the quadrant teeth are not engaged accurately with the cam plate pinion. To rectify this, remove the inner cover again and check that the cam plate has been set as described earlier. Offer up the inner cover again ensuring that the top of the first tooth is on the centre line of the mainshaft (see Fig. B.55).

When correct gearchanging is established, reassemble the kickstart pinion and ratchet as shown in Fig. B.56, replace the tab washer and screw on the securing nut and tighten to torque wrench figures quoted on page J.1.

To facilitate this, place a length of chain round the final drive sprocket and lock the two ends in a vice, top gear should be selected.

Refit the gearbox outer cover with a coating of fresh jointing compound on the junction faces. Then reassemble the transmission referring to page B.26 for correct assembly.

For correct quantities and grades of lubricant refer to page A.4.

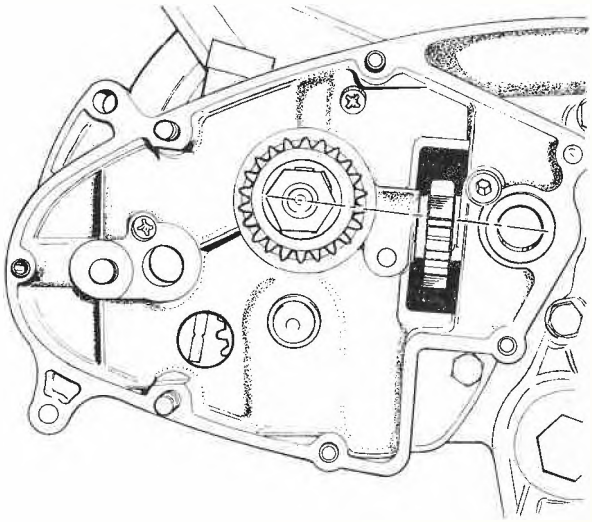


FIG. B.55A. *Selector quadrant position.*

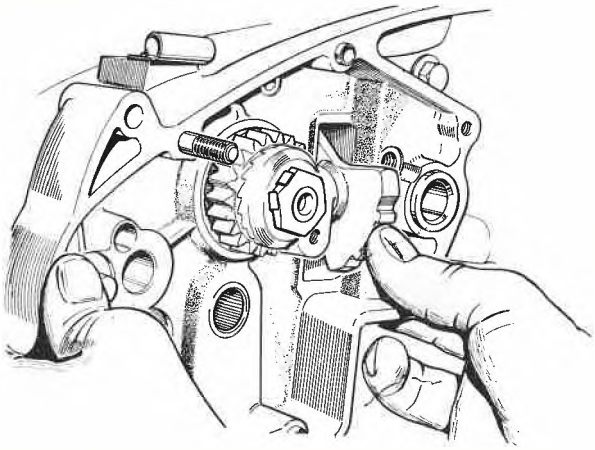


FIG. B.55. *Replacing inner cover.*

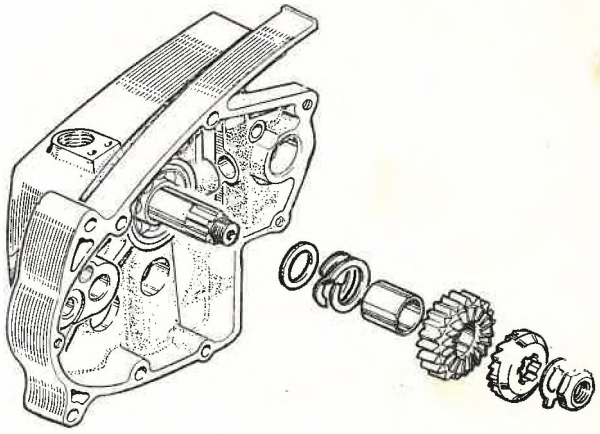


FIG. B.56. *Kickstart ratchet.*

SEQUENCE OF GEARCHANGING

To understand this description of the gear-changing sequence, it is necessary to refer to the various drawings and to understand some of the terms used.

(1) CAM PLATE — this is the large star-shaped part with notches round the outside and a cam track in the middle, it also has a gear pinion on the rear side.

(2) LARGE PLUNGER — this operates at the bottom of the cam plate to locate gear positions.

(3) SELECTOR PLUNGERS — these operate at the small end of the gear selector quadrant.

(4) SELECTOR FORKS — these only show as small spots in the wavy cam tracks on the cam plate. They are the rollers which move the selector forks up and down the tracks.

(5) SLIDING GEARS — there are four gears in the box which move along the splined shafts. These are operated by the selector forks, there being one on each shaft.

(6) GEAR SELECTOR QUADRANT — this is the large fan-shaped part which transmits movement from the selector plunger to the cam plate. It has teeth at both ends.

The gears must always be in the neutral position for starting the engine, this is the position shown in Fig. B.57.

The large plunger is holding the cam plate by the second notch. At the end of the gear selector quadrant the selector plungers are either side of the first tooth ready to operate whichever way the pedal is moved.

When the pedal is moved down, to select first gear, the plunger will engage underneath the first tooth on the selector quadrant and move the cam plate to first gear position, this in turn will operate the layshaft sliding gears with the layshaft first gear.

Reference to Fig. B.57A will now show the selector quadrant plunger on top of the first tooth to move the quadrant and cam plate from first to second gear.

This time the cam plate moves in the opposite direction and again operates the layshaft selector fork moving the layshaft sliding gears in the opposite direction to mesh with the second gear.

Reference to Fig. B.57B will show two quadrant plungers in the selector quadrant teeth ready to move the gears from second to first or neutral or back again.

When the cam plate is moved to third gear position as will be seen by reference to Fig. B.57C, the action moved both selector forks, drawing the layshaft sliding gears to a neutral position and moving the mainshaft third gear. Again the quadrant plungers are ready to move the gears either way.

Finally, the move into fourth or top gear (Fig. B.57D) operates the mainshaft selector fork only, again sliding the gears the opposite direction to mesh with the sleeve pinion. After each movement of the gearchange pedal the quadrant returns to a static position so that the plungers are ready to operate the cam plate. The large plunger at the base of the cam plate is the positive gear location and it also serves to steady the cam plate whilst the quadrant plungers are returning to their static position.

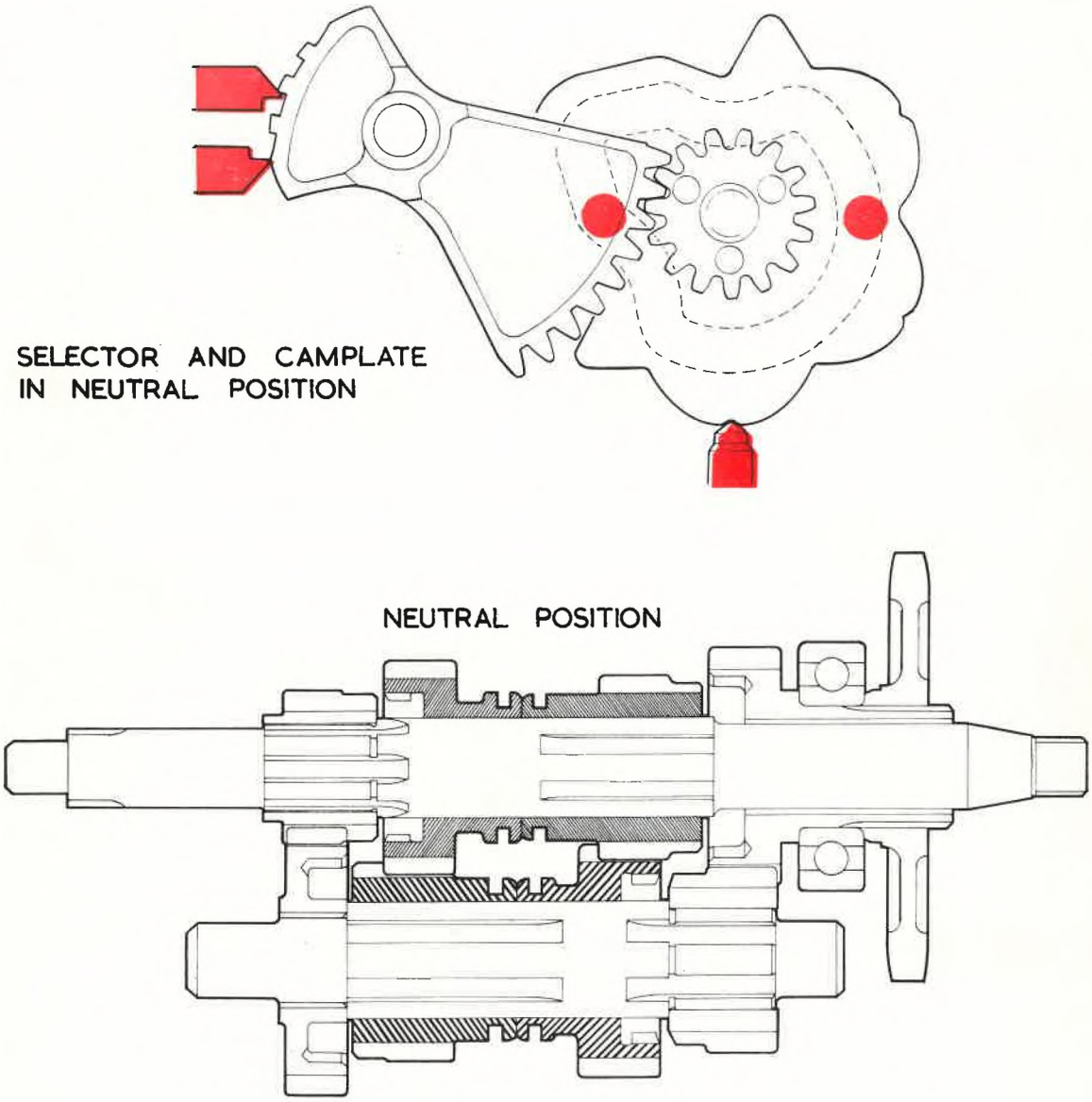

SELECTOR AND CAMPLATE
IN NEUTRAL POSITION
NEUTRAL POSITION

FIG. B.57.

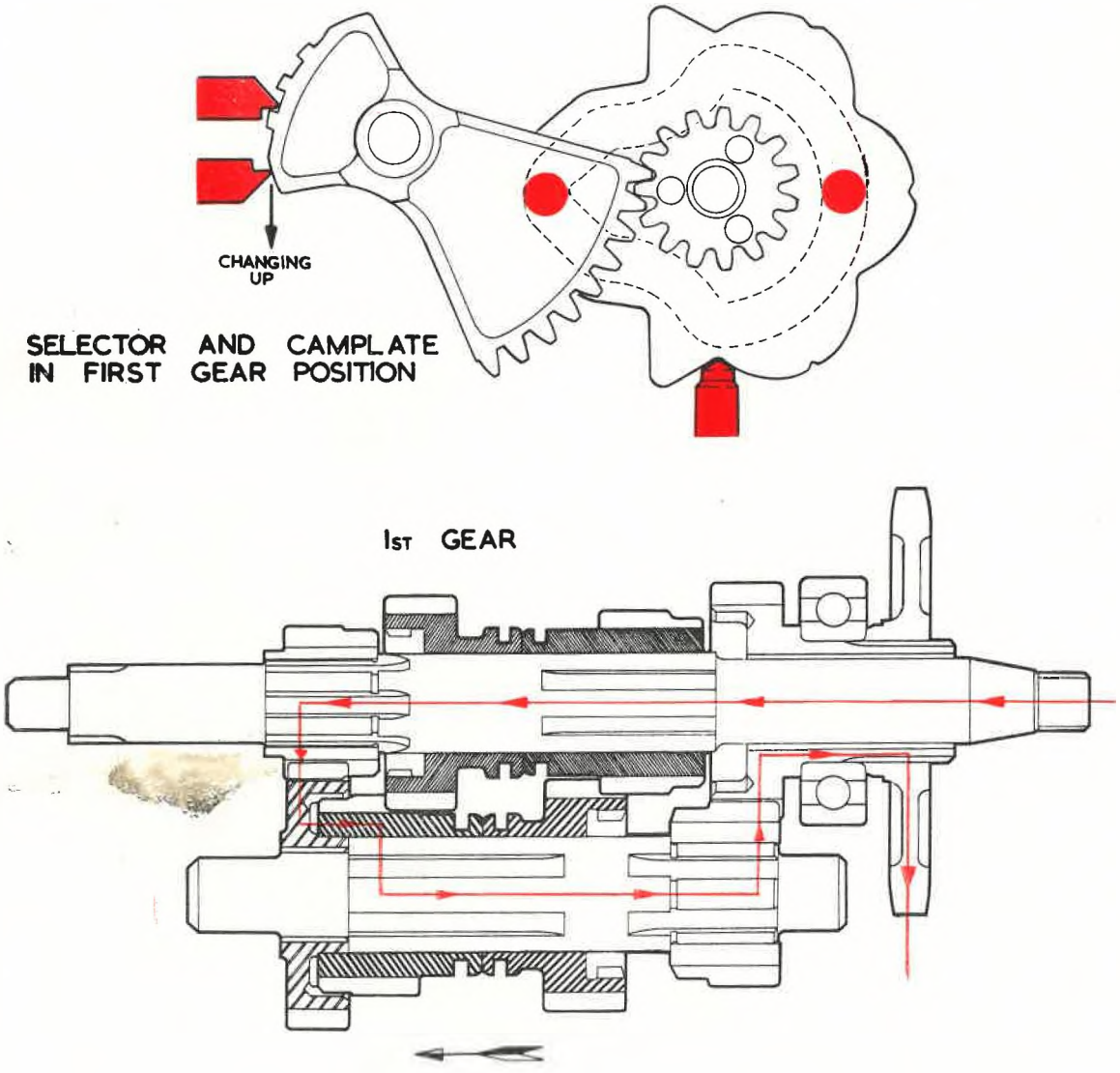
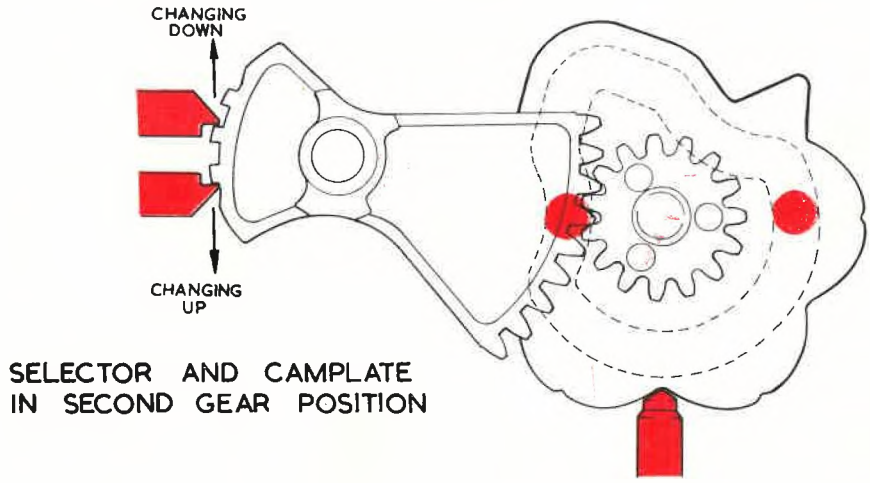

CHANGING UP
SELECTOR AND CAMPLATE IN FIRST GEAR POSITION
1ST GEAR

FIG. B.57A.


CHANGING DOWN
CHANGING UP
SELECTOR AND CAMPLATE IN SECOND GEAR POSITION

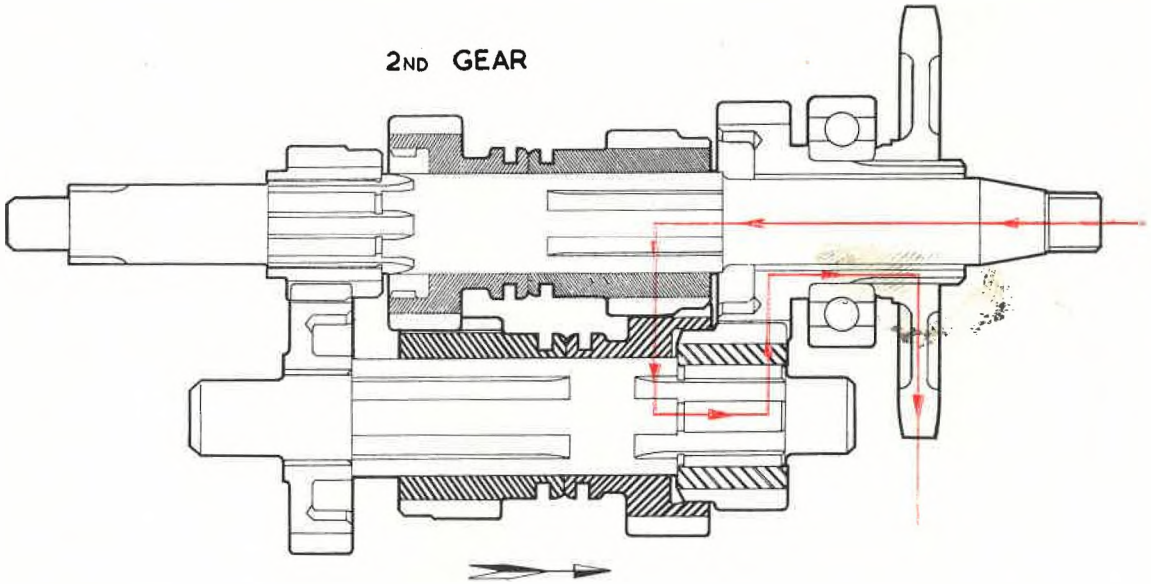

2ND GEAR

FIG. B.57B.

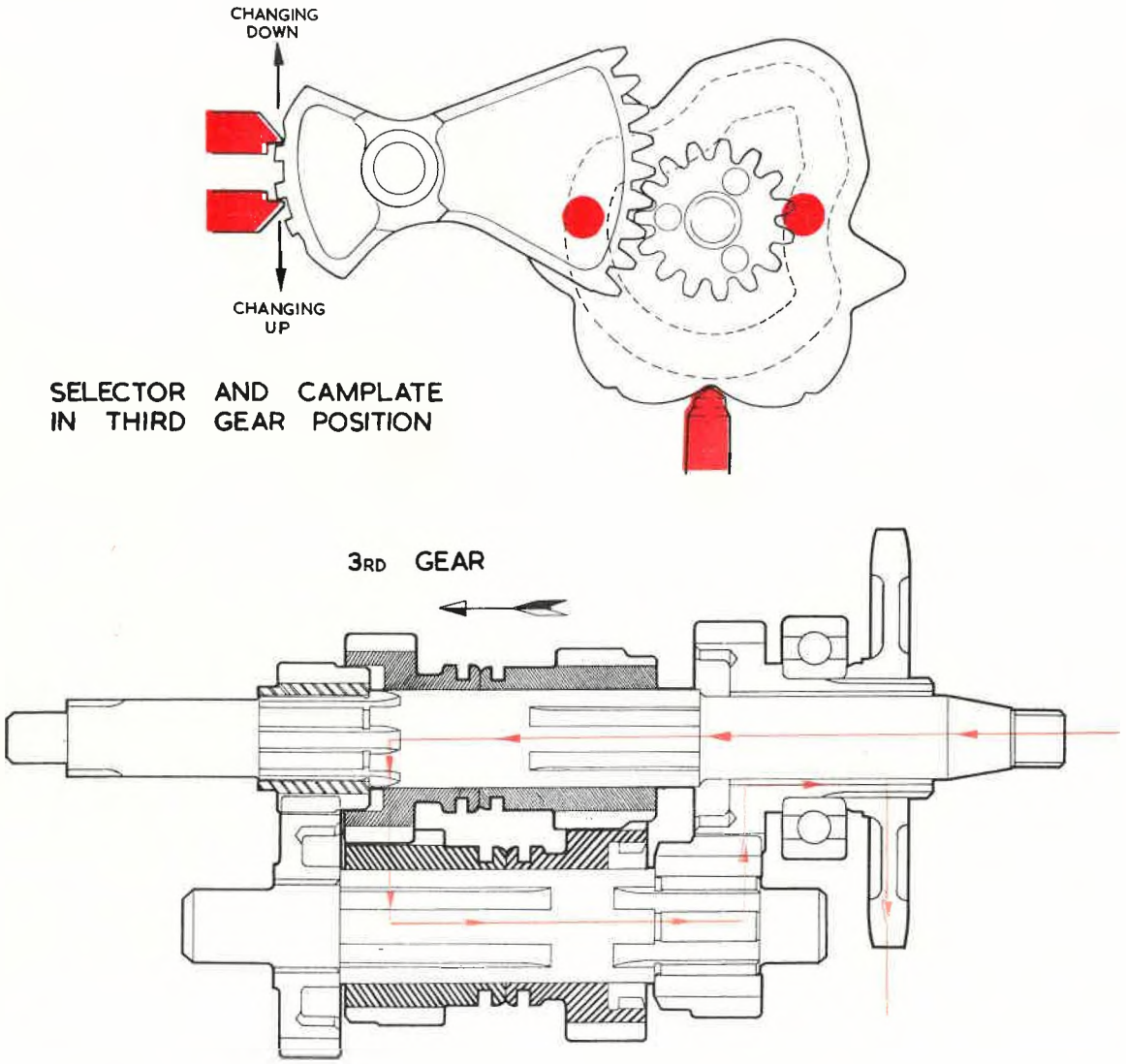
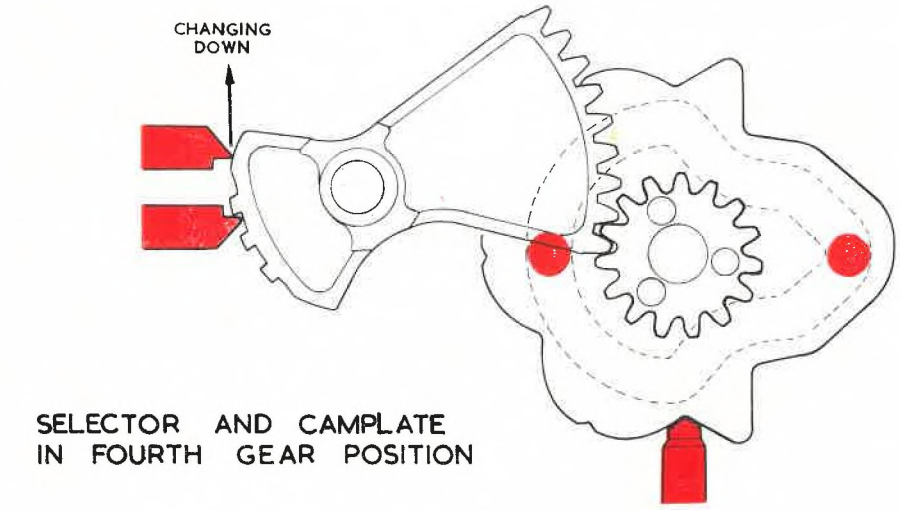

CHANGING DOWN
CHANGING UP
SELECTOR AND CAMPLATE IN THIRD GEAR POSITION
3RD GEAR

FIG. B.57C.


CHANGING
DOWN
SELECTOR AND CAMPLATE
IN FOURTH GEAR POSITION

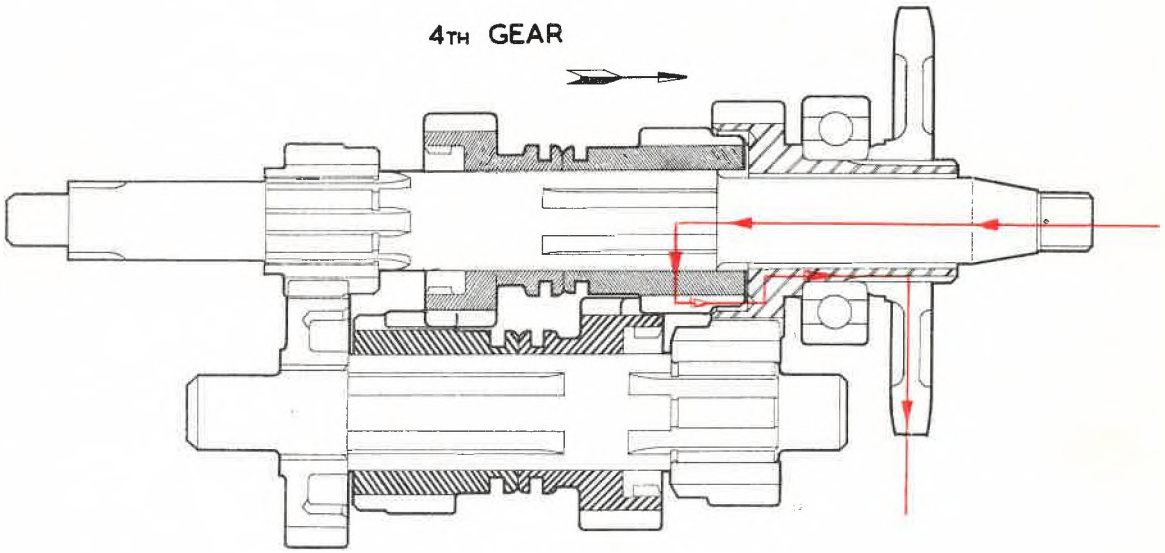

4TH GEAR

FIG. B.57D.

SPLITTING THE CRANKCASES

Before attempting to part the three sections of the crankcase all the timing gear must have been removed as detailed on pages B.30—B.32, and primary drive gear as detailed on pages B.22—B.25.

It is not absolutely necessary to remove the gear cluster but, since the work already involved constitutes a major operation it is sometimes good policy to examine the gears at the same time. Removal and replacement of the gear cluster is detailed on pages B.32—B.34.

The gearbox outer case must be removed and also the full flow main oil filter in the bottom of the crankcase which is retained by the large brass plug. Remove the plug, fibre washer, the spring, and finally withdraw the filter.

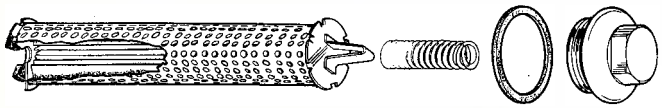


FIG. B.58. *Full flow filter.*

To remove timing-side crankcase remove the four bolts (*A*) two at the rear of the crankcase, and two at the front. The single bolt (*B*) at the rear, the single bolt (*C*) at the bottom of the case and the single socket head screw (*D*) inside the timing case in the top right-hand corner. Also remove the nuts and washers from the studs (*E*) each side of the crankcase mouth behind the timing case (see Fig. B.59).

To remove drive-side crankcase remove the two bolts (*F*) from the crankcase mouth, the single bolt (*G*) from beneath the case, and the five bolts (*H*) from the front and back of the case (see Fig. B.60).

The two outer crankcase sections are located on two dowels each so the cases will have to be tapped off these. The timing-side can be removed with service tool No. 61–6046, and the drive-side crankcase drive-side section can be removed with the aid of an aluminium drift and mallet. Place the drift just behind the crankcase against the lug shown in Fig. B.62 and gently tap with the mallet until the case is released (see Fig. B.62).

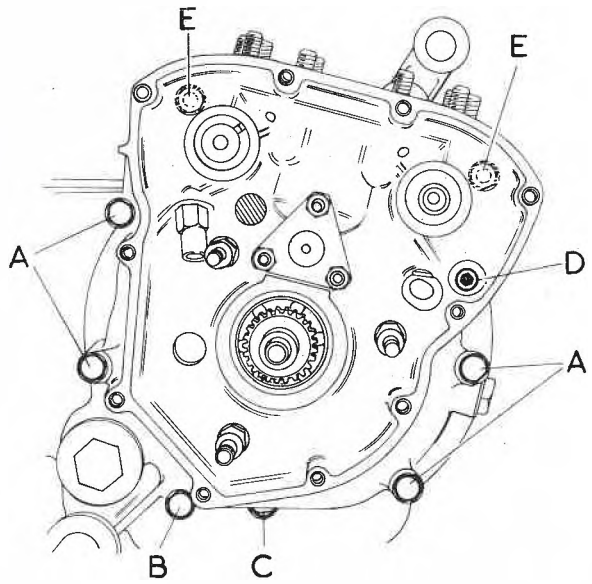


FIG. B.59. *Crankcase screws, timing-side.*

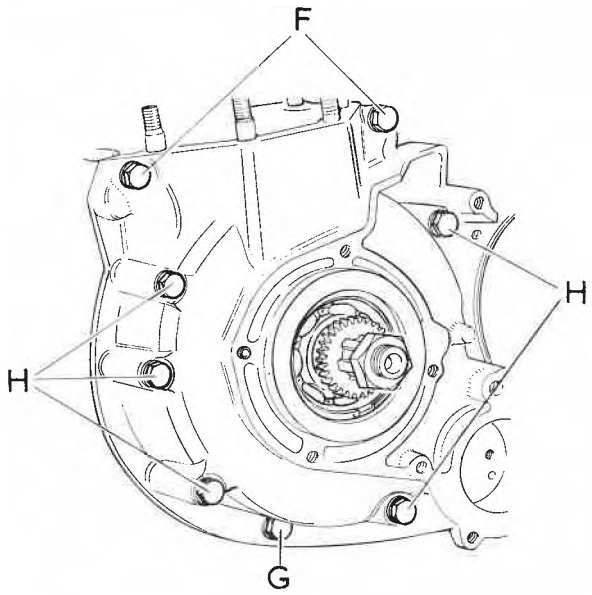


FIG. B.60. *Crankcase screws, drive-side.*

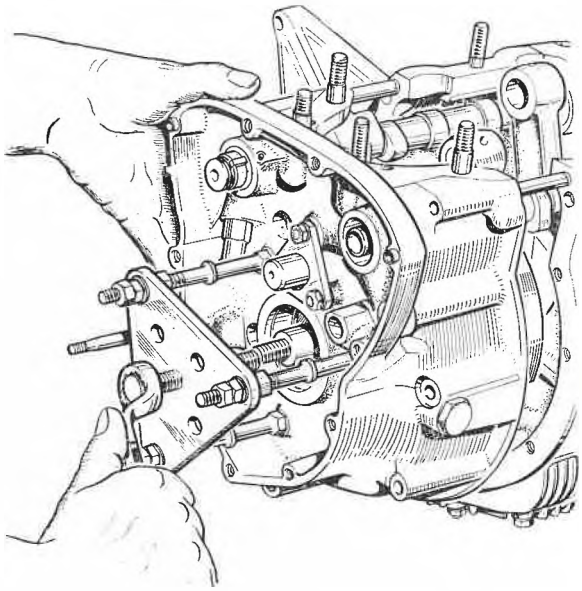


FIG. B.61. *Removing timing-side crankcase.*

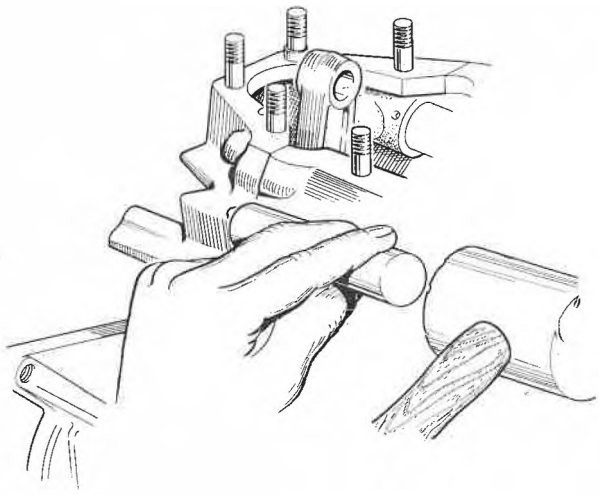


FIG. B.62. *Removing drive-side crankcase.*

The two camshafts will come away with the timing-side case and these can now be withdrawn, examine the peaks of the cams for wear or scuffing. If the peaks are worn the valves will not open completely and the camshaft should be replaced. Examine the rev-counter drive teeth on the exhaust camshaft for chipped or worn teeth if any is evident the camshaft should be replaced.

There are two O-ring seals in the centre crankcase for sealing the oil filter these should be checked and replaced if necessary.

CRANKSHAFT REMOVAL

On the top of the two main bearing journal caps there are two small oil pipes these are for tappet lubrication and are held to the caps by a small screw. They then bend forward and locate in rubber grommets in the front of the crankcase. To remove take out the screws and pull the pipe upwards bodily, once the pipe is free from the cap turn it away from the cap and push it back down and out of the crankcase.

Remove the self-locking nuts and washers from the caps. Because the caps are tight on their location dowels the only way to remove them is as follows.

Replace the small oil pipe screws with a large washer on each, then with the two levers gently prise the caps off their studs (see Fig. B.63).

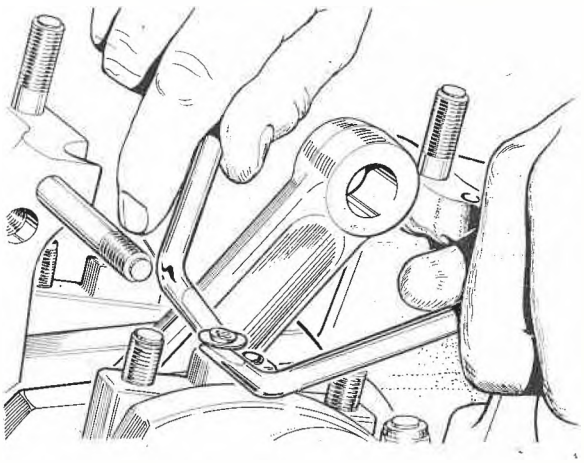


FIG. B.63. *Removing journal caps.*

The crankshaft assembly can now be removed and placed to one side.

CRANKSHAFT ASSEMBLY

Removal of the connecting rods from the crankshaft is quite straightforward but, the rods, bolts and caps must be marked so that they can be replaced in the same positions if they are being used again.

If the crankshaft is to be reground it is essential that the correct regrind sizes are used to suit the undersize big-end bearing shells and centre main bearings shells.

There are four undersize bearings shells available for both big-end and main bearings, they are 0·010″, 0·020″, 0·030″ and 0·040″.

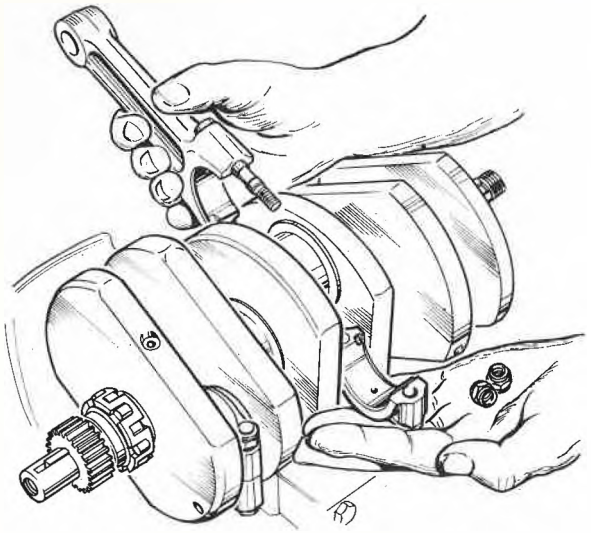


FIG. B.64. *Removing connecting rods.*

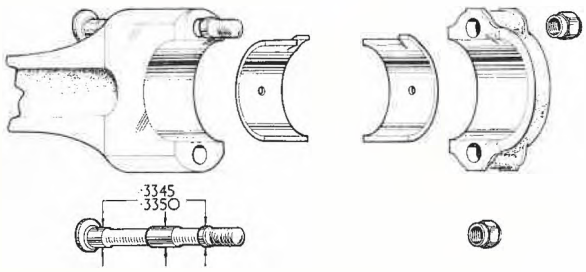


FIG. B.65. *Connecting rod assembly.*

CRANKSHAFT GRINDING

It will be necessary to regrind the bearing surfaces if the overall wear of the crankpins and main bearings journals exceed ·002″ or if the surfaces have been damaged by seizure. Worn bearings will develop a distinct "knock" and the engine will become generally very rough.

CENTRE MAIN BEARING JOURNALS

Grind journal to: 1·9070″—1·9075″ with ·070″ —·080″ radius and use ·010″ undersize bearing shells No. 70–9027.

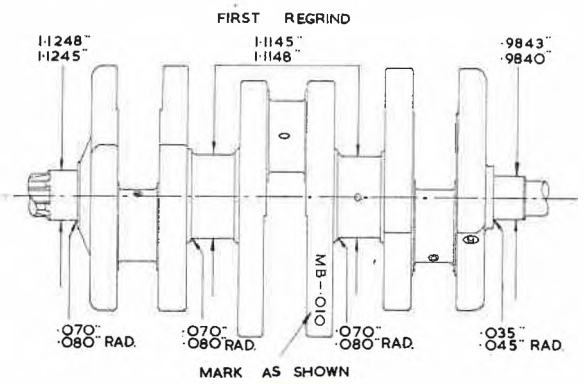


FIG. B.66. *First regrind.*

Grind journal to: 1·8970″—1·8975″ with ·070″ —·080″ radius and use ·020″ undersize bearing shells No. 70–9028.

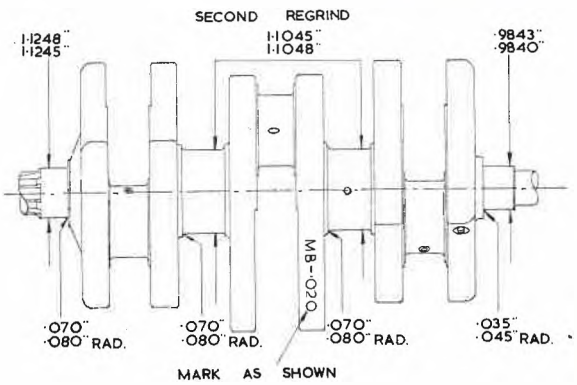


FIG. B.67. *Second regrind.*

Grind journal to: 1·8870″—1·8875″ with ·070″—·080″ radius and use ·030″ undersize bearing shells No. 70–9029.

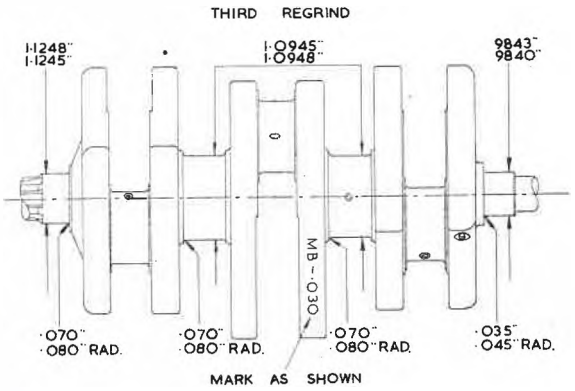


FIG. B.68. *Third regrind.*

Grind journal to: 1·8770″—1·8775″ with ·070″—·080″ radius and use ·040″ undersize bearing shells No. 70–9030.

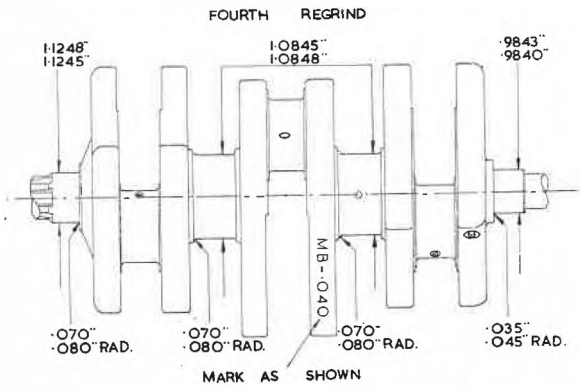


FIG. B.69. *Fourth regrind.*

BIG-END JOURNALS

First Regrind

Grind the crankpins to 1·6135″—1·6140″ with ·070″—·080 face radius. Fit bearing shells No. 70–9023 (6 off) marked ·010″ undersize.

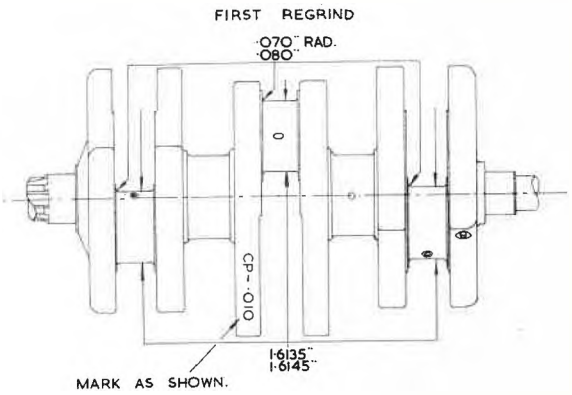


FIG. B.70. *First regrind.*

Second Regrind

Grind the crankpins to 1·6040″—1·6035″ with ·070″—·080″ face radius. Fit bearing shells No. 70–9024 (6 off) marked ·020″ undersize.

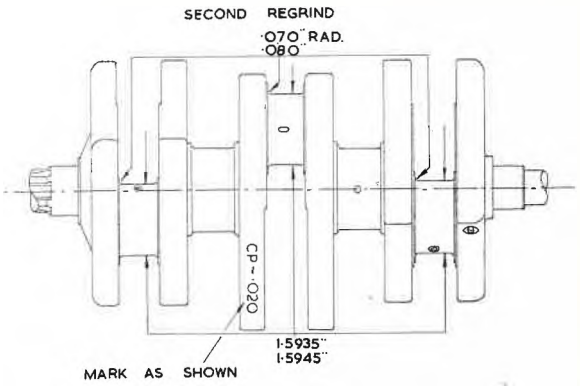


FIG. B.71. *Second regrind.*

Third Regrind

Grind the crankpins to 1·5940″—1·5935″ with ·070″—·080″ face radius. Fit bearing shells No. 70–9025 (6 off) marked ·030″ undersize.

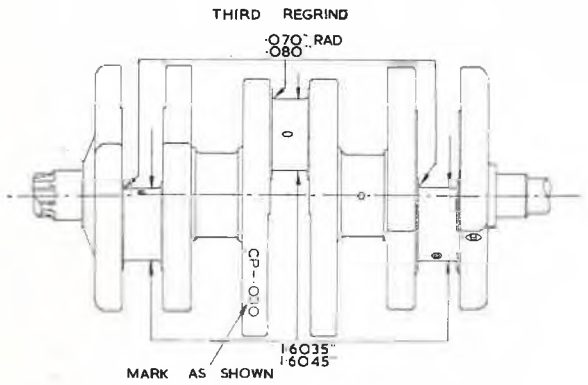


FIG. B.72. *Third regrind.*

Fourth Regrind

Grind the crankpins to 1·5840″—1·5835″ with ·070″—·080″ face radius. Fit bearing shells No. 70–9026 (6 off) marked ·040″ undersize.

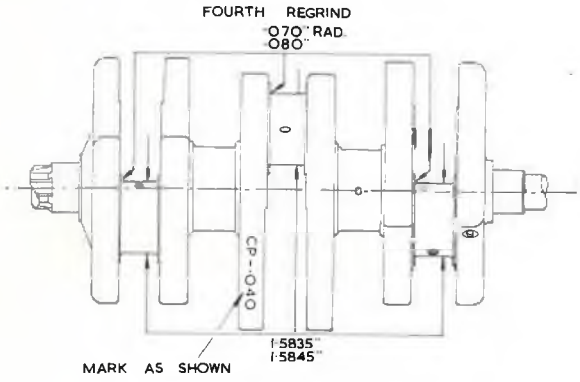


FIG. B.73. *Fourth regrind.*

CRANKSHAFT BALANCING

The crankshaft assembly is accurately balanced on special equipment therefore it will NOT need any attention.

BEARINGS, BUSHES AND OIL SEALS

With the crankcase split the opportunity should be taken to examine and replace all bushes and bearings which may be worn or damaged.

Ball journal bearings should be checked for roughness, indicating damaged balls or ball tracks.

To remove the outer main bearings it is necessary to remove one of the circlips on either side of the bearings, it does not matter whether it is the inside or the outside. The timing-side roller bearing centre will be removed with the crankshaft leaving the outer ring between the circlips. Before pressing the bearings out, the cases should be warmed up. They should also be warmed for reassembly of the bearings.

Most bearings and bushes can be pressed out, and in, quite normally, but the crankcase must always be heated first and well supported.

When replacing oil seals they must be handled very carefully to avoid damaging the knife-edge

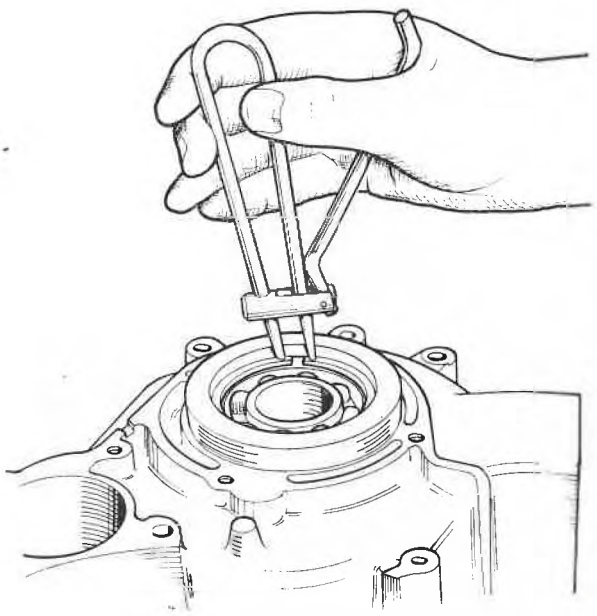


FIG. B.74. *Removing main bearing circlip.*

of the seal and they must be pressed into the housing squarely, with the open side always towards that part which is to be sealed.

Never reassemble a component which is deeply scored by the seal, to a new seal, it will be useless, the component should be replaced as well as the seal.

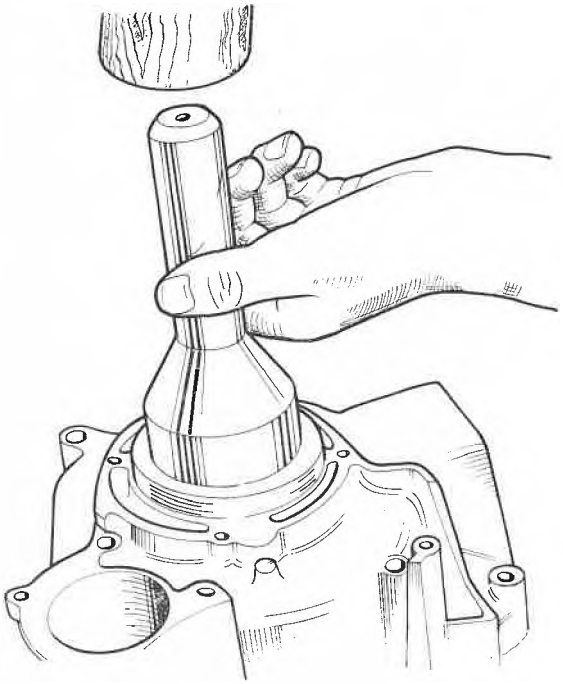


FIG. B.75. *Removing main bearing.*

Check all oilways to see that they are clear and see that the oil scavenge non-return valve in the base of the crankcase is quite free. If there is any possibility of sludge in the return pipe obstucting the ball, soak the case in gasoline and blow out with a high-pressure air line.

REASSEMBLING THE CONNECTING RODS

The need for cleanliness cannot be over emphasised, all parts should be clean and free from grit or rust. As the various parts are assembled all bearing surfaces should be coated with clean engine oil.

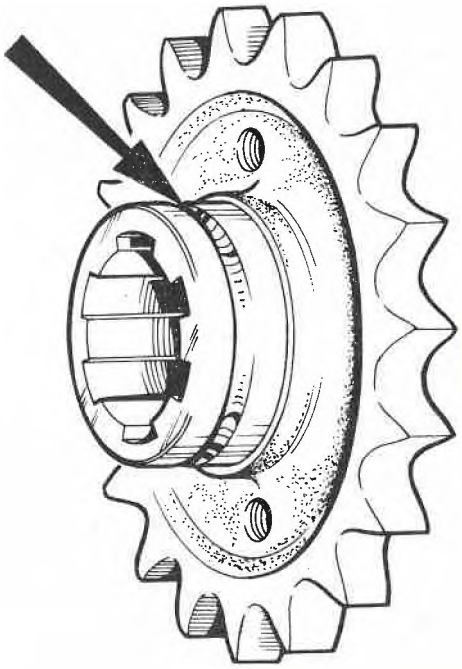


FIG. B.76.
Final drive sprocket (worn by seal).

Place the bearing shells in both the caps and connecting rods. If the old shells are being refitted see that they go into their original positions. No scraping is necessary with these bearing shells and must not be attempted or damage will result.

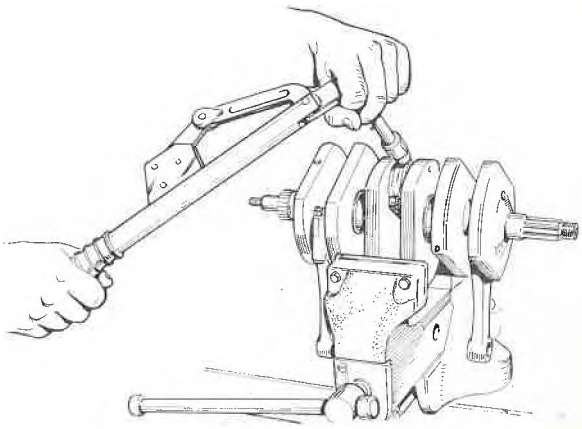


FIG. B.77. *Using torque wrench.*

Connect each rod in turn to its crank journal making sure that the marks on rod and cap correspond, and that the rods are the right way round on the journal which they came off. Insert the bolts and secure the new self-locking nuts with a torque wrench set to the figure quoted on page J.1.

REASSEMBLING THE CRANKCASE

Again cleanliness is essential for the success in this job.

Place the bearing shells in the pillars and caps. If the old shells are to be used replace them in their original positions. No scraping is necessary with these bearing shells, and must not be attempted or damage will result.

Coat the faces of the shells and crankshaft journals with clean engine oil and place the crankshaft in position with the splined shaft on the drive-side.

Replace the main bearing caps making sure that the marks on pillar and cap correspond. Screw the new self-locking nuts and washers on to the bolts and secure with a torque wrench set to the figure quoted on page J.1.

See that the crankshaft revolves easily and smoothly.

Renew the small rubber seals for the tappet oil feed pipes.

Replacement of the oil pipes is the reverse of removal but care must be taken when inserting the pipe into the bearing caps, if they are not pushed down squarely the rubber seal will be damaged.

Renew the rubber O-rings for the oil filter, if they are damaged in any way.

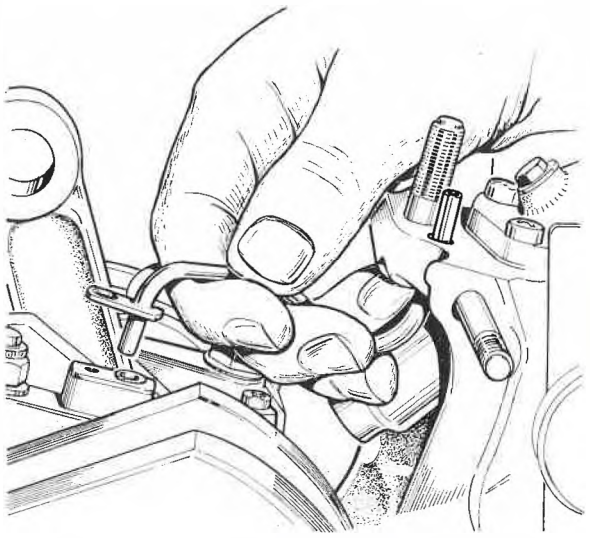


FIG. B.78. *Replacing oil pipes.*

A thin smear of jointing compound should be applied to each face of the crankcase. Replacement of the drive-side crankcase portion is the reverse of removal. When fitting the timing-side portion however the camshafts should be inserted into their bushes and the whole assembly replaced together, care must be taken when fitting, as the exhaust camshaft is a close fit under the tappet oil feed pipes. If care is not taken the pipes may be bent or broken.

Replace all the nuts, bolts and washers and tighten evenly all round the crankcase, to torque settings quoted on page J.1.

Check that both the crankshaft and camshafts rotate quite freely, if they do not, then the alignment is incorrect and the cause of the trouble must be found and rectified.

Replace the crankshaft spacer on the timing-side and then the special key and timing pinion with the timing mark on the outside.

Replace the camshaft pinions with keys.

Both inlet and exhaust camshaft pinions should be replaced with a No. 1 keyway locating on the key, this is the keyway in line with the timing mark on the outer face (see Fig. B.79).

Fit both camshaft nuts and tighten in an anti-clockwise direction as both threads are left-handed.

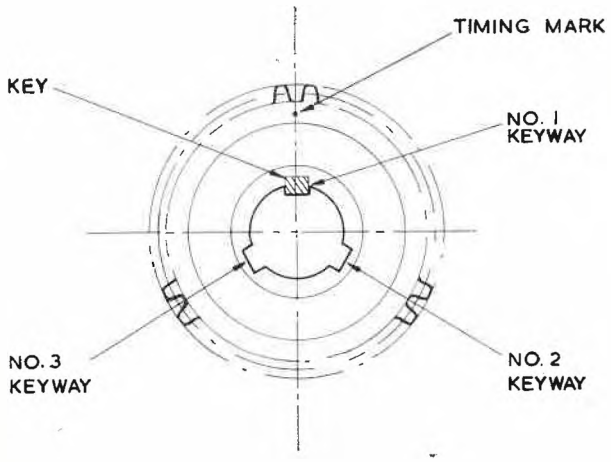


FIG. B.79. *Inlet and exhaust camshaft.*

When fitting the idler gear the timing marks should be lined up on the crankshaft pinion and the two camshaft pinions as shown in Fig. B.80, finally push the idler gear home and replace the rest of the timing-side as on page B.32.

Replacement of drive-side is described on page B.26, and if the gearbox has to be stripped replacement is dealt with on page B.34.

Replace rev counter drive in the reverse (page B.32) of removal, not forgetting to smear the gasket with jointing compound on both sides.

Replace the upper part of the engine as detailed for decarbonising on pages B.16—B.18.

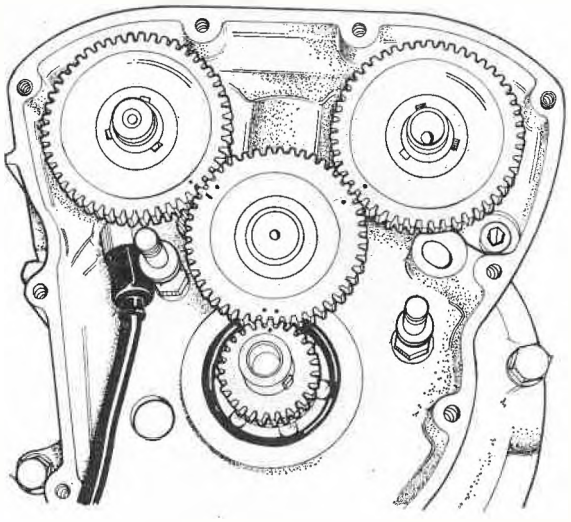


FIG. B.80. *Valve timing.*

IGNITION TIMING

The simplest way to set the ignition timing, that is the point at which the compressed charge in the combustion chamber is ignited, is to set it statically.

Unfortunately, due to manufacturing tolerances this is not ideal because, whilst it will set the timing of the engine for tick-over speeds, the firing at wide throttle openings can be varied due to differences in the amount of automatic-advance.

The automatic-advance functions by centrifugal force, acting in spring-loaded bob-weights, and advances the ignition timing as the engine revolutions rise. Since exact timing accuracy is required at operating speeds, it is better to time the engine in the fully-advanced position, so transferring any variations in the firing to the tick-over or low engine speeds, when it can least affect the performance.

Before carrying out any check on the ignition timing, the fully-open points gap on each of the three contact sets must be varified and if necessary, re-adjusted as detailed on page B.29.

So that the engine can be rotated easily, take out the sparking plugs to relieve any resistance from compression. If the engine is in the frame, it will also help if top gear is engaged enabling the engine to be turned either backwards or forwards by rotation of the rear wheel.

PISTON POSITION

Having chosen which contact set on which to start, the corresponding piston must be set at 0·375″ — 38° before top dead centre on its compression stroke (both valves closed).

The correct contact set for each piston is as follows.

No. 1 piston (at the timing-side) is ignited by the contact set having the black/white lead; No. 2 by the set having the black/red lead; and No. 3 by the set having the black/yellow lead (see Fig. B.81).

NOTE:—The engine firing order is:
(1) Timing-side cylinder;
(3) Driving-side cylinder;
(2) Centre cylinder.

An accurate method is provided for spark timing by the crankshaft web drillings which, used in conjunction with the ignition finder plug (service tool No. 60–1858) located in the crankcase base provided.

Roughly set No. 1 cylinder at top dead centre on compression stroke (both valves closed) and slowly reverse the crankshaft to 38° before top dead centre finding this position when the ignition finder plunger drops into the hole in the crankshaft wed at that position. (There are three holes for three pots. Holes disposed at equal 120° intervals but to find consecutive firing points move 240° each time.)

DO NOT FORGET TO REMOVE IGNITION FINDER PLUNGER BEFORE REVOLVING ENGINE.

An accurate means of checking the opening of the contact points can be made by connecting a battery and bulb in circuit with the points. Attach one lead between the C-spring and the battery terminal. Take a second lead from the other battery terminal to a bulb, then from the base of the bulb to a good earthing point on the machine. As soon as the contacts open, the circuit will be broken and the light will go out.

To release the advance and retard unit from the camshaft, insert ATD withdrawal tool (service tool No. 60–782) and screw it in until it releases the taper. To allow the contact breaker cam (*B*) to be locked in the fully-advanced position, fit a washer (*C*) having a hole just large enough to clear the cam inner bearing (see Fig. B.83). Then replace the central fixing bolt (*A*) and original washer.

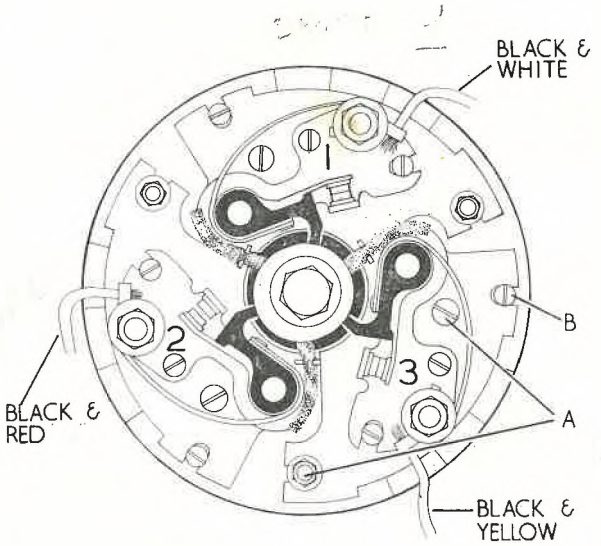


FIG. B.81. *Contact breaker*

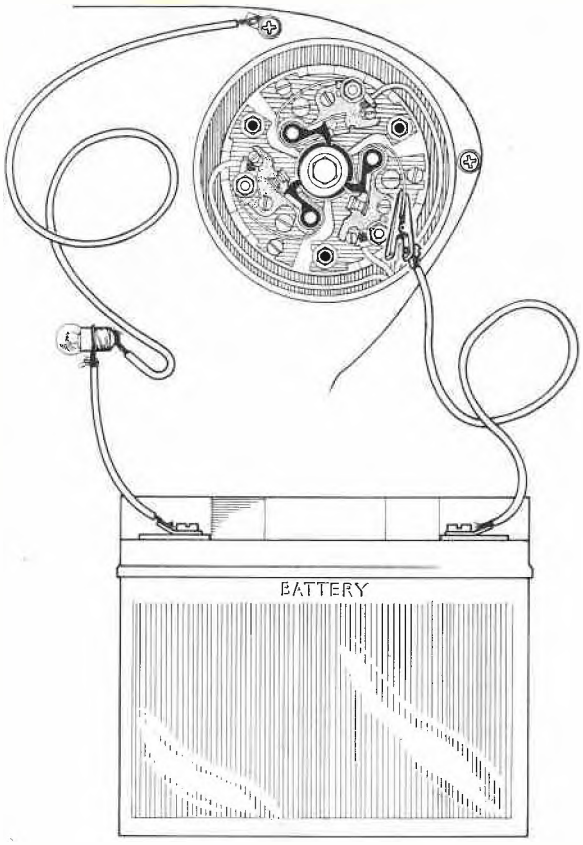


FIG. B.82. *Battery and bulb in circuit.*

Re-lock the ATD to camshaft when, under clockwise rotation, the opening flank of the contact breaker cam "just breaks" the No. 1 points with the ATD "wound up" to absolute full-advance position. This will be shown by a break in the current to the tell-tale lamp. Check by removing the ignition finder from the engine, and carefully re-rotate the engine to the firing point as shown by the bulb. Then the ignition finder should be re-engageable without further crankshaft movement.

For cylinders 3 and 2 proceed as follows.

Set to 38° before top dead centre on the next cylinder and insert the ignition finder tool in the hole in the crank web. Transfer the tell-tale to the appropriate contact breaker lead, black/yellow for No. 3 pot; black/red for No. 2; and **leaving the points gap completely alone,** adjust

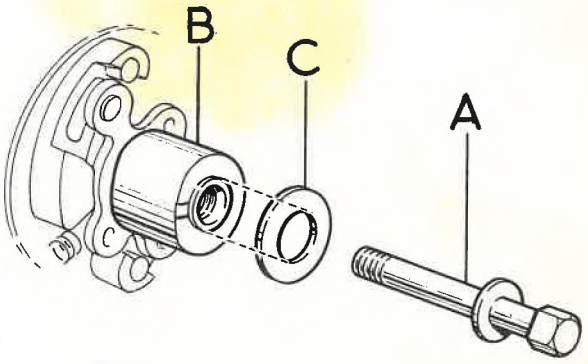


FIG. B.83. *Locking ATD unit.*

the contact plate by slackening the two fixing screws (*A*) and turning the eccentric screws (*B*) one way or the other to find the required break points as indicated by the tell-tal bulb. Lock up the contact plates and check the settings as previously described.

Remove the sleeve washer which is still holding the ATD cam at the fully-advanced position, being careful not to release the whole unit from its taper. Retighten the centre bolt and refit the sparking plugs.

The final check for ignition timing should be made with a stroboscope.

USING A STROBOSCOPE

If for some reason the timing has been completely lost, a basic static check and preliminary setting as detailed in preceding pages, must be made in order to facilitate engine starting for the strobe check.

To proceed, remove the small inspection cover alongside the contact breaker housing (retained by two screws), to expose the generator rotor. The lower screws when replaced, acts as a pointer. Connect the strobelight to a suitable battery and attach the high-tension lead to the No. 1 spark plug. Start the engine and direct the light on to the generator rotor. If the ignition timing is correct, the pointer and one of the three marks on the rotor will line up when the engine exceeds 3,000 revs per minute.

Correct any variation by adjusting the No. 1 contact plate as described in the previous section.

Repeat the operation for the other cylinders, making adjustments as necessary to their corresponding contact sets.

NOTE:—A small hole is drilled into the crankcase wall behind the generator and allows the timing case oil level to drop sufficient to allow the strobe check to be carried out without loss of oil through the inspection aperture. After starting the engine, the oil level quickly rises and will give only four minutes (approximately) in which to conduct the test. Should oil begin to discharge from the aperture, stop the engine and allow enough time for the oil level to fall, before continuing with the test.

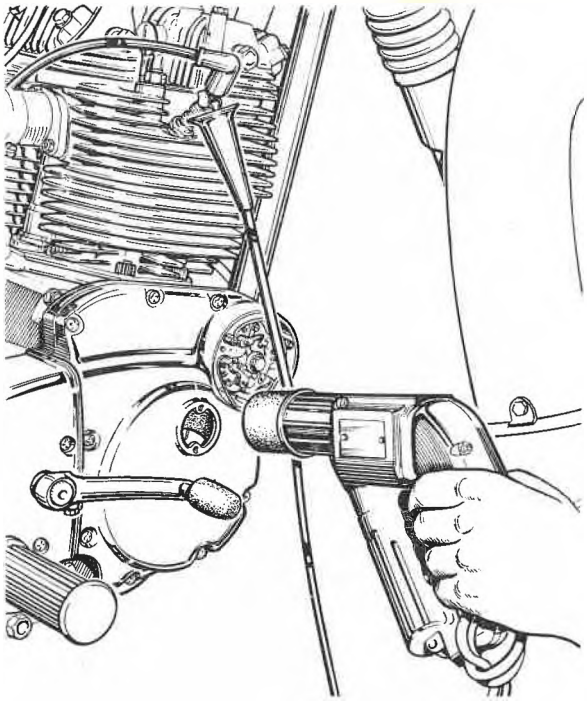
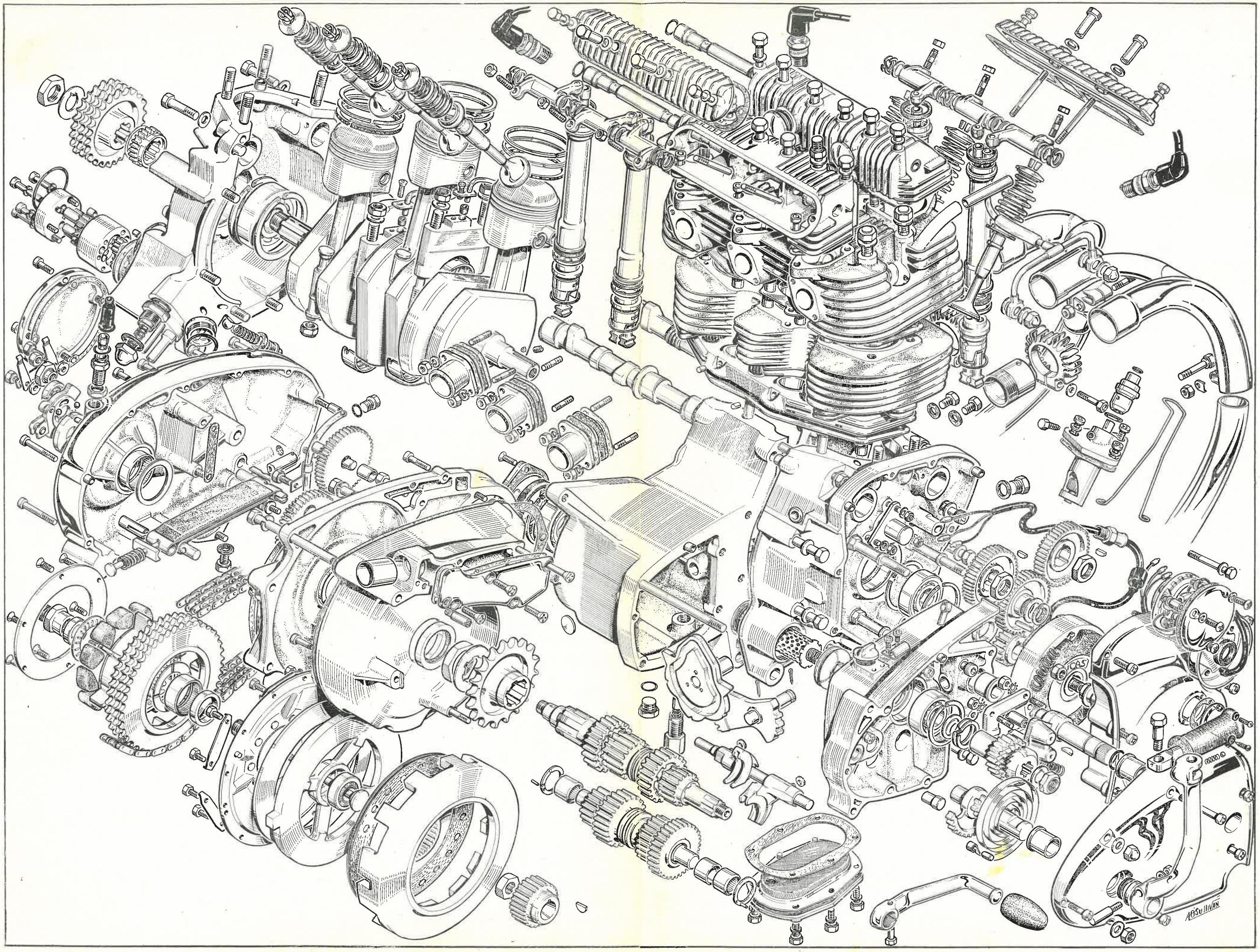


FIG. B.84. *Using the strobelight.*


CAS
ADRIAN SULLIVAN

INDEX

AMAL CONCENTRIC CARBURETTER

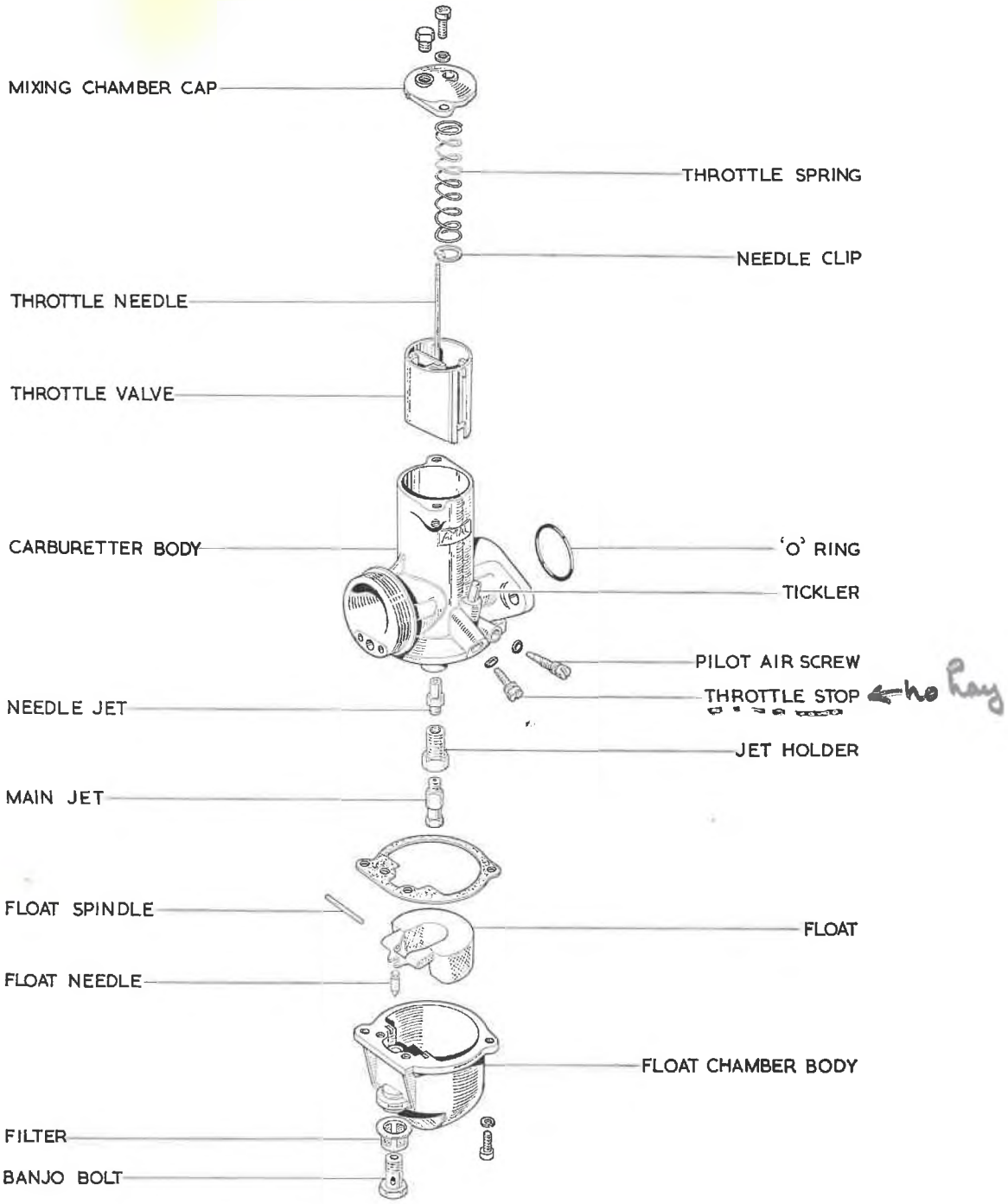


FIG. C.1. *Carburetter exploded.*

DESCRIPTION

Three Amal concentric carburetters are fitted to a one-piece manifold with rubber hoses to the cylinder head. So making the carburetters rubber-mounted.

The throttle, being operated by a single cable from the handlebar twist grip, to the special lever arrangement on top of the carburetters.

The carburetter, because of its jets and choke bore, proportions and atomises just the right amount of petrol with the air that is drawn into the engine and provides a highly-inflammable mixture which is ultimately burnt inside the cylinder head, hence the term "combustion chamber."

The float chamber maintains a constant level of fuel at the jets and incorporates a valve which cuts off the fuel supply when the engine stops.

The throttle valve, controls the volume of mixture and therefore the power.

At tick-over the mixture supply is from the pilot jet system, then as the throttle is opened via the pilot by-pass, the mixture is augmented from the main jet, the earlier stages of which action is controlled by the needle in the needle jet.

The pilot system is supplied by a jet which is detachable for cleaning purposes when the float chamber is removed.

Starter

The carburetter also has a separately operated mixture control known as an air valve, for use when starting from cold, and until the engine is thoroughly warm. This control partially blocks the passage of air through the main choke and is operated from the handlebar.

The design of the carburetter is such that it provides quite simple and effective tuning facilities.

The main jet does not spray directly into the mixing chamber, but discharges through the needle jet into the primary air chamber, and goes from there as a rich petrol/air mixture, through the primary air choke. This primary air choke has a compensating action in conjunction with bleed holes in the needle jet, which serve the double purpose of compensating the mixture from the needle jet and allowing the fuel to provide a well outside and around the needle jet, which is available for snap acceleration.

DISMANTLING AND REBUILDING THE CARBURETTER

Remove the carburetters, inlet manifold and air cleaner as described on page B.8 and Fig. C.2. Detach air cable from its lever on the handlebars and the throttle cable from the main operating lever.

To remove the carburetters from the inlet manifold unscrew the throttle rods from the trunnions in the lever arms. Then take off the six nuts and washers securing the carburetters to the manifold, the carburetters can now be removed by pulling them off their studs and at the same time unhooking the throttle rods from the slotted trunnions.

There should be no need to dismantle the lever assembly, unless it is known to be faulty, in which case one circlip should be removed from the end of the spindle and the spindle then withdrawn from the other end.

Before reassembly of the lever mechanism, check the bushes for wear and replace if necessary, also if the spindle is worn or the trunnions have become very loose these items should be renewed. This is very important as the smooth throttle action relies on these parts being in good order.

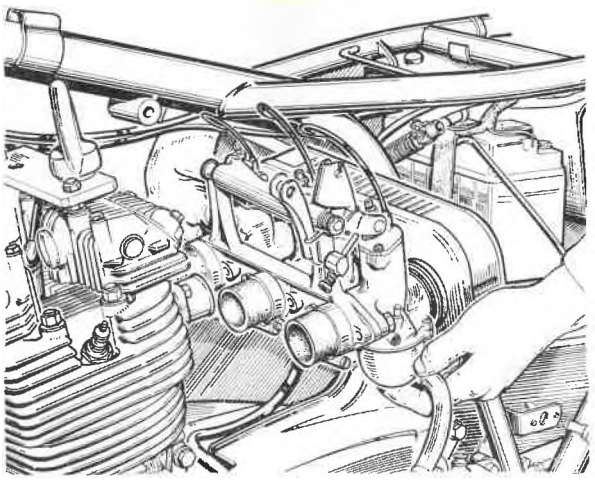


FIG. C.2. *Removing carburetters.*

Check that the rubber hoses between the manifold and cylinder head are not split or perished, if these faults are evident new hose must be fitted.

Take out the two Phillips-head fixing screws and remove the carburetter top cover complete with throttle valve assembly and air slide. Compress the air slide spring and release cable nipple from its register.

To remove or replace a throttle needle it will be necessary to disconnect the throttle rod, to do this push C-washer downwards compressing the spring and flip the washer out. The needle clip is then clear for removal together with the needle. Care should be taken not to lose the C-washer or clips when removing the throttle rod assembly. To remove and replace clip, it is necessary to use service tool No. 60–1865 (see Fig. C.4).

Unscrew the three "banjo" bolts which secure the fuel pipe "banjo" connectors to the float chamber and withdraw the nylon filters.

The float chambers are secured to the base of each mixing chamber by two screws with spring washers. On removal, it will be noted that the float spindle is a press-fit into the chamber body and that the needle is retained in position by the rear forked end of the float.

The pilot jet, needle jet, and main jet (with holder) can now be unscrewed from the mixing chamber base.

Take out the throttle stop adjusting and pilot air adjusting screws, and ensure that the small rubber O-ring on each screw is in good condition before replacing.

The float chamber tickler (or primer) consists of a spring and plunger, splayed at one end to retain it in the mixing chamber. This item should not be subjected to a great deal of wear and is therefore unlikely to require replacement.

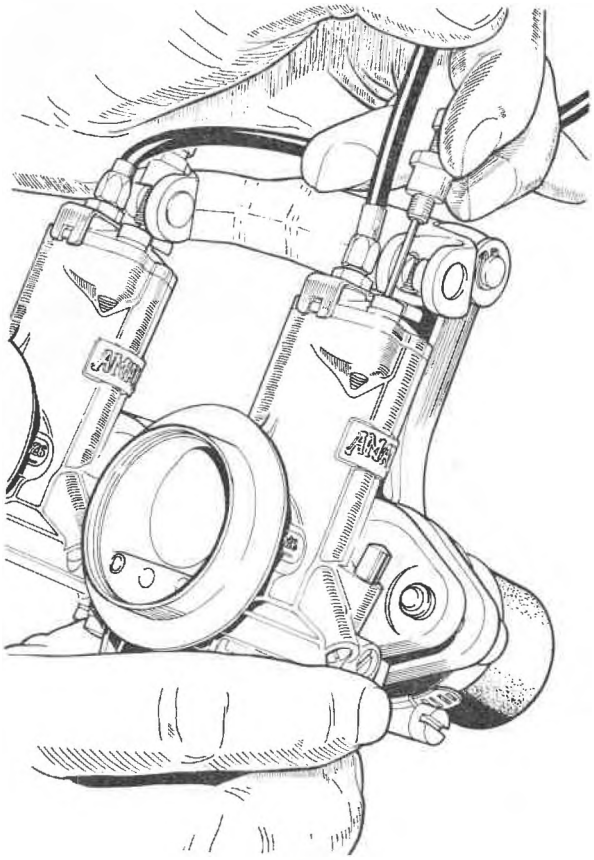


FIG. C.3. *Removing carburetter.*

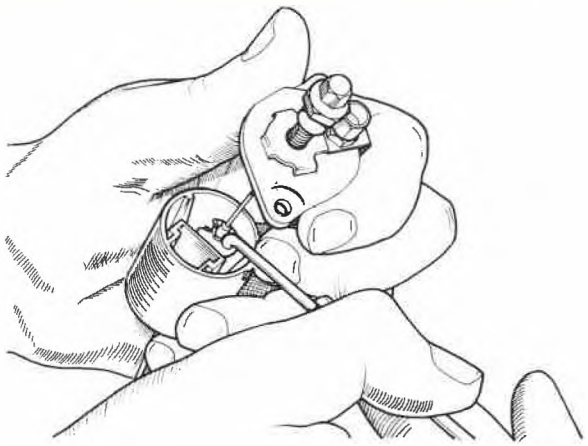


FIG. C.4. *Removing throttle rod.*

Having dismantled the carburetter, carefully clean all parts in gasoline. Hard deposits on the carburetter body are best removed with a light-grade wire brush. After washing the parts in clean gasoline, allow to dry and ensure that all holes or small drillings are free from dirt. A hand pump is ideal for "blowing through" any blockages in the drillings. Inspect the component parts for wear and check that the jets are in accordance with the recommended sizes given on page GD.5.

Reassembly is simply a reversal of the above instructions, but remember to replace any gaskets or O-rings that appear unserviceable. Refer to Fig. C.1 for guidance.

INSPECTING THE CARBURETTER COMPONENTS

The parts most liable to show wear after considerable mileage are the throttle valve slide and the mixing chamber.

(1) Inspect the throttle valve slide for excessive scoring of the front area and check the extent of wear on the rear slide face. If wear is apparent, the slide should be renewed; be sure to fit slide with correct degree of cut-away (see page GD.5).

(2) Examine the air valve for excessive wear and check that it is not actually worn through at any part. Ensure that the air valve spring is serviceable by inspecting the coils for wear (see page GD.5).

(3) Examine the needle jet for wear or possible scoring, and check the tapered end of the needle for similar signs. The needle should also be perfectly straight.

(4) Check the float needle for efficiency by inserting it into the float needle seating block, pouring a small amount of gasoline into the aperture surrounding the needle and checking it for leakage.

(5) Ensure that the float is not punctured by shaking it to see if it contains any fuel. Do not attempt to repair a damaged float. If there is any doubt about its condition, replace it with a new one.

(6) Check the petrol filter that fits over the needle seating block, for any possible damage to the mesh. If the filter has parted from its supporting structure it will allow the gasoline to pass through unfiltered.

HINTS AND TIPS

Throttle Cable
See that there is a minimum of backlash when the twist grip is turned back and that any movement of the handlebar does not cause the throttle to open.

Petrol Feed
Unscrew the float chamber "banjo" bolt, remove the "banjo", and take off the filter gauze from the needle seating.

Ensure that the filter gauze is undamaged and free from all foreign matter. To check fuel flow before replacing the "banjo", turn on the fuel tap momentarily and see that fuel gushes out.

Flooding
This may be due to a worn needle or a punctured float, but is more likely due to impurities (grit, fluff etc.), in the tank. This trouble can sometimes be cleared by periodically cleaning out the float chamber. If however, the trouble persists the tank must be drained and swilled out.

Carburetter Air Leaks
Erratic slow-running is often caused by air leaks between the carburetter flanges and the inlet manifold or at the rubber hose connections and at the cylinder head adaptor stubs (see Fig. C.5). These faults can be detected by applying oil around the joints.

Eliminate by fitting new joint washers and new rubber hoses. Only fit new rubber hoses if a leak cannot be eliminated by further tightening of the hose clips.

In old machines look for air leaks caused by a worn throttle or worn inlet valve guides.

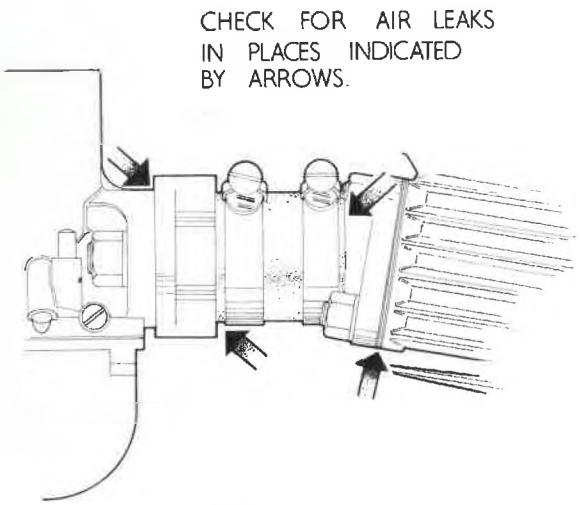


FIG. C.5. *Air leaks.*

Banging in Exhaust
May be caused by too weak a pilot mixture when the throttle is closed or nearly closed, also it may be caused by too rich a pilot mixture and an air leak in the exhaust system: the reason in either case is that the mixture has not fired in the cylinder and has fired in the hot exhaust. If the banging happens when the throttle is fairly wide open the trouble will be ignition not carburation.

Bad Petrol Consumption
If this cannot be corrected by normal adjustments, it may be due to flooding caused by impurities from the petrol tank lodging on the float needle seat, so preventing its valve from closing. The float needle should also be checked for wear or damage.

High consumption can also be caused by a worn needle jet, and may be remedied or improved by lowering the needle in the throttle.

If this method is unsatisfactory, then a new needle and needle jet will have to be fitted.

There are many other causes of high petrol consumption and it should not be assumed that the fault lies in the carburetter alone.

Air Filters
These may effect the jet setting. If a carburetter is set with an air filter and the engine is run without, take care not to over-heat the engine due to too weak a mixture; testing with the air valve will indicate if a larger main jet and higher needle position are required.

Effect of Altitude on a Carburetter
Increased altitude tends to produce a rich mixture; the greater the altitude, the smaller the main jet required. Carburetters ex-works are suitably set for use in altitudes of up to approx-imately 3,000 feet. Carburetters used constantly in altitudes of between 3,000 to 6,000 feet should have a reduction in main jet size of 5%. A further reduction of 4% should be made for every 3,000 feet in excess of 6,000 feet altitude.

No adjustment can be made to compensate for lost power due to rarified air.

RE-SYNCHRONIZATION OF THROTTLE LINKAGE

This job is easiest done with the carburetters and inlet manifold removed from the cylinder head.

Slacken off the adjuster nuts on the throttle rods so that the throttle slides are at the bottom of their stroke. Also slacken off the throttle lever adjuster screw.

Now with the aid of three rods, $\frac{3}{16}$" diameter, place one rod under each of the three slides (see Fig. C.6). Screw the adjusters up or down until the slides just grip the rods, tighten the locknuts.

Check now to make sure that nothing has moved, while tightening the locknuts.

If the synchronization of the throttle linkage is the slightest bit out, power will be lost, an even tick-over impossible, and the engine will seem very erratic, causing possible damage. So it can be seen that synchronization of the carburetters is very important.

Once harmony is achieved the carburetters should be replaced complete with air cleaner, and tuning can be carried out as described on page C.9.

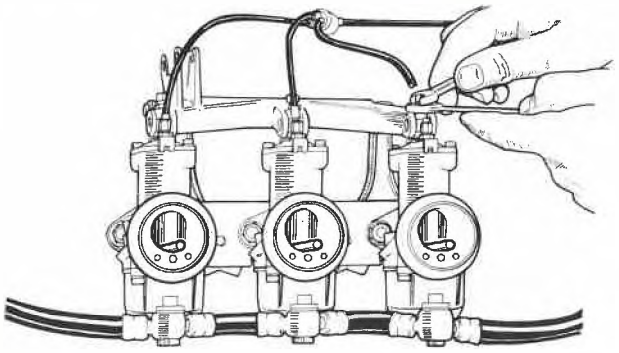


FIG. C.6. *Re-synchronization of throttle linkage.*

TRACING FAULTS

Faults likely to occur in carburation can be placed in one of two categories, either richness or weakness of petrol/air mixture.

Indications of Richness

Black smoke in exhaust.
Petrol spraying out of carburetter.
Four-strokes, eight-stroking.
Two-stroke, four-stroking.
Heavy lumpy running.
Sparking plugs sooty.

Indications of Weakness

Spitting back in carburetter.
Erratic slow-running.
Over-heating.
Engine goes better if throttle is amost closed.

Having established whether the mixture is too weak or too rich, check if caused by:—

(1) Petrol feed—check that the jets and passages are clear, that the filter gauze in float chamber "banjo" connection is not choked with foreign matter, and that there is ample flow of fuel. Also ensure there is no flooding.

(2) Air leaks—usually at the manifold joints or due to worn inlet valve stem and guide.

(3) Defective or worn parts—such as loose fitting throttle valve, worn needle jet, loose jets.

(4) Air cleaner choked up.

(5) Air cleaner having been removed.

(6) Removal of the silencers—this requires a richer setting.

Having verified the correctness of the fuel feed and that there are no air leaks, check over ignition, valve operation and timing. Now test to see if mixtures are rich or weak. This is done by partially closing the air valve, and if engine runs better, weakness is indicated, but if engine runs worse, richness is indicated.

To remedy proceed as follows.

Position 1. Fit smaller main jet.

Position 2. Screw out pilot air adjusting screw.

Position 3. Fit a throttle with a larger cutaway (see paragraph E, page C.9).

Position 4. Lower needle one or two grooves (see paragraph D, page C.9).

To Cure Weakness

Position 1. Fit larger main jet.

Position 2. Screw pilot air adjuster screw in.

Position 3. Fit a throttle with a smaller cutaway (see paragraph E, page C.9).

Position 4. Raise needle one or two grooves (see paragraph D, page C.9).

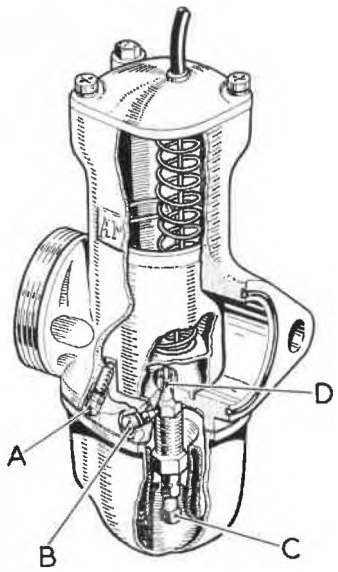


FIG. C.7. *Carburetter parts.*

Positions 1, 2, 3 and 4 refer to positions of throttle openings as shown in Fig. C.8, page C.10.

NOTE:—It is incorrect to attempt to cure a rich mixture at half-throttle by fitting a smaller jet because the main jet may be correct for power at full throttle. The correct method is to lower the throttle needle.

VARIABLE SETTINGS AND PARTS

The following paragraphs have reference letters for guidance and should be read in conjunction with the sectioned diagram (Fig. C.7) indicating the variable parts.

(A) **Throttle Adjusting Screw**

This screw is usually used for tick-over adjustments but these should be slackened right back as screw (*G*) Fig. C.9 on the inlet manifold takes care of this adjustment.

(B) **Pilot Air Adjusting Screw**

This screw regulates the strength of the pilot mixture for "idling" and for the initial opening of the throttle. The screw controls the depression on the pilot jet by metering the amount of air that mixes with the petrol.

(C) **Main Jet**

The main jet controls the petrol supply when the throttle is more than three-quarters open, but at smaller throttle openings although the supply of fuel goes through the main jet, the amount is diminished by the metering effect of the needle in the needle jet.

Each jet is calibrated and numbered so that its exact discharge is known and two jets of the same number are alike. Never ream out a jet, get another of the right size. The bigger the number the bigger the jet.

To gain access to the main jet the float chamber must first be removed (two screws). The main jet can now be unscrewed from its holder in the mixing chamber base.

(D) **Needle and Needle Jet**

The needle is attached to the throttle valve and being tapered—either allows more or less petrol to pass through the needle jet as the throttle is opened or closed throughout the range, except when idling or nearly full throttle. The taper needle position in relation to the throttle opening can be set according to the mixture required by fixing it to the throttle valve with the jet needle clip in a certain groove, thus either raising or lowering it. Raising the needle richens the mixture and lowering it weakens the mixture at throttle openings from quarter- to three-quarters open.

(E) **Throttle Valve Cut-away**

The atmospheric side of the throttle is cut-away to influence the depression on the main fuel supply and thus gives a means of tuning between the pilot and needle jet range of throttle opening. The amount of cut-away is recorded by a number marked on the throttle valve. *Viz*: 626/3½ means throttle valve type 626 with No. 3½ cut-away; larger cut-aways, say 4 and 5, give weaker mixtures and 2 a richer mixture.

(F) **Tickler or Primer**

This is a small spring-loaded plunger, in the carburetter body. When pressed down on the float, the needle valve is allowed to open and so "flooding" is achieved. Flooding temporarily enriches the mixture until the level of the petrol subsides to normal.

TUNING THE CARBURETTER

Tune up in the following order.

Read remarks on pages C.7 and C.8 for each tuning device and get the motor going perfectly on a quiet road with a slight up-gradient so that on test the engine is pulling under load.

1st **Main jet** with the throttle in position 1 (Fig. C.8). If at full throttle the engine runs "heavily" the main jet is too large. If at full throttle, the engine seems to have better power when the throttle is eased off or the carburetter intake is slightly covered, then the main jet is too small.

With the correct sized main jet, the engine at full throttle should run easily and regularly with maximum power.

If testing for speed work, ensure that the main jet size is sufficient for mixture to be rich enough to maintain a cool engine. To verify this, examine the sparking plug after first taking a fast run, declutching and stopping the engine quickly. If the sparking plug has a cool appearance the mixture is correct; if sooty, the mixture is rich; if, however, there are signs of intense heat, the plug being very white in appearance the mixture is too weak and a larger main jet is necessary.

2nd **Pilot jet** (Fig. C.8) with the throttle in position 2 and 5. Screw down the pilot air screws on each carburetter, as far as they will go without strain, then unscrew them in an anti-clockwise direction approximately one full turn each. Start the engine and loosen the throttle lever adjuster screw (*C*) Fig. C.9, until the engine runs slower and just begins to falter. Now screw the pilot air screws in or out exactly the same amount each, to obtain a regular and faster engine tick-over. Continue by screwing out the throttle lever adjuster until the closing of the throttle valves makes the engine begin to falter and run slower, then again adjust the pilot air screws to obtain a slow even tick-over. If, after this second adjustment, the engine is still running too fast, carry out the same procedure a third time.

After adjustment of the pilot air screw and throttle lever, test that the engine responds when the throttle is opened fairly quickly. If the engine falters or cuts-out, this indicates that the engine "pick-up" is too slow, resulting from an over-weak pilot mixture.

Use the cable adjuster (*H*) Fig. C.9, to take up any slack in the cable.

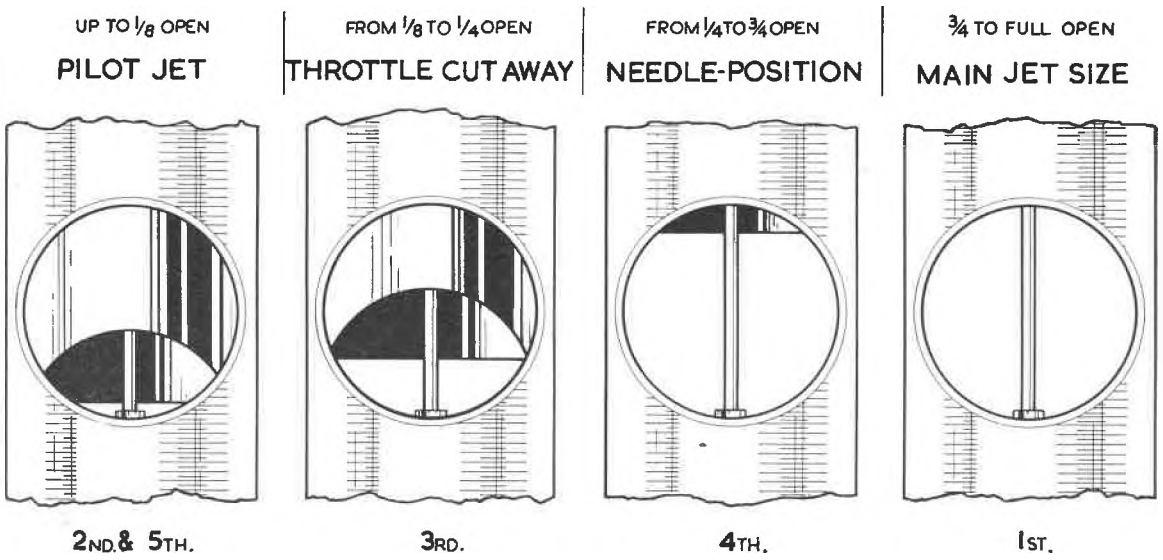


FIG. C.8. *Sequence of tuning.*

NOTE:—The adjuster nuts (*J*) see Fig. C.9, on the individual throttle valve rods are preset at the works. If they are disturbed (as they have to be if work is to be done on the throttle slide and needle) they will have to be accurately re-synchronized (see page C.7).

3rd **Throttle cut-away,** with throttle in position 3 Fig. C.8. If, as you take off from the idling position, there is an objectionable spitting from the carburetter, slightly richen the pilot mixture by unscrewing in the air screw. If this is not effective, screw it back again, and fit a throttle with a smaller cut-away. If the engine jerks under load at this throttle position and there is no spitting, either the jet needle is much too high or a larger throttle cut-away is required to cure richness.

4th **Needle** with the throttle in position 4 (Fig. C.8). The needle controls a wide range of throttle opening and also the acceleration. Try the needle in as low a position as possible, *viz*: with clip in a groove as near the top as possible; if acceleration is poor and with the air valves partially closed the results are better, raise the needle by two notches; if very much better, try lowering the needle by one groove and leave it where it is best. If mixture is still too rich with the clip in groove No. 1 nearest the top, the needle jet probably wants replacement because of wear. If the needle itself has had several years use replace it also.

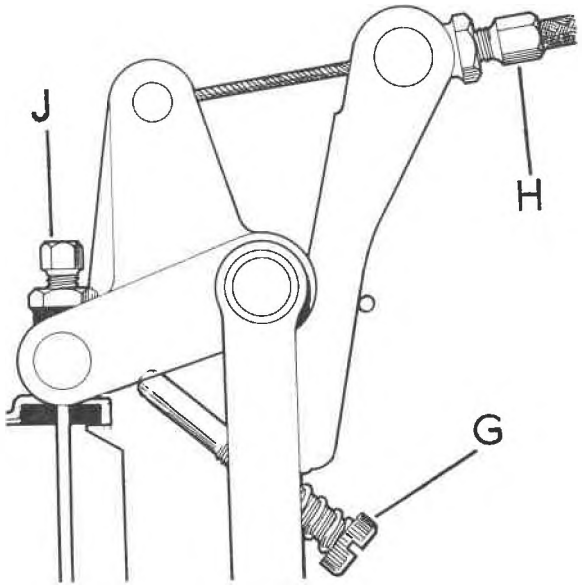


FIG. C.9. *Throttle lever assembly.*

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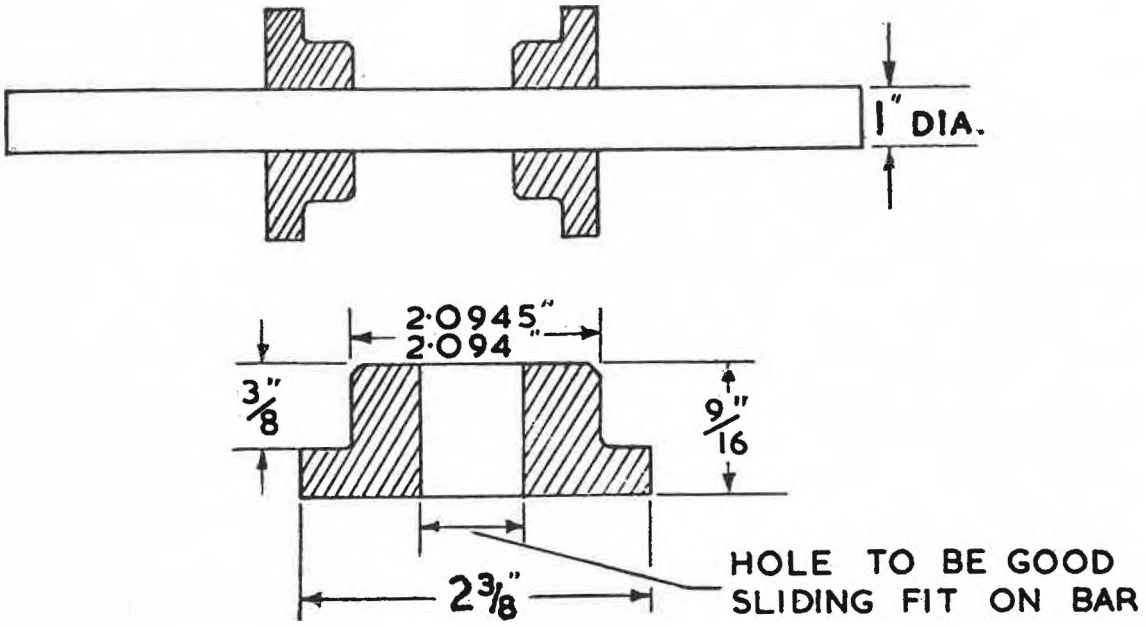


FIG. D.1. *Steering head mandrel.*

One off mild steel bar.

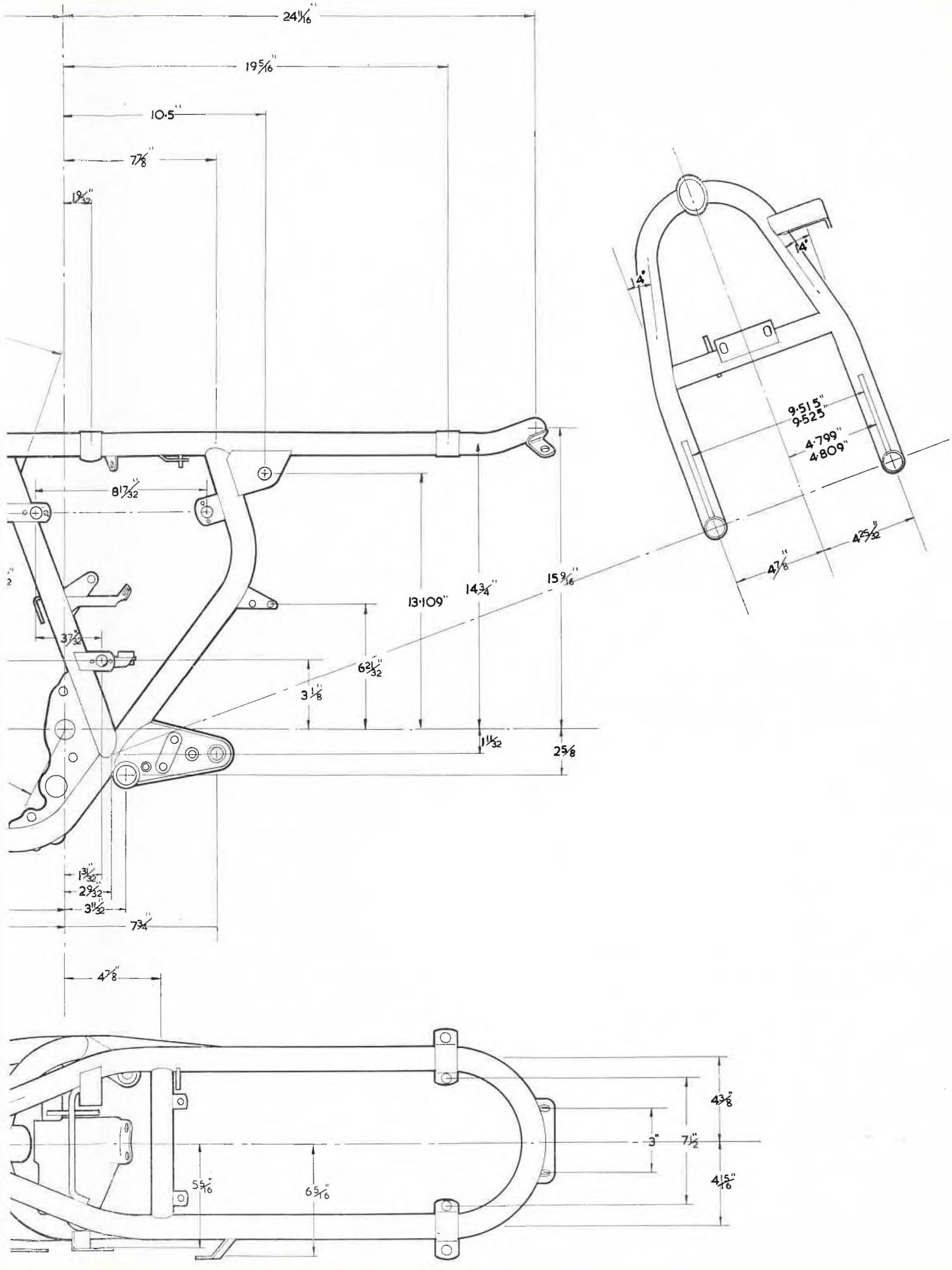
24"×1" to suit blocks.

Two off mild steel blocks.

The only satisfactory way of checking the frame for alignment is an engineer's setting-out table. The drawings on pages D.3 and D.5 will help in checking the basic dimensions.

In addition to the table which should be approximately 6 ft.×4 ft. the following equipment will also be necessary.

One mandrel and two blocks as in Fig. D.1.
One mandrel or bar for swinging arm pivot 13/16" diameter × 12" long.
One large set-square.
One 18" Vernier height gauge or large scribing block.
One pair of large V-blocks and several adjustable height jacks.


24 11/16"
19 5/16"
10.5"
7 7/8"
1 9/32"
8 17/32"
3 7/32"
6 21/32"
3 1/8"
13.109"
14 3/4"
15 9/16"
1 1/32"
2 5/8"
1 3/32"
2 9/32"
3 11/32"
7 3/4"
4 7/8"
14°
14°
9.515"
9.525"
4.799"
4.809"
4 25/32"
4 7/8"
5 5/16"
6 5/16"
3"
7 1/2"
4 3/8"
4 15/16"

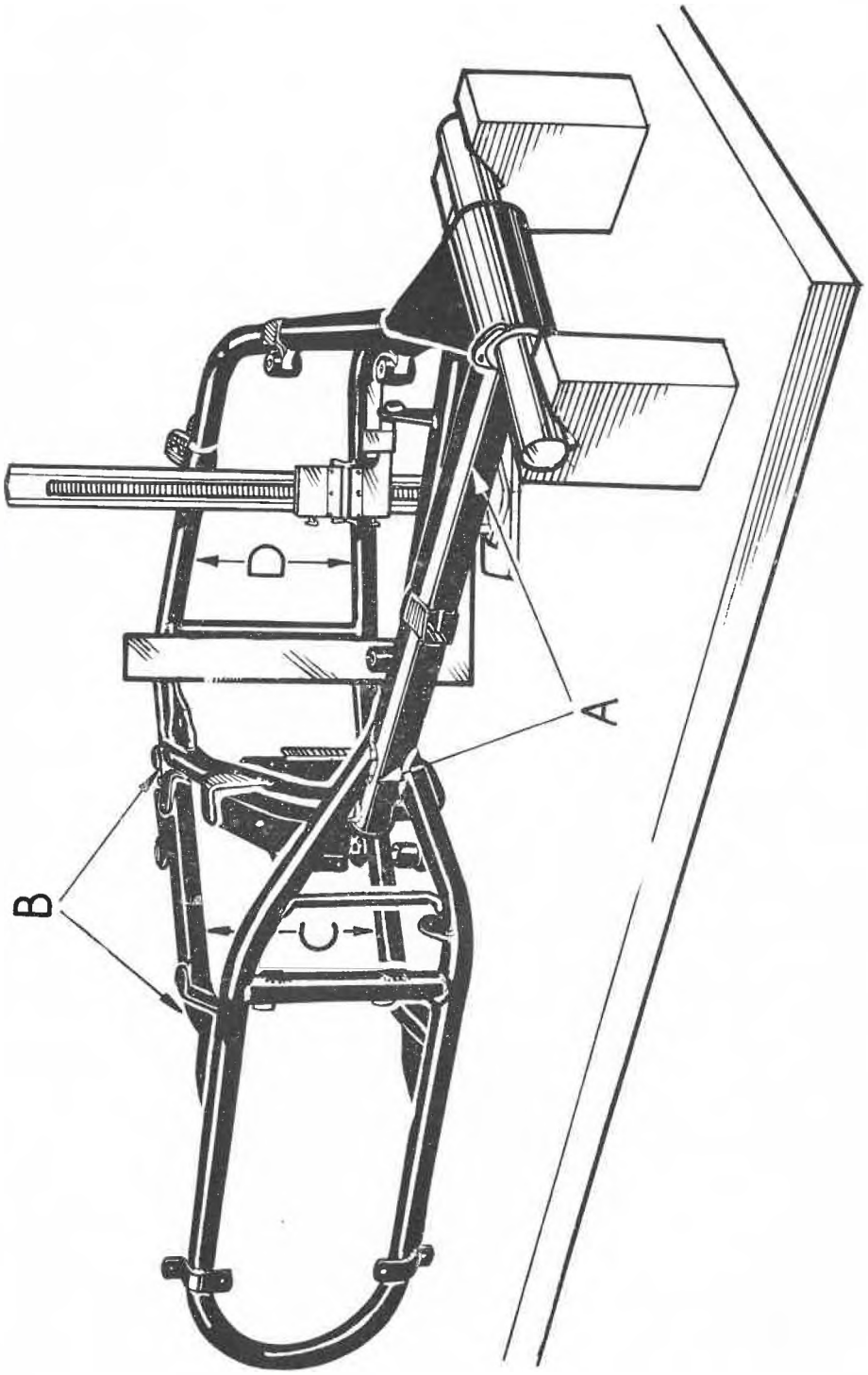


FIG. D.3. *Setting up the frame.*

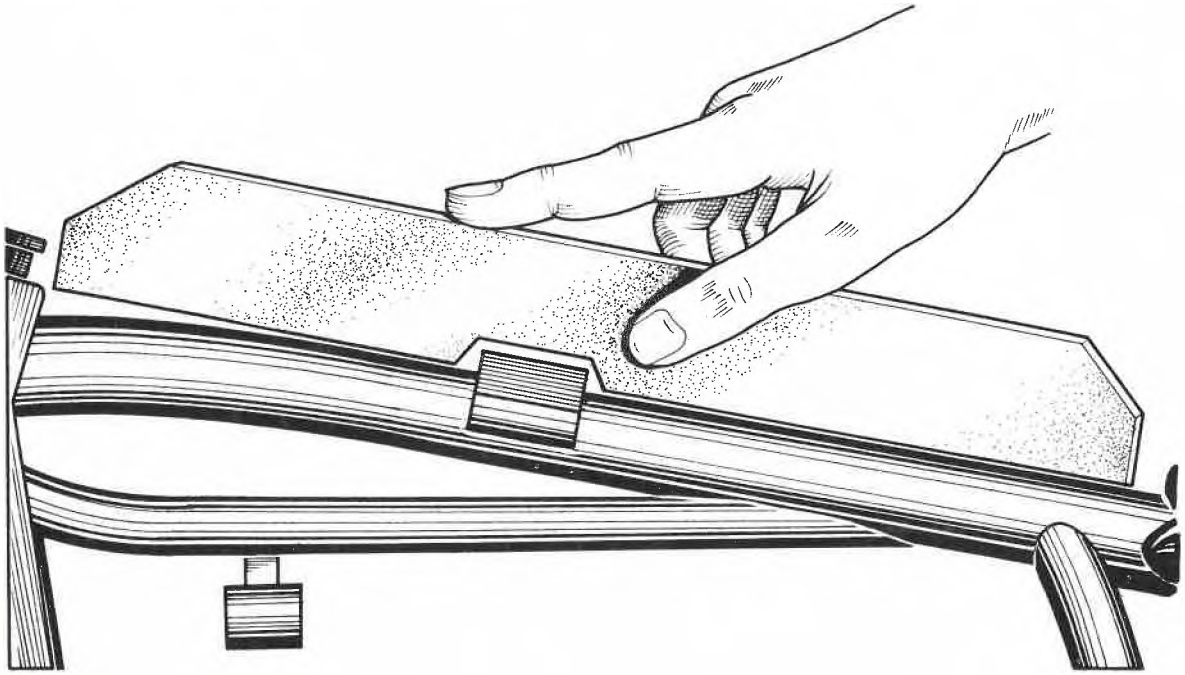


FIG. D.4. *Showing bent top tube.*

FRAME ALIGNMENT

If a scribing block is used then an 18″ steel rule will also be required. The mandrels must be straight and round, otherwise measurements will be affected. The basic set-up for checking is shown in Fig. D.3, variations can of course be used according to facilities available.

Place the mandrel and blocks in the steering head and V-blocks, and position the blocks at one end of the setting-out table.

Check the mandrel at each end to ensure that it is parallel with the surface of the table.

Insert the 13/16″ diameter mandrel through the swinging arm pivot holes.

Using jacks or packing pieces set the frame horizontal to the table so that checks taken at point (*A*) are the same.

If the frame has suffered damage in an accident, it may not be possible to set points (*A*) parallel in which case points (*B*) can be used.

Sometimes if the machine has suffered a frontal impact, the main tube will be parallel at points (*A*) but will be bent as shown in Fig. D.4. The straight-edge can be made quite easily from say, a piece of good quality hardboard but the checking edge must be quite straight.

When set parallel to the surface table, the mandrel through the swinging arm pivot holes should be vertical in all directions, this can be checked using the set-square and internal calipers or a slip gauge between the mandrel and the square.

The set-square should touch the upper and lower tubes together at points (*C*) and (*D*) if the frame is true and correctly set-up on the table.

To find the frame centre line take the height of the main tube and subtract half the diameter of the tube, checks can then be taken of the engine mounting lugs and other points of the frame.

Errors at any point should not exceed $\frac{1}{32}$" (·75 mm.).

CHAINGUARD

The chainguard is held by one bolt through a bracket on the swinging arm and a screw into a captive nut on the chainguard front. It is held at the rear end by a bracket, which is held by the bottom rear suspension unit nut and bolt.

After these two bolts have been removed, withdraw the chainguard out from the rear of the machine.

Replacement is simply the reversal of the removal procedure.

SWINGING ARM REMOVAL

If the engine is in the frame the left-hand rear engine and footrest mounting plate will have to be removed to allow access to the swinging arm spindle.

Remove the 13/16" U.N.F. nut and star washer from the right-hand side of the spindle and unscrew the nut and bolt from the location plate, on the left-hand end of the spindle.

Remove the chainguard as described above.

Take off the chain from the chainwheel after disconnecting the spring link.

Remove the rear wheel and chainwheel as covered on page F.4.

Remove the rear suspension units as detailed on page D.8.

Now draw out the spindle from the left-hand side of the machine.

If the spindle has corroded use a drift not more than ·805" diameter to drive the spindle out.

The swinging arm fork is now ready to be removed, using a raw-hide mallet, gently tap the left-hand side downwards and the right-hand side upwards to release it from the plates.

Replacement is simply the reversal of removal procedure, but do not forget to fit the thrust washers and dust caps on both sides of the swinging arm. Also coat the spindle with grease before inserting it into the bushes.

To check the swinging fork, the bushes must be in good condition or, be renewed.

Using the same mandrel that was used for the swinging arm pivot on the frame, and the rear wheel spindle, set the swinging arm in V-blocks as shown in Fig. D.6. In this position both the spindle and mandrel should be parallel to the surface table.

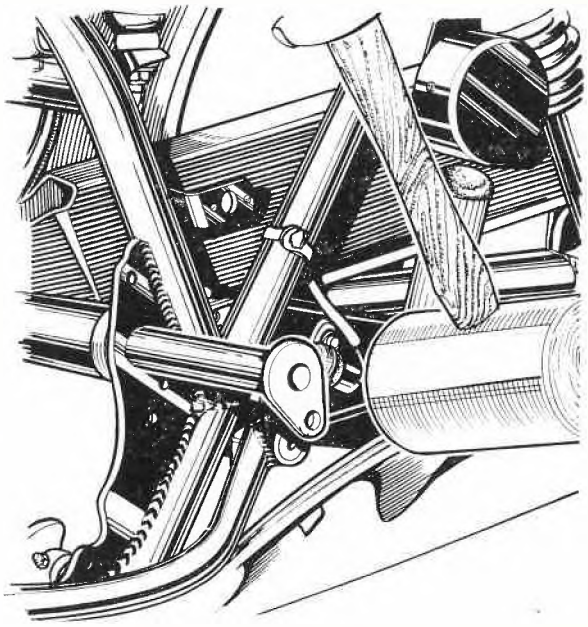


FIG. D.5. *Replacing swinging arm spindle.*

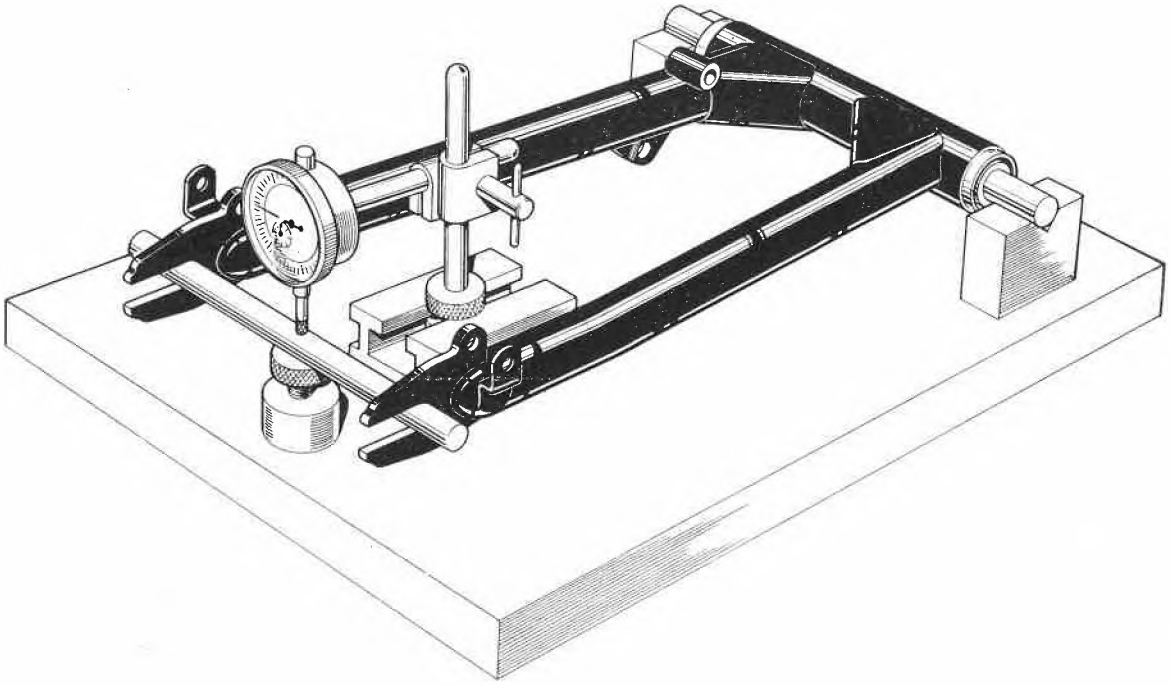


FIG. D.6. *Checking the swinging arm fork.*

Should there be less than ¼″ in malalignment of the swinging arm fork it is permissible to correct it by means of a suitable lever but, great care is necessary if further damage is to be avoided.

To check that the forks are square to the pivot they must be set up at 90° to the position illustrated, that is the pivot must be vertical.

Next find the centre of the pivot and check the fork ends etc., in accordance with the drawing dimensions (see Fig. D.7).

There may also be variations in the rear dampers and a careful examination should be made of the overall length between the mounting eyes. It is possible that one damper may be weaker than the other, this may be due to "settling" of one spring in which case it is advisable to renew both springs.

When there is considerable malalignment in either frame or swinging arm, owners in the British Isles can obtain works-reconditioned units through the dealer network.

REAR SHOCK ABSORBERS

The rear shock absorbers are the coil spring type, hydraulically damped, with bonded rubber mounting bushes at each end. The only dismantling possible is for the removal and replacement of the springs.

To remove the dampers take out the upper and lower mounting bolts after placing a suitable block of wood between the rear tyre and the mudguard.

Take careful note of the positions of the spacers and washers used with the top mounting.

If the springs are to be changed the spring must first be compressed with service tool No. 61–3503 and the split collets removed, the tool is then removed, the spring changed and a new spring compressed to replace the split collets.

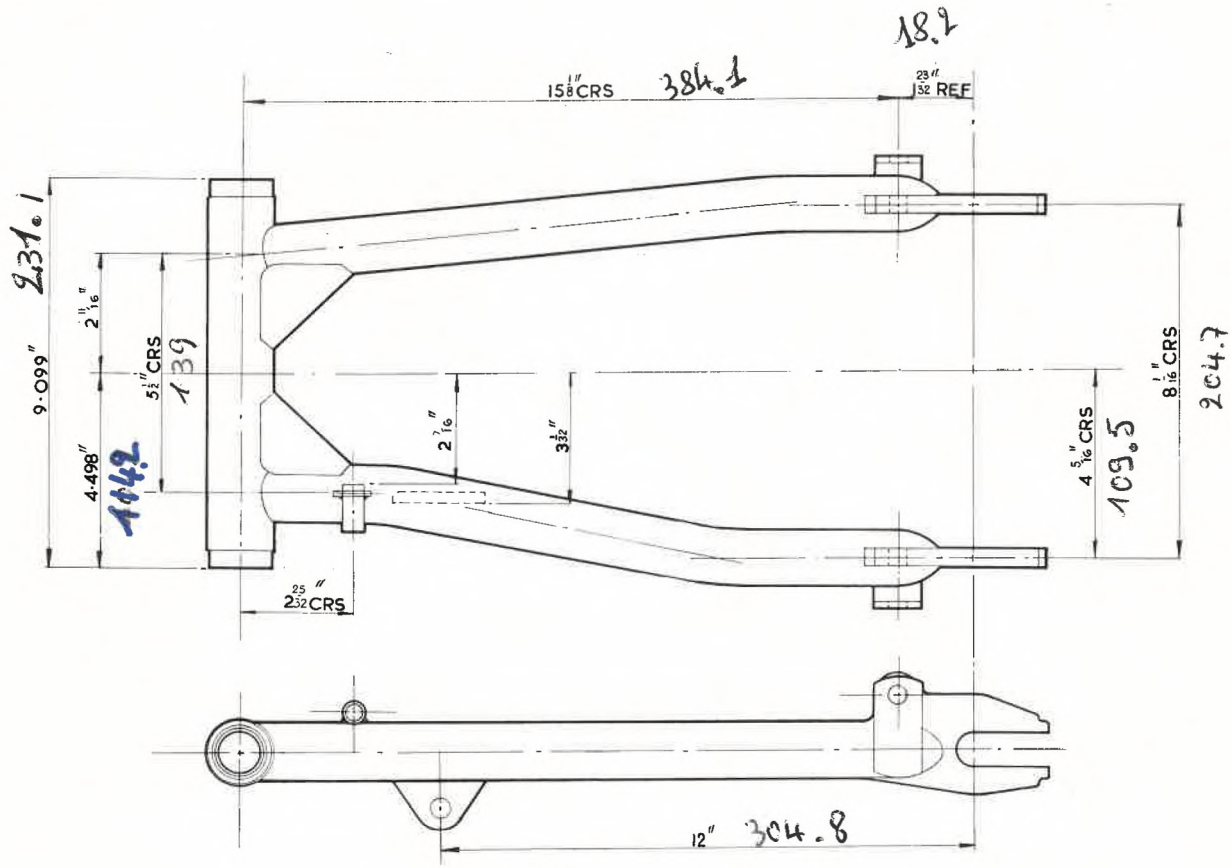


FIG. D.7. *Swinging arm fork dimensions.*

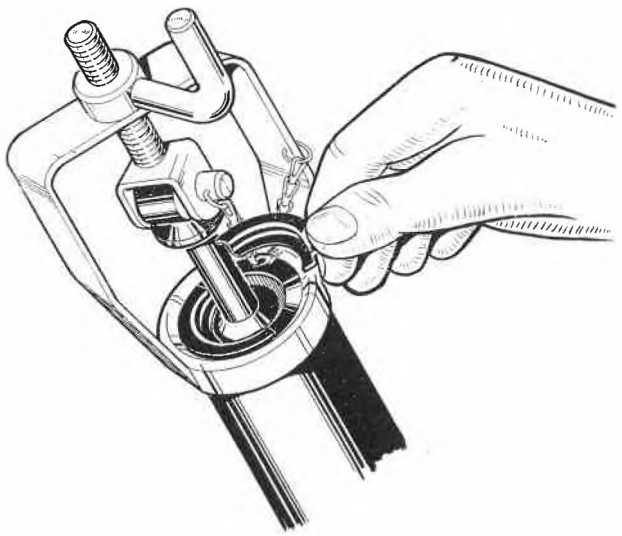


FIG. D.8. *Using tool No.* 61–3503.

The dampers have three load positions: light, medium and heavy, and they should be in the "light-load" position before dismantling.

The mounting bushes at each end can be driven out quite easily, and new ones fitted if a little liquid soap is used to assist.

Do not lubricate the plunger rod.

SWINGING ARM BUSHES

The bushes fitted to the swinging arm fork take the form of two thin split bushes. On the outside of the swinging arm there are two thrust washers. Through the centre of these passes a spacer tube with a dust cap fitted at each end.

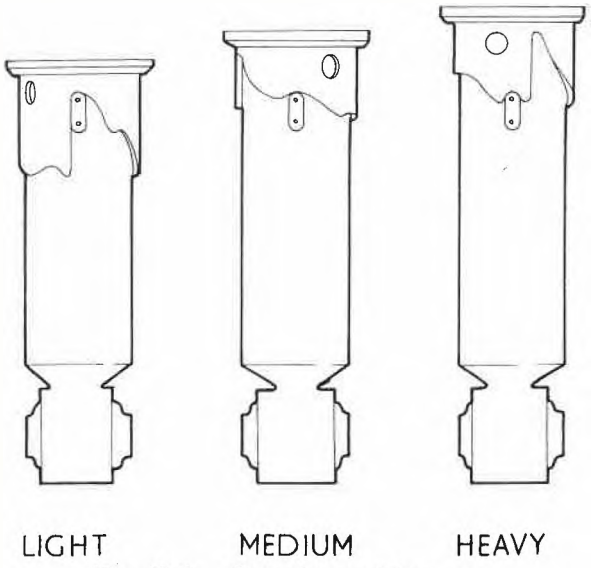


FIG. D.9. *Cam ring positions.*

When the swinging arm is assembled in the frame with the spindle tightened, the frame plates clamp up to the dust caps which in turn clamp the spacer tube.

The thrust washers take up the side play in the fork.

Under normal circumstances and if the bushes are greased regularly they should last for a long time. If they do require renewal, the easiest way

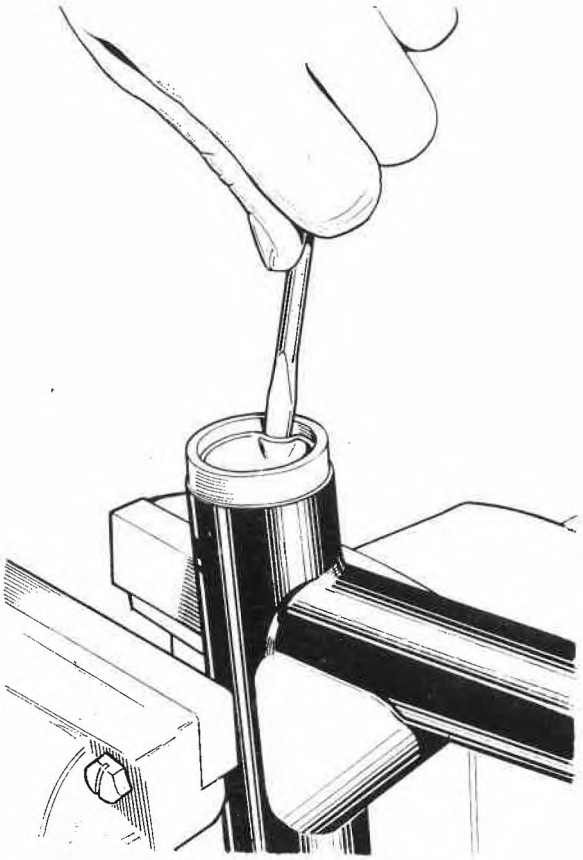


FIG. D.10. *Removing swinging arm bushes.*

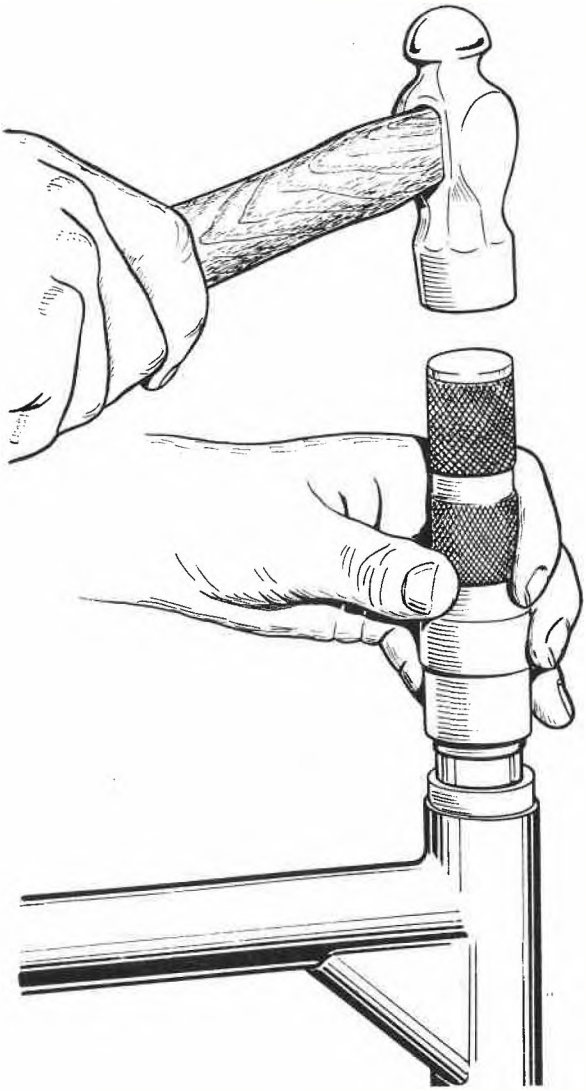


FIG. D.11. *Replacing swinging arm bushes.*

to remove the old ones is to collapse them by inserting a sharp tool such as a strong screwdriver near to the split and prise them out.

New bushes can be driven into the swinging arm with service tool No. 61–6050.

Whenever the swinging arm bushes are being changed, the thrust washers should be replaced also.

SWINGING ARM SIDE PLAY

There should be no detectable side play in the swinging arm fork, if there is, the thrust washers should be renewed.

DUALSEAT

The dualseat is retained in position by two nuts and washers on studs underneath the seat at each side of the rear mudguard. The seat sits on four rubber pads. To remove take off the nuts and washers, then unhook the seat at the front.

Replacement is the reversal of this procedure.

SIDECOVERS

The sidecovers are made of steel and are held at three points on each side.

The left-hand sidecover is held by three special fasteners and it is only necessary to give the fasteners a half-turn to release or to lock them.

The right-hand sidecover is held by three screws which screw into the oil tank pommels. The cover also has cooling windows for the oil tank.

SIDECOVER FASTENERS

The fastener bolts in the left-hand cover are known as "Oddie" studs and are retained in the cover by rubber bushes. If at any time it is necessary to replace a stud, simply press the old one out, place a new bush in over the hole and press the new stud into position using a little liquid soap as a lubricant.

The fasteners on the frame brackets are known as "Oddie" clips and are retained in position by ⅛" Whitworth bolts and nuts.

REAR MUDGUARD

Remove the dualseat as described and disconnect the rear light cables (brown and brown/green) at their snap connectors under the seat.

Take out the rear wheel as described on page F.4.

Take out the two nuts and bolts at the front of the mudguard, where it meets the frame cross-member, the two nuts and bolts securing the mudguard to the bridge piece and the two nuts and bolts through the bracket on the seat rail.

Replacement is simply the reversal of dismantling procedure.

BATTERY CARRIER AND TOOLBOX

The battery carrier is retained on its platform by three special $\frac{5}{16}$" U.N.F. bolts and nuts, with two rubber spacers to each bolt.

To remove, take off the left-hand sidecover as described earlier. Remove the large rubber engine breather tube and unhook the strap securing the battery. Also remove the battery tray to reveal the three bolt heads.

Take out the three bolts noting the position of the rubber spacers and washers.

To take off the toolbox it is simply a matter of removing two bolts and washers at the top of the toolbox, after first removing the dualseat,

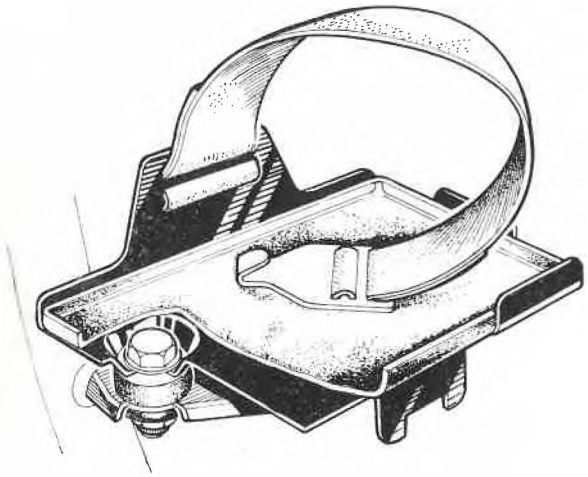


FIG. D.12. *Battery carrier.*

then the horn relay which is held by two nuts and bolts, also the rectifier should be removed to save damage. Take a careful note of the cable connections.

Replacement of the battery carrier and toolbox is simply the reversal of the removal procedure.

See page G.11 for rectifier fitting instructions.

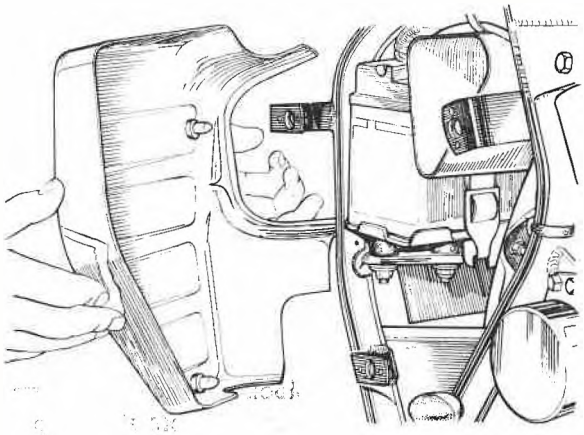


FIG. D.13. *Removing sidecover.*

OIL TANK

Unscrew the tank filter plug and allow the oil to drain into a suitable recptacle, taking care not to lose the large fibre washer. Whilst waiting for the oil to drain, remove the seat as described on page D.10. Undo the small fixing clip and detach the oil return pipe from its connection on the top of the tank. Disconnect the feed pipe underneath the tank, after loosening the clip.

One bolt and one stud secure the tank to the dualseat support rail. Each clip is fitted with a rubber sleeve which should be left in place, unless in need of renewal. The tank is secured at its base by a bolt that passes upwards through a bracket on the frame, and into the tank. This bolt also has a rubber sleeve fitted in the hole in the frame bracket.

After removing the bolts disconnect the chain oiler pipe and tank breather. The tank can now be withdrawn.

The tank can be replaced in the reverse manner but a thorough check must be made of the oil pipe connections to ensure that there is no oil leakage. If the mounting rubbers have become saturated with oil, it is advisable to renew them.

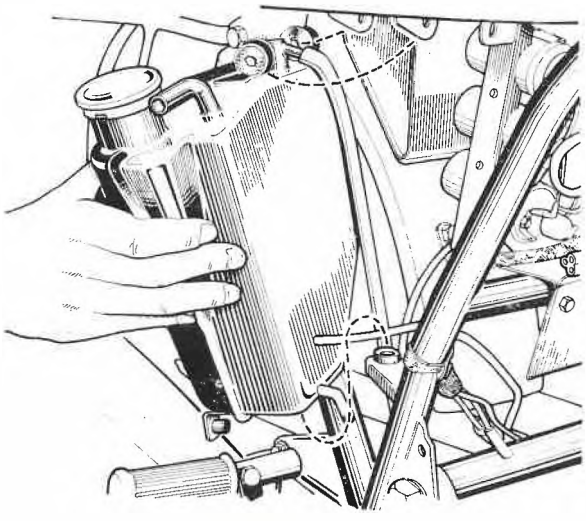


FIG. D.14. *Removing oil tank.*

PROP STAND

The prop stand is secured to the frame lug with one bolt.

To remove, unscrew the bolt. The return spring will be released as the stand is drawn off the frame lug.

CENTRE STAND

The centre stand spindle is in three pieces, it comprises of two half-spindles threaded at one end, and a centre spacer (see Fig. D.15). To remove take out the cotter pin in the ends of both half-spindles and remove the springs and washers.

It will be noted that each spindle has flats machined on them next to the threaded portion

Flats are also machined on the centre spacer.

Now with spanners on these flats, unscrew the two spindles out of the centre spacer. The spindles can now be pushed through towards the centre of the frame releasing the stand.

Replacement is the reverse of removal.

On later models there are two locknuts fitted on the two half spindles next to the centre spacer. This new arrangement can be fitted to the earlier centre stand.

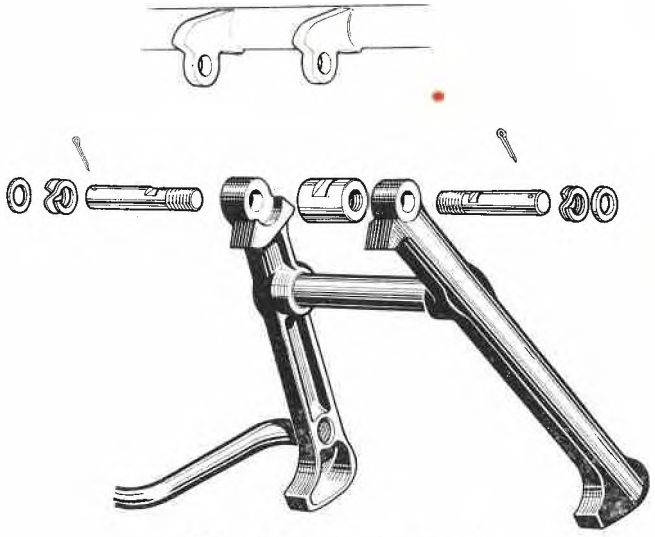


FIG. D.15. *Centre stand.*

CENTRE STAND SPRING

The simplest way to replace the centre stand spring is to use a Phillips-type screwdriver. Place the eye of the spring over the frame anchorage, insert the screwdriver in the other eye, place the screwdriver slot under the hook on the stand and lever downwards to press the spring over the hook (see Fig. D.16).

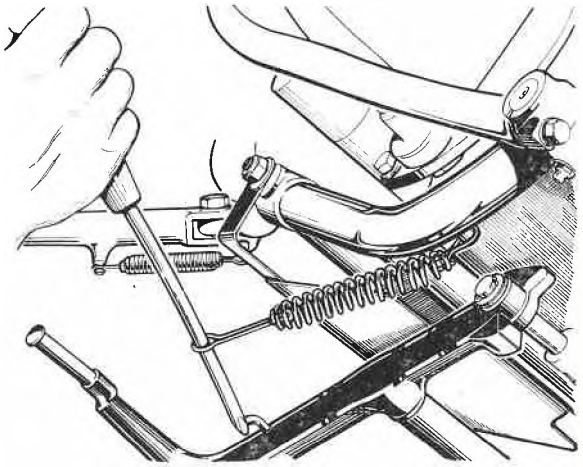


FIG. D.16. *Centre stand spring.*

OIL COOLER

The oil cooler assembly hangs from the frame top tube by a triangular bracket. The whole assembly is held by two rubber-mounted bolts.

To remove the oil cooler from the cradle take off the two styling panels, each held by three screws, these being two Phillips screws at their front edge and one cheesehead screw behind the panel at the rear corner.

Once these have been removed spread the cradle out slightly at the top and withdraw the oil cooler.

When rebuilding the oil cooler assembly in the reverse of removal, great care should be taken not to displace the rubber corner pads, if any of

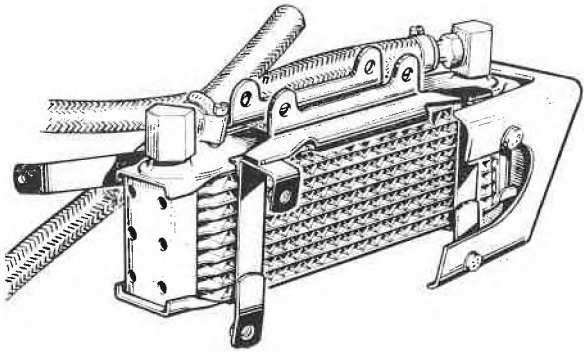


FIG. D.17. *Oil cooler assembly.*

these rubbers fall off the cradle, they should be glued back on with "Evostick" or any equivalent adhesive (see Fig. D.17 for correct reassembly).

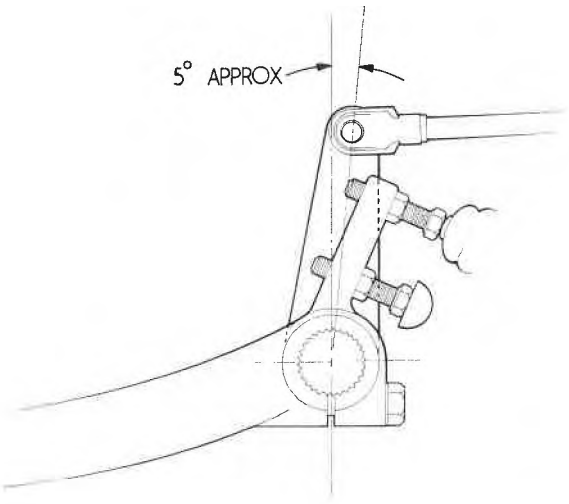


FIG. D.18. *Lever position.*

REAR BRAKE PEDAL

To remove the rear brake pedal unscrew the single bolt at the back of the pedal. The pedal can now be withdrawn from its splined shaft.

If the operating shaft is to be removed, take off the brake rod spring pin and slide the operating shaft out of its hole.

When refitting the rear brake pedal it is important to set the brake operating shaft in the correct position before fitting the pedal (see Fig. D.18) for position.

After setting the shaft in its correct position fit the pedal back on the splines in the fully off position.

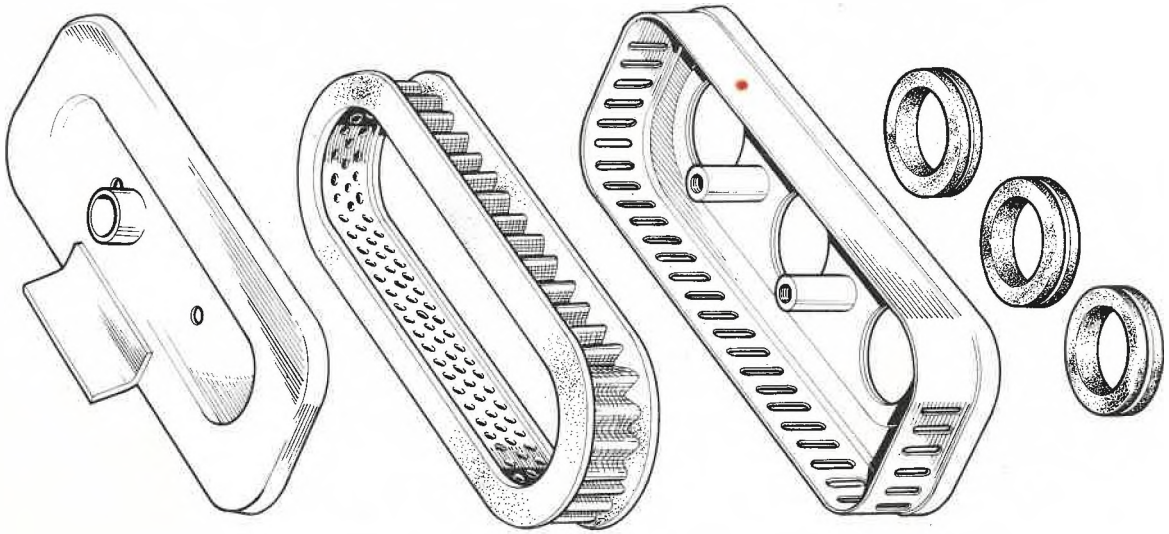


FIG. D.19. *Air cleaner.*

Adjust the stop screw until it is just bearing on the stop. Also adjust the stop-light screw until it compresses the switch button.

Before riding the machine the rear brake adjustment must be checked and adjusted if necessary, using the wing-nut on the brake rod.

AIR CLEANER

The air cleaner comprises of a frontal box, this is simply a plate with three holes with a large rubber grommet in each, these in turn fit over the carburetter air intakes, fitted around the outside of the plate is a slotted support band.

The actual air cleaner element is fitted inside this box. The element is then retained by the air cleaner cover, this is held in position by two short screws, which pass through the cover, and screw into two long nuts welded to the inside of the air cleaner box. On the cover there is a breather stub this is positioned slightly left of centre. Fixed on to this is a breather pipe the other end of which pushes on to the main engine breather stub.

To replace an air cleaner element it will not be necessary to remove the whole air cleaner assembly. All that is necessary is to remove the breather pipe, unscrew the two screws at the cover and withdraw the element. The element is of the dry surgical gauze type, and can therefore be washed in clean gasoline and allowed to dry. If, however, the element can not be washed because of too much dirt a new element must be fitted.

To remove the complete air cleaner assembly, take out the two long bolts from the front of the inlet manifold.

THROTTLE CABLE REPLACEMENT

Throttle cable replacement is an operation which the private owner should practice once or twice so that in the event of a cable failure on the road, the replacement can be quickly carried out.

It is also good practice to carry spare throttle and air cables taped to the existing cables.

First turn the twist grip to open the throttle, then release it, and at the same time pull the cable out of its register in the grip, finally slide the cable out at the slotted grip body.

Now remove the two slotted screws from the twist grip control and take off the top half to expose the cable nipple.

Ease the nipple out of the grip and remove the cable.

Fit the replacement cable to twist grip, by locating the nipple in its register, but do not slide the cable into the slot.

Replace the grip on to the handlebar and tighten the screws evenly, now ensure that the grip turns freely.

Remove the petrol tank as described on page B.8.

Pull the cable from the frame clips and unscrew the cable adjuster from its stop on the inlet manifold.

Turn the cable upwards slightly and slide the nipple from its register.

Fit the new cable in the reverse manner but ensure that the long end of the nipple is fitted towards the centre of the machine.

Secure the cable to the frame, replace the cable into its register in the grip, and adjust the cable as necessary by means of the adjuster on the cable at the inlet manifold.

Finally, check the action of the controls before starting the machine.

AIR CONTROL CABLE

To replace an air control cable, first open the control to its fullest extent, then close it pulling the cable out of the body, at the same time releasing the cable nipple.

Remove the petrol tank and dualseat as described on pages D.11 and B.8, this will expose junction box under the seat. It is then only necessary to unscrew the one cap off the junction box to expose the cable nipple.

If any of the three shorter air cables are in need of replacement it must be noted that each one is a different length. The long one connects the left-hand carburetter, the medium length one connects the centre carburetter and the short one goes to the right-hand carburetter.

To remove the cables take out the two Phillips screws from the top of each carburetter and withdraw the slide assembly (see page C.4).

Now pull the air slide out of the throttle valve and compress the spring to release the cable nipple. Next remove the cap on the other end of the junction box to expose the three cable nipples.

Replacement is the reverse of removal but when adjusting the cables it must be done very accurately, as carburetter synchronization is very important on an engine of more than one cylinder (see page C.7 for synchronization of throttle rods).

FRONT BRAKE CABLE

To remove the front brake cable, unclip the brake cable spring pin from the brake lever at the brake anchor plates and slip the cable end out of its register on the anchor plate.

Now turn the adjuster on the handlebars until the slots correspond with the slot in the lever body and remove cable. Replacement is the reverse of removal but adjustment must be checked before the machine is ridden.

CLUTCH CABLE

To remove the clutch cable it is first necessary to take off the large inspection cover on the primary chaincase.

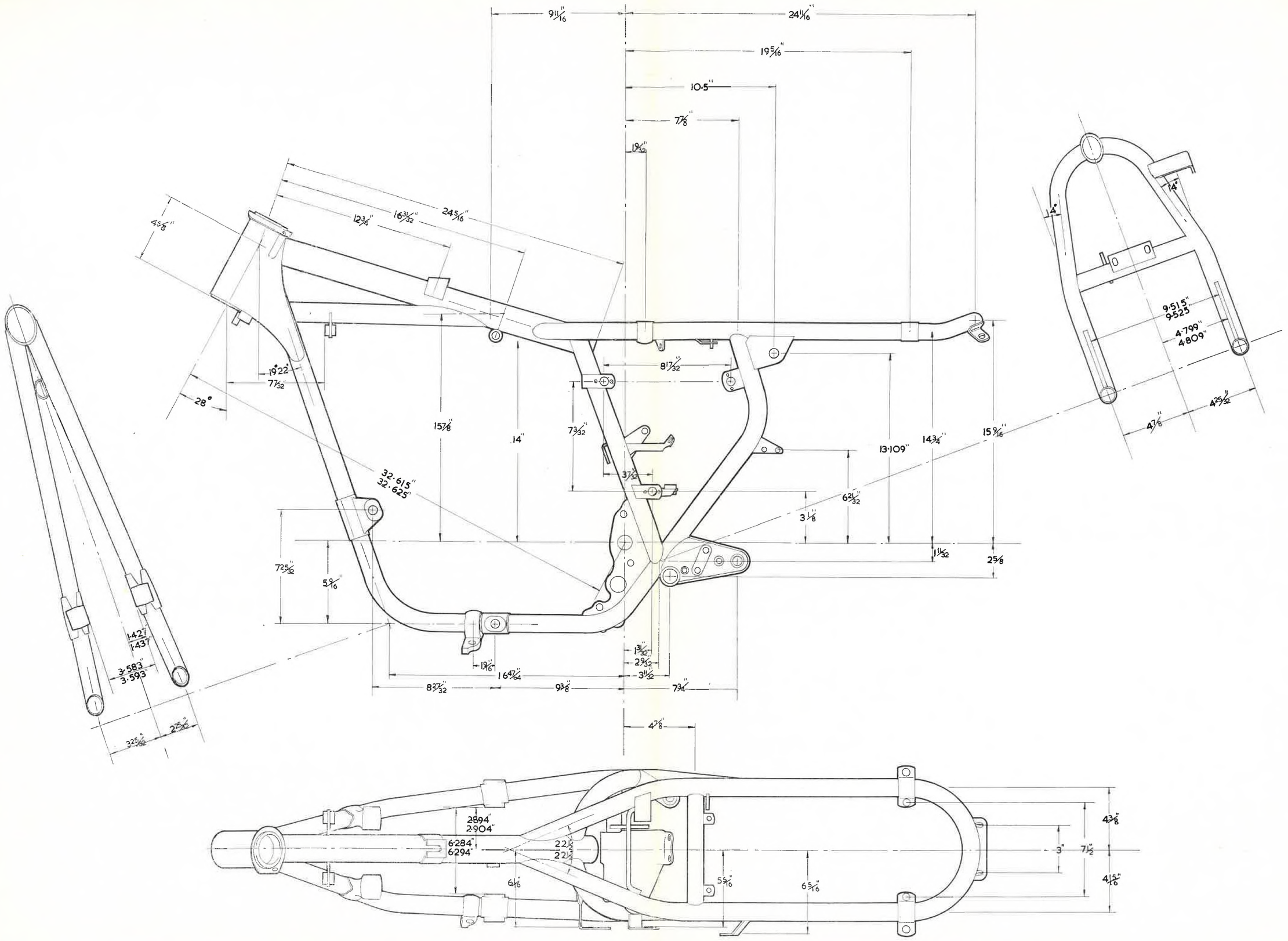
Slacken off both the adjusters on the handlebar lever and at the primary chaincase.

Pull the handlebar lever in, then release it, and at the same time pull the cable out of the adjuster.

Unhook the cable nipples from the handlebar lever and also the actuating lever at the clutch.

Ressembly is in the reverse manner but check for correct adjustment and operation before the machine is ridden.

Fig. D.2.
Frame Dimensions


9 11/16"
24 11/16"
19 5/16"
10.5"
7 7/8"
19/32"
45/8"
12 3/4"
16 31/32"
24 5/16"
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7 7/32"
28°
15 7/8"
14"
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8 17/32"
13.109"
14 3/4"
15 9/16"
32.615"
32.625"
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3.593"
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1 3/32"
2 9/32"
3 11/32"
1 19/64"
16 47/64"
8 27/32"
9 3/8"
7 3/4"
4 7/8"
2.894"
2.904"
6.284"
6.294"
22.2
22.3
6 1/16"
5 5/16"
6 5/16"
4 3/8"
3"
7 1/2"
4 15/16"
4"
1/4"
9.515"
9.525"
4.799"
4.809"
4 25/32"
4 7/8"

INDEX

DESCRIPTION

The telescopic hydraulically-controlled front forks require little attention other than an occasional check at the external nuts and bolts etc., and the routine oil changes given in the Lubrication Section.

ADJUSTING STEERING HEAD RACES

It is most important that the steering head races are correctly adjusted.

There should be no play evident between the races but great care must be taken not to over-tighten, the latter can indent the balls into the races and make steering extremely difficult and dangerous.

Place a strong support underneath the engine so that the front wheel is lifted clear of the ground, then standing in the front of the wheel, push and pull alternately on the lower fork legs to determine if there is any play in the steering head (Fig. E.2).

It should also be possible to move the forks from lock to lock quite smoothly and without any jerky movement. If the movement is jerky

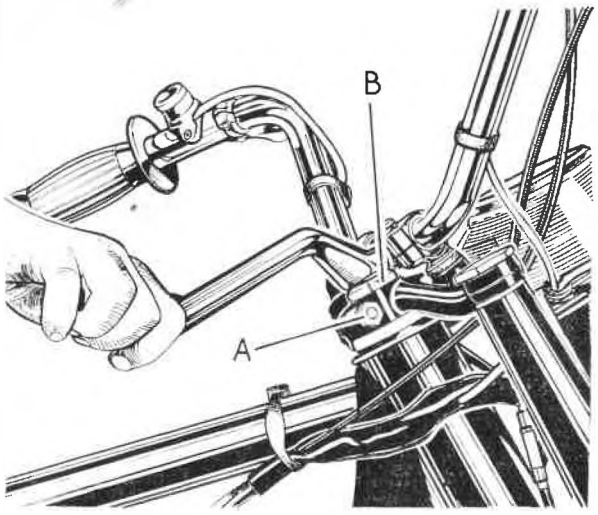


FIG. E.1. *Steering head adjustment.*

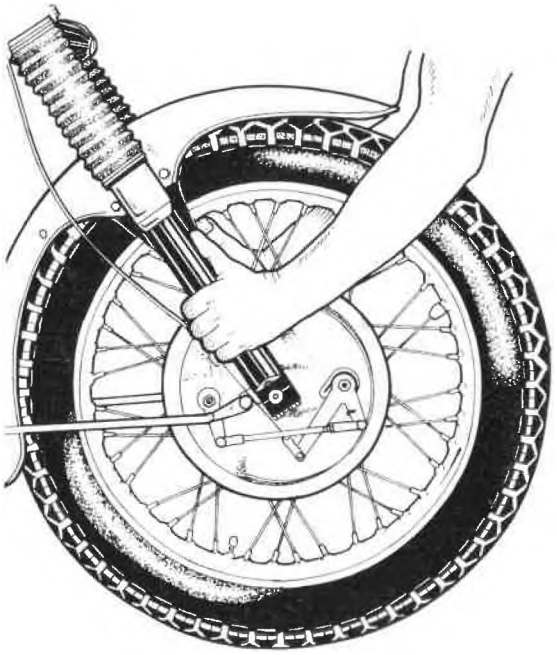


FIG. E.2. *Testing the steering head for play.*

the balls are indented into the races, or broken, in either case they and the cups and cones should be renewed. The steering damper must of course be completely free while testing.

To adjust the steering, remove the damper rod. Slacken off the pinch bolt (*A*) and the two bolts on the bottom yoke, and using a spanner, screw the nut (*B*) in (clockwise) to reduce steering play or out (anti-clockwise) to increase steering play (see Fig. E.1).

Having adjusted the steering, tighten the pinch bolts and the steering damper rod.

Care is necessary when testing for play to distinguish between play in the head races and play in the fork bushes. In some cases there may be both.

If possible get a friend to place the fingers of one hand lightly round the top head races whilst the forks are being pushed and pulled, if play is there, it will be felt quite easily by the fingers.

RENEWING HEAD RACES

The steering head can be dismantled to change the steering head races without stripping the forks but the lighting cables must be removed by pulling them from the sockets at the rear of the headlamp, the binnacle, the ignition switch, and the light switch. The two wires should also be disconnected from the front brake light switch.

As there are so many wires under the binnacle, it may be a good idea to label each one as it is disconnected.

Disconnect the front brake cable from the handlebar lever, and remove the damper rod.

Slacken the pinch bolt (*A*), and remove the adjuster nut (*B*) Fig. E.3. Unscrew and remove top caps (*C*) with service tool No. 60–779.

Using a raw-hide mallet strike the sides of the top yoke alternately to release it from the tapered legs. Now place a piece of cloth over the petrol tank and lay the handlebars and top yoke on it. Draw the steering column down and out of the head, but be careful to catch the bearings which will be released as the column is withdrawn.

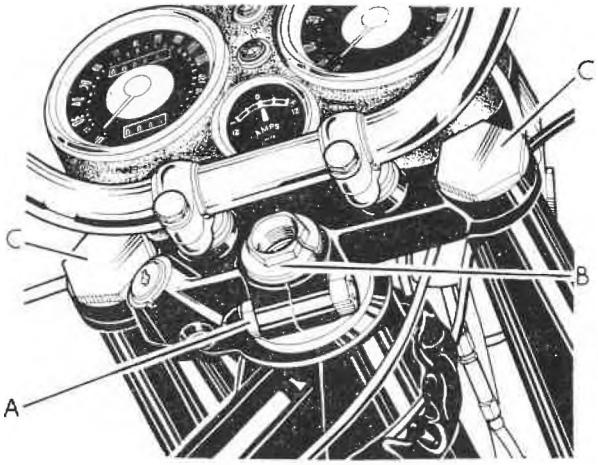


FIG. E.3. *Top yoke.*

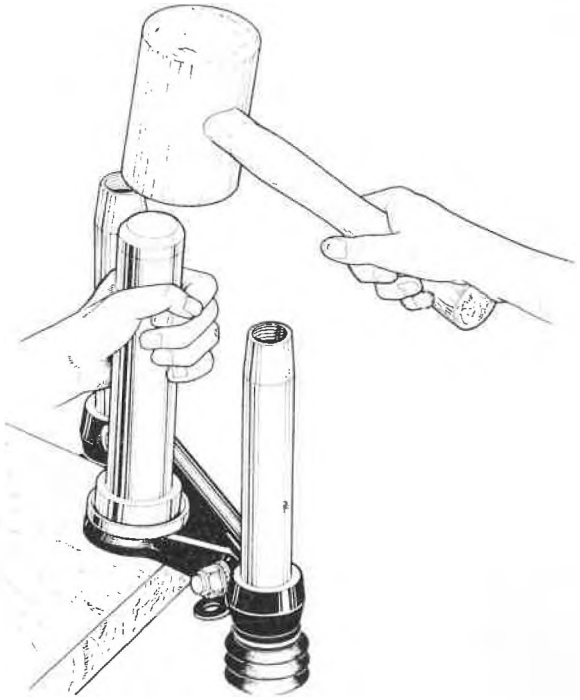


FIG. E.4. *Replacing bottom cone using service tool No.* 61–6009.

There should be 20, ¼" diameter, steel balls in each race. See page A.5 regarding lubrication.

The two cones differ slightly in that the top cone has a dust cap pressed over it and the bottom cone has not. The cups are identical to each other.

The lower cone can be prised off the column, but care is necessary when fitting the replacement.

For this purpose the use of service tool No. 60–2218 is recommended, this is simply a steel tube which is slipped over the steering stem and used for driving the cone on to the seat squarely and firmly (see Fig. E.4) make sure that the dust cover is correctly fitted under the cone.

To remove the two cups, place a suitable drift through the head tube until it rests against the back of the cup, now working round the cup gently drive it out (see Fig. E.5).

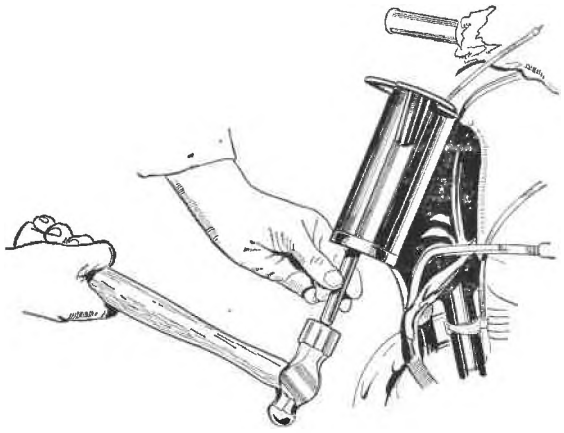


FIG. E.5. *Removing top cup.*

When replacing the new cups see that they enter the housing squarely and be very careful to avoid cracking the cup. If possible use a piece of steel bar or tube slightly less than the outside diameter of the cup. Do not drive the cup in with a drift resting in the radius of the ballrace, this will impose undue strain and is liable to fracture the cup. A suitable drift would be as Fig. E.6.

REASSEMBLING THE STEERING HEAD

After replacing the cups and bottom cone, grease the cups, assemble 20 balls in each cup then slide the column back into the head. Replace the top cone and dust cover then the top yoke and screw in the adjuster nut. Adjust as quoted on page E.2, and complete the assembly in the reverse order to that used for dismantling. It may be found necessary to remove the headlamp to make it easier to complete the job of connecting all the cable leads. If any difficulty is found in determining which wire goes to certain connections, refer to the wiring diagram on page G.23.

REMOVING THE HEADLAMP

Take out the two chromed bolts and washers securing the headlamp to the fork cover. Pull the headlamp away and disconnect the wires at the rear of the headlamp.

REMOVING THE BINNACLE

The binnacle is secured by four nuts and washers, and can only be removed after the headlamp has been taken off.

Unscrew the nuts and remove binnacle. Disconnect the speedometer and tachometer cables by unscrewing the nuts at the instrument heads, and withdrawing the inner wire. Now unplug all the cable leads, and the light leads from the warning lights and instrument heads. Replacement is in the reverse order but check to see that the wiring is correct.

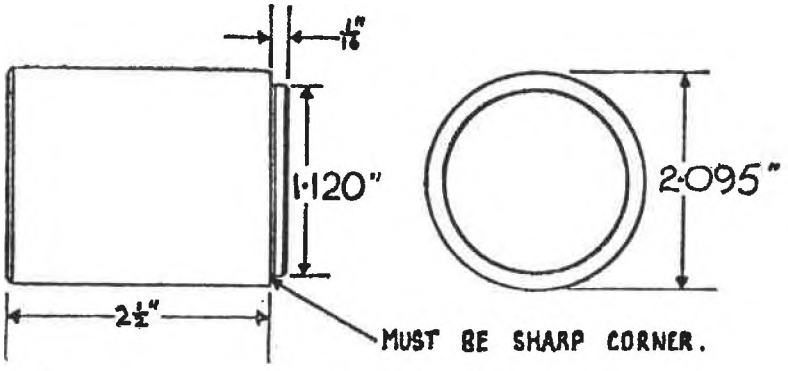


FIG. E.6. *Cup drift.*

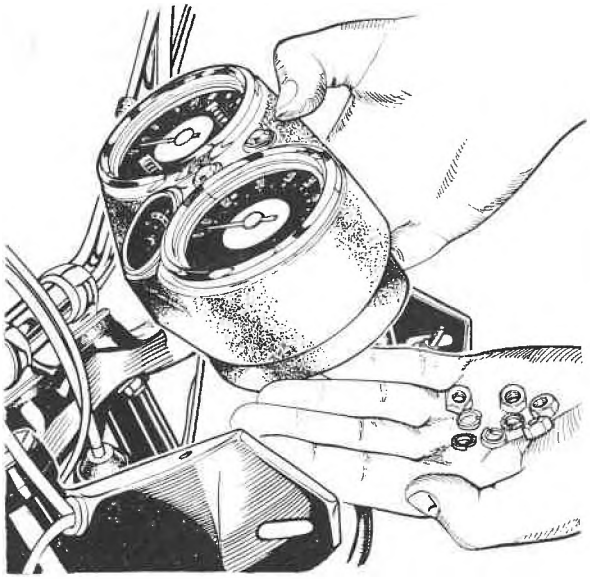


FIG. E.7. *Removing binnacle.*

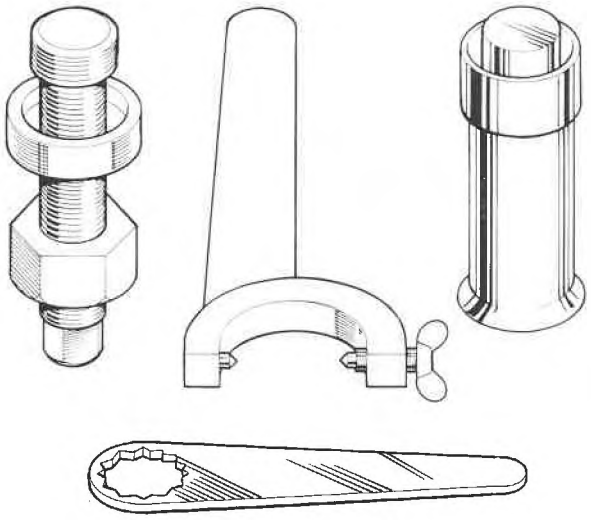


FIG. E.8. *Fork tools.*

REMOVING THE FORK LEGS

Before commencing work on the forks it is advisable to have the following tools and replacements available:—

75–5099 Oil seal (2)
75–5105 Top bush (2)
75–5104 Lower bush (2)
60–779 Service tool
61–6017 Service tool
61–3824 Service tool
61–3007 Service tool

Remove the front wheel as described on page F.00, then remove the front mudguard, by taking out the bolts from the fork ends and the four nuts and bolts from the brackets behind the fork legs.

Remove the two caps (*C*), Fig. E.3.

Drain the oil from the forks as described on page A.12.

Screw into the stanchion top, service tool No. 61–3824, and slacken the bottom yoke pinch bolts. Now drive the stanchion out of the bottom yoke holding on to the stanchion with one hand to save them falling, which may damage them. Repeat the operation on the other stanchion.

SPRING CHANGING

At this stage—if no other work is required—the springs can be changed. All that is necessary is to remove the rubber gaiters and pull out the old

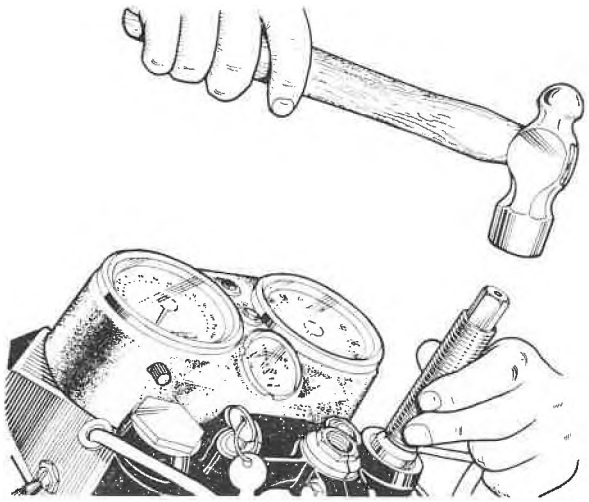


FIG. E.9. *Removing fork leg.*

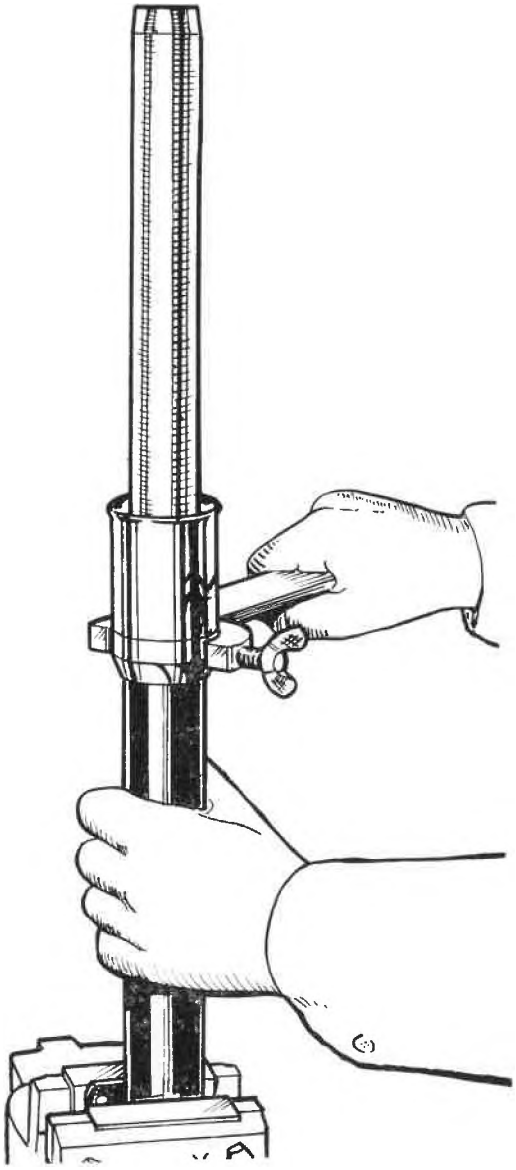


FIG. E.10. *Removing sleeve nut.*

springs, apply a liberal coat of grease to the new springs and to replace.

Replacing the fork leg is described on page E.7.

DISMANTLING THE LEG

To dismantle the lower section of the fork, hold the sliding tube by gripping the wheel spindle lug in a soft-jawed vice.

Removal of the chrome dust excluder sleeve nut is facilitated by service tool No. 61–6017, which should be located in the holes around the sleeve nut. The nut has a right-hand thread and should unscrew easily once the nut has been initially loosened by giving the spanner a sharp tap with a hide mallet.

FIG. E.11. *Removing oil seal.*

When the dust excluder nut is removed, a few sharp pulls should release the stanchion, bush and damper sleeve assembly from the bottom slider tube.

The oil restrictor rod is secured within the slider tube by means of a hexagonal-headed bolt counterbored into the wheel spindle lug. When this bolt is unscrewed the restrictor rod can be withdrawn.

The bolt is sealed by means of an aluminium washer which should be removed from the counterbore and placed in safe keeping.

The bottom fork bearing bush and damper shuttle are retained by a special slotted nut. Removal of this nut is facilitated by using a suitable C-spanner or careful use of an aluminium drift.

To remove the damper shuttle take off the circlip on the end, and withdraw the schuttle from the special nut.

OIL SEALS

The fork oil seal is pressed into the dust excluder sleeve nut and is freely accessible from the bottom of the nut. The oil seal can be driven out by inserting a suitable drift and locating it on the oil seal at the peripherial slot.

The new oil seal should be pressed into the sleeve nut with the lip and spring side facing the threaded end of the sleeve nut, a check should be made to ensure that it is fully and squarely engaged. Service tool No. 61–3007 will be found beneficial.

Great care is required to avoid damaging the feather-edge of the seal and this should be greased before reassembly.

Check to see that the rubber O-ring in the dust excluder is still serviceable, if not replace.

REBUILDING THE FORK LEG

Reassembly is carried out in the reverse order to dismantling.

Cleanliness is essential and before attempting to reassemble, clean all parts thoroughly, and the work bench on which the forks have been dismantled.

Replace the lower fork bush and damper shuttle at lower end of the stanchion, and make sure the circlip is located correctly on the shuttle. Tighten the special nut.

To refit the restrictor rod place fork leg upside down in a soft-jawed vice and place the restrictor rod in the shuttle valve, then locate the fork slider over the fork leg and replace restrictor rod bolt complete with washer. When tightening, press down on the fork slider to grip the restrictor rod and prevent it from turning.

Assemble the stanchion to the bottom member and fit the damper sleeve and top bush. Make sure that the rubber O-ring is in position and the outer retaining washer is fitted above the top bush.

Then screw on the dust excluder sleeve nut, and oil seal assembly, while holding the slider tube in a vice by means of the wheel spindle lug.

Tighten the dust excluder sleeve nut with service tool No. 61–6017.

When both stanchions are assembled in this way, fit the plain thrust washer, main spring, rubber gaiter, spring abutment and cork washer over each stanchion in that order. The gaiter spring clips should now be fitted, one securing the gaiter to the dust excluder sleeve and the other securing the gaiter to the top spring abutment.

Offer right stanchion assembly (with bottom mudguard stay lug pointing backwards, and drain plug facing outward) and engage as much of the stanchion as possible in the bottom yoke.

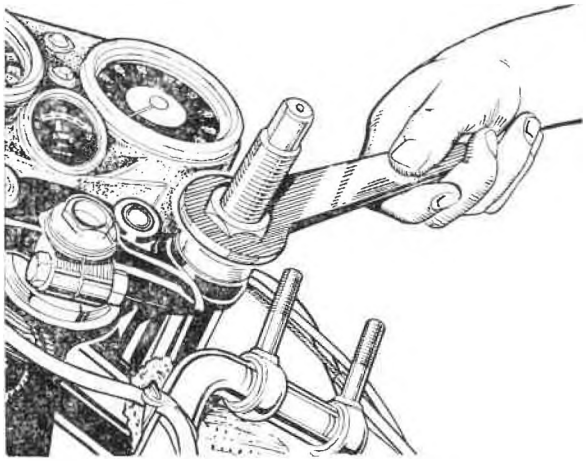


FIG. E.12. *Using service tool No.* 61–3824 *to reassemble the forks.*

To pull the stanchion up to the top yoke, service tool No. 61–3824 is required, which should be inserted into the top yoke and the plug adaptor screwed into the stanchion top. The stanchion can then be easily drawn up to the required level and when this is achieved temporarily tighten the pinch bolt in the bottom yoke, remove the tool and screw in the cap nut until several threads are engaged. Repeat this procedure for the left stanchion assembly and then remove both cap nuts and pour ⅜ U.S. pint (190 c.c.) of the recommended grade of oil (see page A.5) into each fork leg.

Refit the cap nuts until several threads are engaged then slacken off the bottom yoke pinch bolts and fully tighten the cap nuts.

When this operation is completed adjust steering head races as described on page E.2.

Now tighten the top yoke pinch bolt, top cap nuts and the bottom yoke pinch bolts to the torque wrench figures quoted on page J.1.

Reassembly continues as the reversal of the dismantling procedure, referring to page G.23 for the wiring diagram and page G.16 to set the headlamp beam.

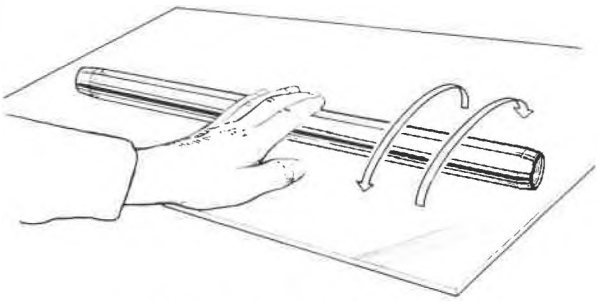


FIG. E.13. *Testing for straightness.*

FORK ALIGNMENT

It is possible during reassembly of the forks, for them to be incorrectly aligned.

For this reason, after the mudguard has been replaced, replace the front wheel so that the front spindle is clamped up tight on the right-hand side but the clamp on the left-hand side is slack and the rest of the bolts in the bottom yoke, top caps, and the pinch bolt in the top yoke are slackened off.

The forks should now be pumped up and down several times to line them up, and then tightened up from bottom to top, that is, wheel spindle clamps, bottom yoke pinch bolts, top caps, and finally the steering stem pinch bolt in the top yoke.

If the forks do not function satisfactorily after this treatment, either the fork stanchions are bent or one of the yokes is twisted.

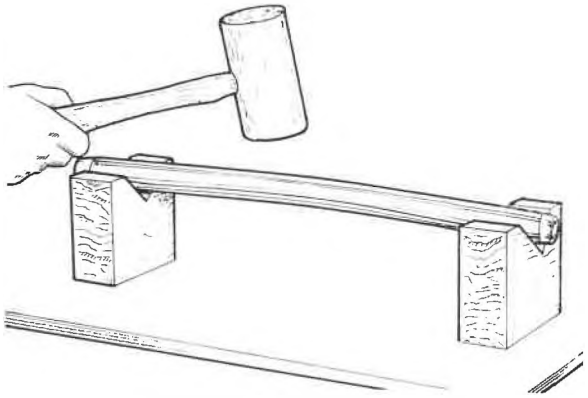


FIG. E.14. *Straightening.*

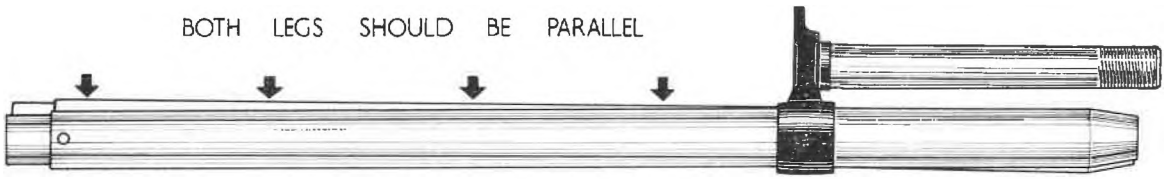


FIG. E.15. *Bottom yoke twisted.*

The tubes can only be accurately checked for straightness with special equipment such as knife-edged rollers and dial gauges and special gauges are required to check the yokes.

It is possible however to take a reasonable check of the tubes by rolling them on a good flat surface such as a piece of plate-glass, but it is not a simple operation to straighten a bent tube, it is far better to obtain a factory service unit if the owner is resident in the British Isles.

If the tube is obviously bent but not kinked, then it may be possible to effect a reasonable repair with patience and care.

Find the highest point on the bend, then with the two ends resting on wood blocks, give the tube a hard blow with a wooden mallet and re-check. The measure of success will of course depend on the extent of the damage and the skill of the operator.

This job is vastly improved and simplified if a press is available to the repairer.

Having checked the tubes for straightness and reset as necessary, the top and bottom yokes can be checked.

First assemble the two tubes into the bottom yoke so that a straight-edge across the lower ends is touching all four edges of the tubes, tighten the pinch bolts.

Now view them from the side, when the two tubes should be quite parallel, or, place the lower 12″ of the tubes on a surface plate when there should be no rocking.

If the tubes are not parallel as in Fig. E.15, then the yoke can be set providing the error is not excessive.

To reset hold the tube in a vice, on the unground portion, using soft clamps and set the other tube using a longer and larger diameter piece of tube for leverage.

Having set the tubes one way, check the gap between them on the ground portion.

The next step is to place the top yoke in position when the steering column should be quite central, Fig. E.16 shows a bent steering column.

Final step is to check with the two tubes assembled into the top yoke only, in this case use the bottom yoke loosely assembled on the tubes simply as a pilot.

It is permissible to rectify slight errors in alignment by resetting, but when there is excessive malalignment it is safer to replace the part effected.

There is an alternative method of checking and straightening the yokes, but this method is successful only if the damage is slight.

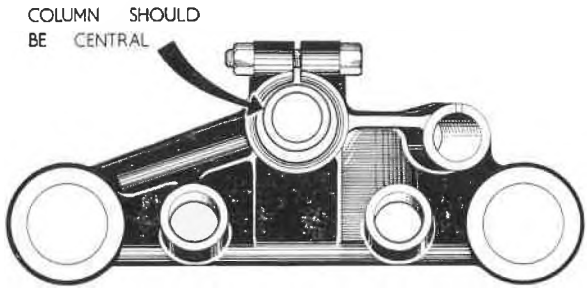


FIG. E.16. *Bent steering column.*

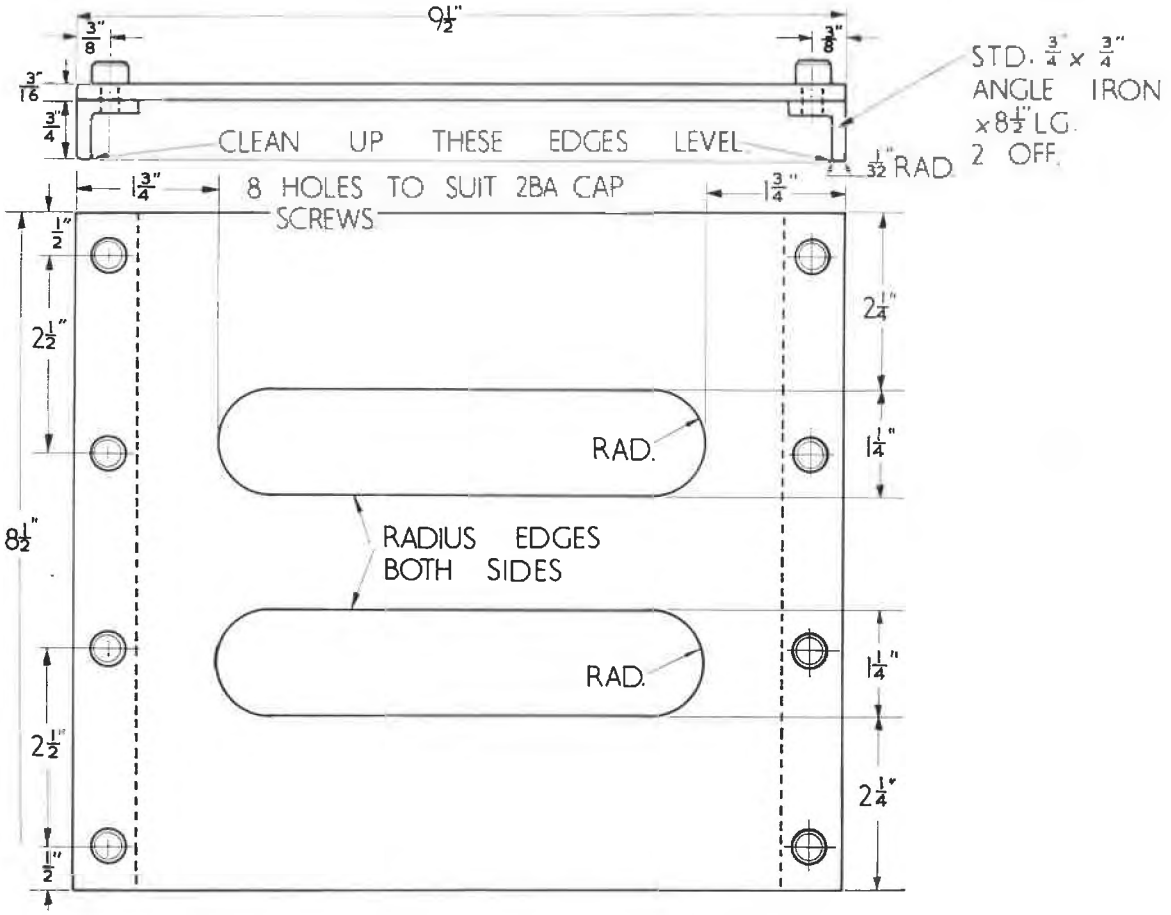


FIG. E.17. *Telescopic fork alignment gauge service tool No.* 61–6025.

For this operation service tool No. 61–6025 will be found necessary, the measurements of which are detailed in Fig. E.17.

For this method the forks can be left in the yokes, all that is necessary is to remove from the forks is the front wheel and mudguard, headlamp, binnacle, ignition and light switches and the Zener Diode heat sink.

A spare front wheel spindle should be clamped in the fork bottoms. If a spare wheel spindle is not available a suitable bar for this purpose can be made from mild steel to the dimensions given in Fig. E.18.

Hold the alignment gauge firmly against the fork legs as shown in Fig. E.19, and check that the gauge contacts at all four corners. If the gauge does not make contact at points (*A*) then this indicates that point (*B*) is too far forward. To remedy this slacken off the two bottom yoke pinch bolts and the stem sleeve nut pinch bolt and give point (*C*) a sharp blow using a hide-mallet or a hammer used in conjunction with a soft metal drift.

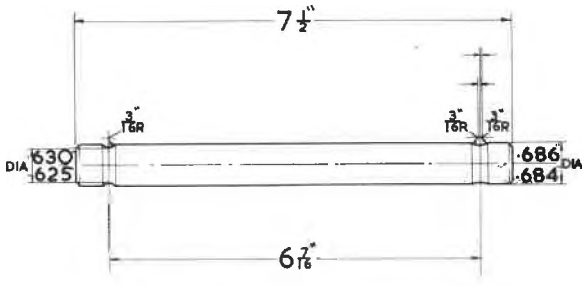


FIG. E.18. *Dummy wheel spindle.*

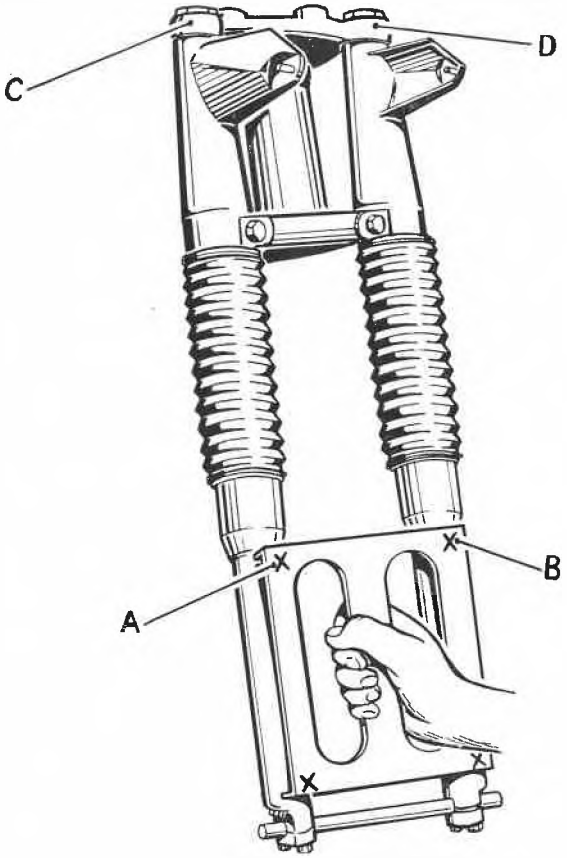


FIG. E.19. *Checking fork alignment with service tool No.* 61–6025.

Check the alignment again with the gauge and again give correction blows in the above mentioned manner until the amount of rock at any one corner does not exceed $\frac{1}{64}$". When this is achieved, tighten all three pinch bolts and then finally apply the gauge to check that tightening has not caused distortion.

If this method does not rectify the distortion the method described on page E.8 should be tried, and if this fails it may be that the damage is not repairable in which case the offending parts should be replaced.

IMPORTANT NOTE: There are two types of fork stanchion fitted to this model. The earlier stanchion has eight peripheral holes at the bottom of the stanchion and the later stanchion retains the eight holes but has two smaller holes drilled in line with the shaft, just above the others.

These shafts a e not interchangeable except in pairs, so that when replacing a damaged stanchion care must be taken not to fit odd ones.

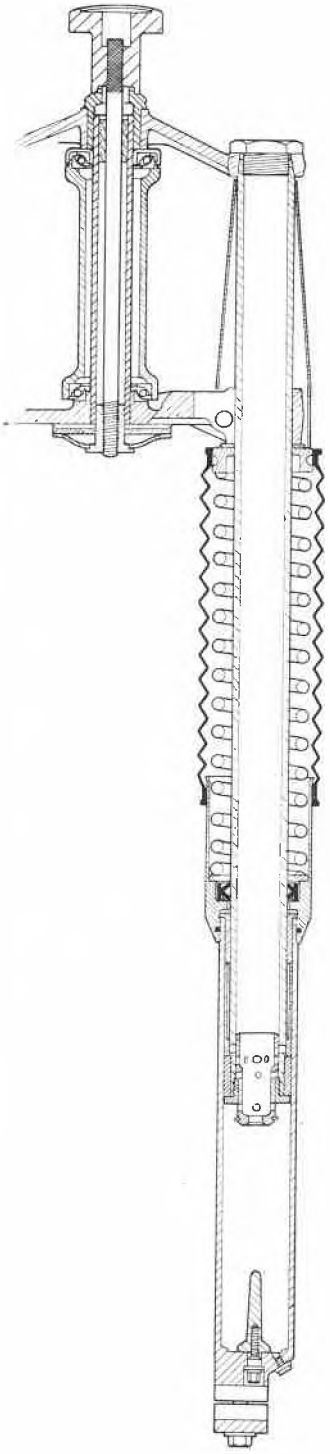


FIG. E.20. *Telescopic front fork.*

INDEX

FRONT WHEEL

Front Wheel Removal

To remove the wheel, first disconnect the front brake cable from the lever on the brake anchor plate, this can be done by removing the brake cable spring pin, and detaching the outer cable end from the cable stop.

Unscrew the four clamp bolts, two on each of the fork legs, remove the caps and withdraw the front wheel.

Front Wheel Replacement

Lift the wheel between the forks and locate the peg on the right-hand fork leg to slot on the brake anchor plate, at the same time locating the spindle ends in the fork bottoms, then pull down on the forks so that they hold the wheel in position while the caps are refitted.

Fully tighten the right-hand cap making sure that the brake anchor stop is fully located, then pump the forks up and down a few times to position the left-hand leg and tighten the bolts on left-hand cap.

The fork leg cap bolts have spring washers on them and these should not be left off.

Finally tighten the four cap bolts to the torque wrench figures quoted on page J.1.

Finally replace the brake cable, and adjust if necessary using the adjuster on the handlebar lever only.

Brake Shoes

The brake plate is a push-fit on the spindle and is retained with a nut which has a right-hand thread.

When this nut has been unscrewed the brake anchor plate complete with brake shoes can be withdrawn from the hub.

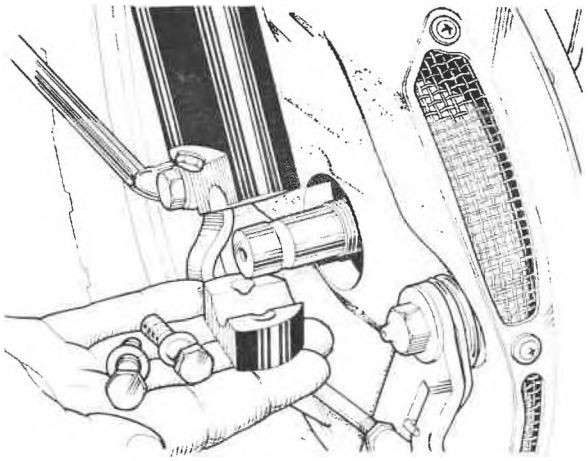


FIG. F.1. *Replacing front wheel.*

To remove the brake shoes from the anchor plate, lever them upwards and outwards of the cams and fulcrum blocks.

The shoes are interchangeable, when refitting the shoes make sure the two abutment pads are in position on the fulcrum blocks.

A grease nipple is provided on the end of each cam spindle for lubrication purposes. It is advisable to check that the holes are not blocked by dirt. Be careful not to over-lubricate, as grease must not come in contact with the linings.

Brake Shoe Adjustment

The tie rod between the brake cam levers is accurately set for correct operation before the machine leaves the factory and in normal circumstances should not need any re-adjustment. If however the adjustment is upset either by damage or the need to replace a part of the assembly, the following notes on re-adjustment may be found beneficial.

Firstly remove the brake plate assembly from the wheel, then take out the brake rod pivot pin from one end of the tie rod.

Now view the brake plate from the brake shoe side, and position the cams so that the flat of the cam sits squarely on the brake shoes.

Turn the brake plate over and carefully adjust the tie rod until the pivot pin will drop through the tie rod fork end and the brake lever, without moving the lever. Tighten up the locknut and check that the cams are still touching the brake shoes all the way along the flat.

Front Hub Dismantling

Unscrew the brake plate retaining nut and pull off the plate complete with brake shoes. Unscrew the bearing retainer on the right-hand side, this has a right-hand thread, and remove the circlip from the left-hand side. Now from the left-hand side drive out the right-hand bearing by striking the end of the spindle with a hide-mallet. If a mallet is not available use a piece of hard wood to protect the spindle.

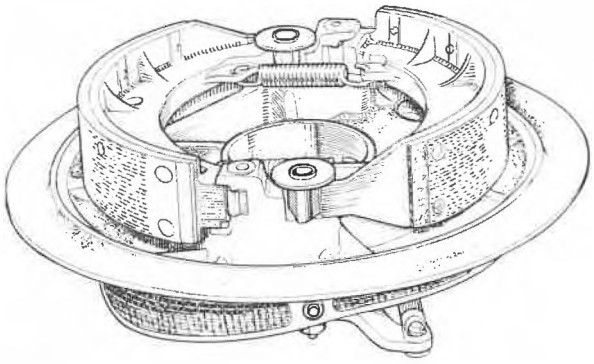


FIG. F.2. *Front brake.*

When the bearing has been removed from the spindle, replace the spindle back in the hub and drive out the left-hand bearing and dust cap.

Both bearings are the same size and therefore interchangeable.

Replacement bearings are simply replaced in the reverse manner but pressure must only be applied to the outer ring of the bearing. Also make certain that the grease retainer and backing ring are in position behind the bearings on the right-hand side, and the grease retainer is behind the bearings on the left-hand side.

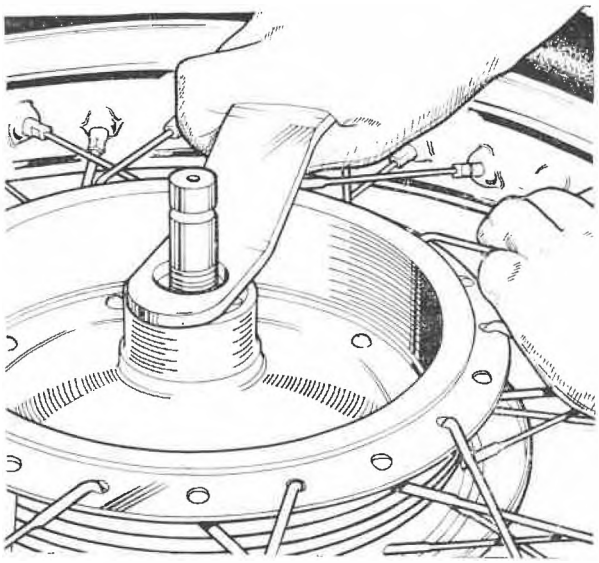


FIG. F.3. *Removing locking ring.*

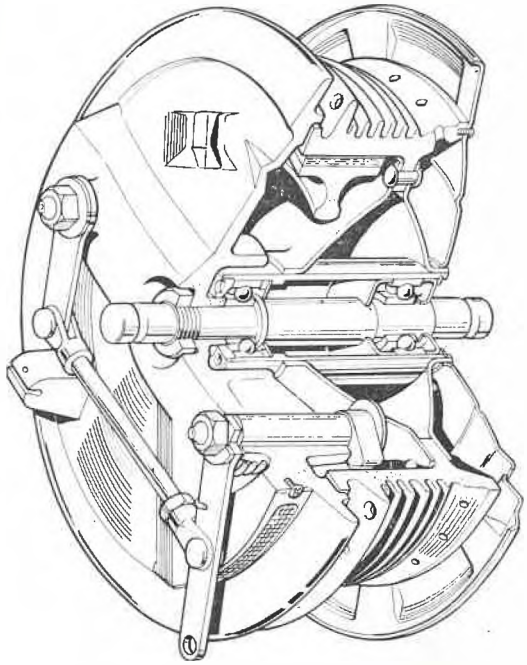


FIG. F.4. *Front hub (cut away).*

REAR WHEEL

Removing Rear Wheel

First unscrew the rear brake adjuster wing-nut and remove the pivot pin from the brake lever. Then disconnect the rear chain at its connecting link.

Detach the speedometer drive at the rear wheel. Remove the nut securing the rear brake torque stay at the brake anchor plate and slacken the nut and bolt at the forward end of the torque stay.

Now slacken off the left- and right-hand wheel spindle securing nuts. The wheel is now free to be withdrawn.

Rear Brake Shoes

Unscrew the brake plate retaining nut and withdraw the anchor plate complete with shoes.

To remove the shoes, lever them upwards and away from the cam and fulcrum pin. Remove the nut and washer securing the lever to the cam spindle, the lever can now be taken off together with the return spring.

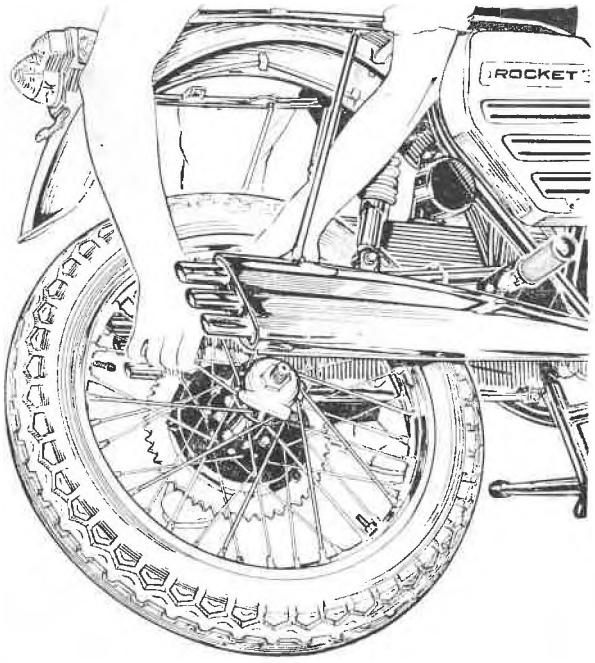


FIG. F.5. *Removing rear wheel.*

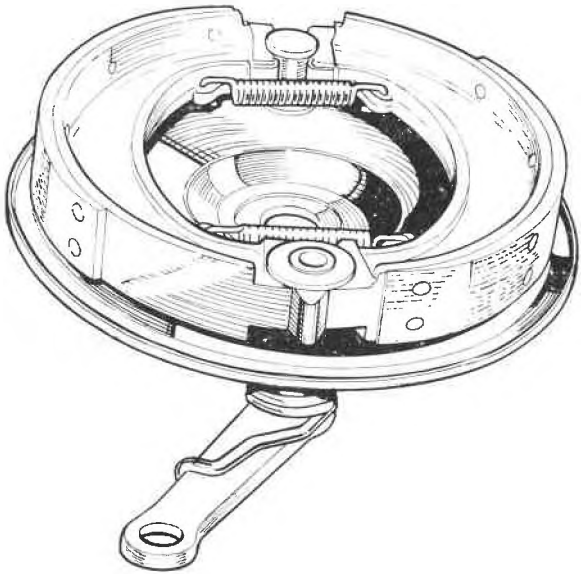


FIG. F.6. *Brake shoe position.*

Examine the anchor plate for cracks or distortion, particularly in the brake cam housing, also check the return springs for fatigue and distortion. Renew them if necessary.

If the brake shoes are badly worn, that is to say, if the linings are worn down to the rivet heads the shoes should be replaced.

For any owner who may wish to reline his own shoes the notes on page F.8 may be found beneficial.

The brake shoes are not interchangeable, and should be replaced in the position shown in Fig. F.6.

Reassembly of the brake anchor plate assembly is in the reverse order of the dismantling procedure.

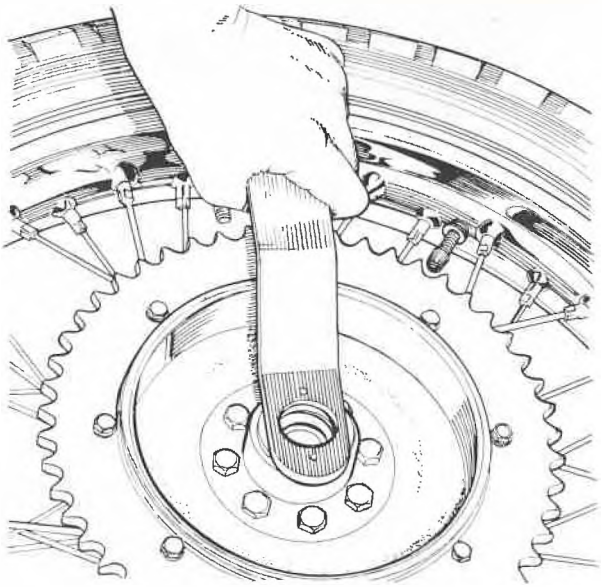


FIG. F.7. *Removing retainer ring.*

WHEEL BEARINGS

Take off the anchor plate as described ealier and withdraw the spindle from the right-hand side. Unscrew the slotted screw which locks the bearing retainer ring. The retainer ring can then be unscrewed using service tool No. 61–3694. So that the left-hand bearing can be removed, the central distance piece must be displaced to one side to allow a drift to be located on the inner ring of the left-hand bearing. To do this, first insert a drift from the left-hand side and move the distance piece to one side so that the grease retainer shim collapses as shown in Fig. F.9. A soft metal drift should then be inserted from the right and the left-hand bearing driven out.

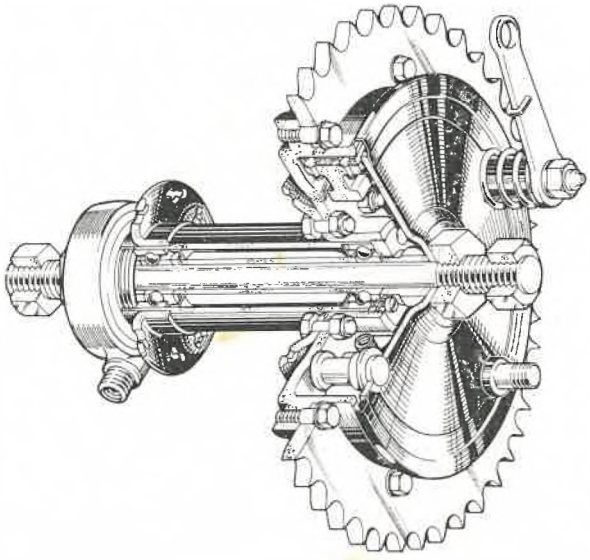


FIG. F.8. *Rear wheel (cut away).*

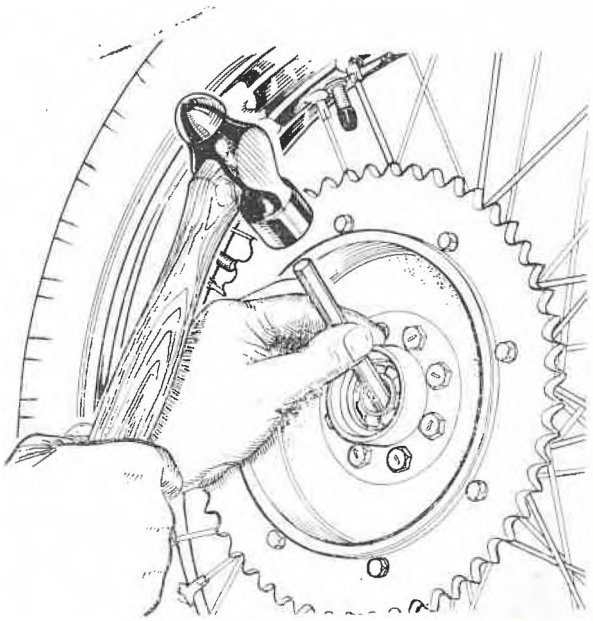


FIG. F.9. *Collapsing grease retainer.*

When this is done, withdraw the backing ring, damaged grease retainer, and distance piece. Now unscrew the speedometer drive ring (left-hand thread) and from the right-hand side drive out the remaining bearing and dust cap, using a drift of approximately 1⅜" diameter.

Fully clean all parts in kerosene and clean and dry the bearings thoroughly. Compressed air should be used for drying out if possible. Test the end float and inspect the ballraces for any signs of indentation or pitting. If the condition of the bearing is in doubt it should be renewed.

The damaged grease retainer shim can usually be reclaimed for further use by carefully hammering it flat to restore its original shape, but if it is split then it should be replaced.

Reassembly is the reversal of dismantling procedure.

REPLACING REAR WHEEL

Before the rear wheel is replaced in the frame the speedometer drive must be set in the correct position as shown in Fig. F.10.

When the position has been achieved, ensure the outer spindle nuts are sufficiently unscrewed, then offer the wheel to the swinging arm fork. Locate the adjuster caps over the fork ends then lightly tighten the wheel spindle nuts. Place the chain around the rear wheel sprocket and replace the connecting link with the closed end of the spring clip pointing in the direction of chains travel, *i.e.*, forwards on top run of the chain.

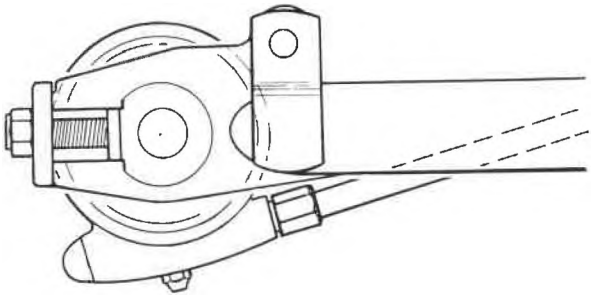


FIG. F.10. *Speedo drive position.*

If, through wear or damage, the brake drum needs to be taken off the wheel, the eight nuts and bolts should be removed from the inside of the drum. It can now be removed from the hub for rectification or replacement.

Connect up the brake anchor plate torque stay. Refitting the chain may necessitate slackening off both the left- and right-hand adjusters. Reconnect the speedometer cable to the drive box and tighten the nut.

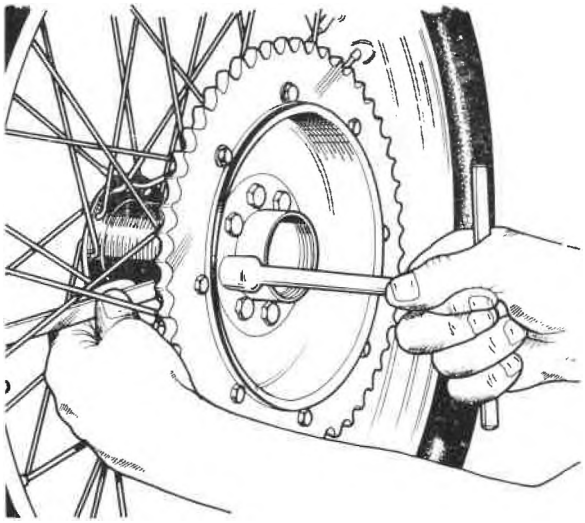


FIG. F.11. *Removing brake drum.*

The front and rear wheel should now be aligned, this procedure is detailed on page F.7. and when this is done the wheel nuts should be tightened securely and ensure the torque stay securing nut is tight.

WHEEL BUILDING

This is a job which is best left to the specialist as it is essential that the wheel is laced correctly and that when truing, the spokes are correctly tensioned.

It is however, possible for the less experienced to avoid trouble by periodically examining the wheels, as spokes and nipples bed-down the tension will be lost and unless this is corrected the spokes will chafe and ultimately break.

Periodically test the tension either by "ringing" that is striking with a metal tool or by placing the fingers and thumb of one hand over two spokes at a time and pressing them together.

If tension has been lost there will be no ringing tone and the spokes will move freely across each other.

When a spoke needs tensioning the nipple through the rim must be screwed further on to the spoke, but at the same time, the truth of the wheel must be checked, and it may be necessary to ease the tension at another part of the wheel in order to maintain its truth.

It will therefore be obvious that spoke replacement, spoke tensioning or wheel tuning are not operations to be treated lightly.

Careful examination of the wheel will show that for every spoke there is another pulling in the opposite direction, and that the adjacent spoke goes to the opposite side of the hub.

Increasing the tension tends to pull the rim, so, to counteract this, it is sometimes necessary to increase the tension on the spoke or spokes either side to maintain the truth of the wheel.

With a little care and patience it is possible for the unskilled to at least retension the spokes but, turn each nipple only a little at a time as, when once the spoke is under tension only a fraction of a turn is sometimes sufficient to throw the rim badly out of truth.

WHEEL BALANCING

When a wheel is out of balance it means that there is more weight in one part than in another. This is very often due to variation in the tyre, and at moderate speeds will not be noticed but at high speeds it can be very serious, particularly if the front wheel is affected.

Weights are available for attaching to the spokes to counteract any out-of-balance but, before starting, ensure that the wheel is absolutely free and revolves quite easily. If the rear wheel is being treated remove the driving chain.

With the wheel clear of the ground, spin it slowly and allow to stop on its own. Now mark the top of the wheel or tyre and repeat two or three times to check.

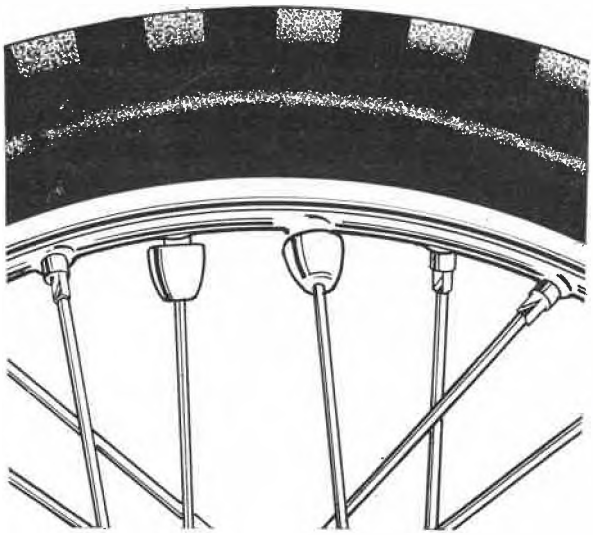


FIG. F.12. *Balance weights.*

If the wheel stops in the same place the extra weight must be added at the marked spot.

The next step is to ascertain how much weight is to be added, this can be done by sticking small pieces of plasticine to the spoke nipples and re-check until the wheel will stop in any position.

Having ascertained how much weight, weights of exactly the same amount must be attached to the spokes at the spot originally marked. In the case of the rear wheel the security bolts should always be fitted before attempting to balance the wheel.

WHEEL ALIGNMENT

Steering will be affected if the wheels are the slightest bit out of alignment (out of track).

Since the front wheel cannot be adjusted in this respect, it is the rear wheel which must be aligned to the front wheel. This is necessary whenever the chain is adjusted or the wheel removed. It is necessary to adjust the rear brake whenever re-alignment has been carried out.

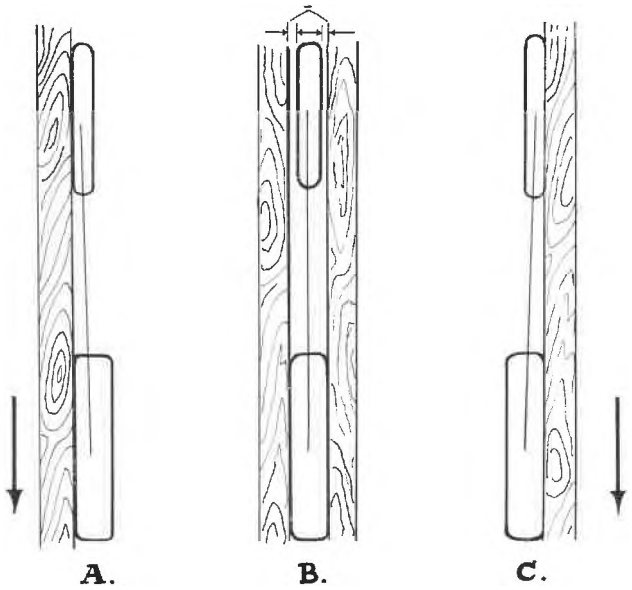


FIG. F.13. *Checking alignment.*

To check the alignment of the wheels a straight-edge of timber or steel is required approximately 85″ long.

The straight-edge should have a slot cut in it to allow it to fit round the centre stand.

The straight-edge should be laid on blocks, four to six inches high (alternately) each side of the machine.

If the tyres are the same size and the wheels in alignment the straight-edge will be touching the tyres at four points on each side.

If the front tyre is of smaller section then it should be as drawing (*B*) Fig. F.13.

If the alignment is as either (*A*) or (*C*) then the rear chain adjusters must be moved as indicated by the arrows to correct the alignment.

Assuming that the chain adjustment is correct the movement of the rear wheel will be made on the right-hand side chain adjuster, which should be screwed in or out as necessary after the spindle nuts have been slackened off.

A machine suffering accidental damage may have wheels so out-of-alignment that they cannot be corrected in this way. Frame, fork or wheel geometry may be basically upset, in these cases a specialist repairer can probably reset any offending assembly using information in Section D.

RENEWING BRAKE LININGS

Hold the shoe firmly in vice and using a good sharp chisel, cut off the peened-over portion of the rivet.

Drive out the old rivets with a suitable pin-punch. Reverse the shoe in the vice and draw-file the face of the shoe to remove any burrs.

Clamp the new lining in position and drill straight through with 5/32″ diameter drill using the holes in the shoe as a jig.

Remove the clamps and holding the lining carefully in the vice, counterbore or countersink, according to the type of rivet used, to no more than two-thirds the thickness of the lining. That is if the lining is $\frac{3}{16}$″ thick, then the counterbore must not be deeper than $\frac{1}{8}$″.

Having prepared the linings for riveting, start at the centre and position the lining with one or more rivets.

Using either small "G" or toolmakers clamps, close to the rivets and with a suitable mandrel in the vice, peen over the rivets working alternately outwards from the centre.

The mandrel in the vice must be flat on the end, and the diameter no more than that of the rivet head. It will also help to bed the rivet down if a hollow punch is used before peening.

If the clamps are used correctly, that is, next to the rivet being worked on, the linings can be fitted tight to the shoe.

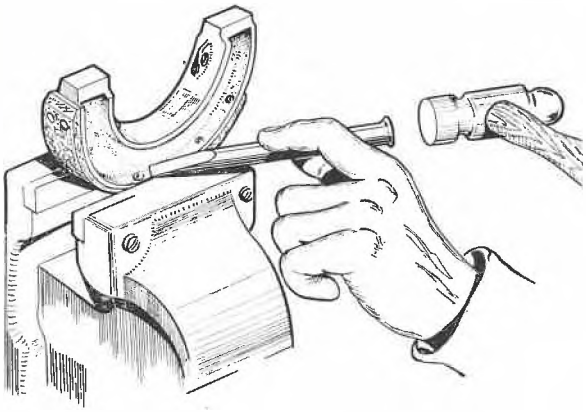


FIG. F.14. *Chopping out the rivets.*

Incorrectly fitted linings having a gap between the linings and the shoe will result in a spongy brake.

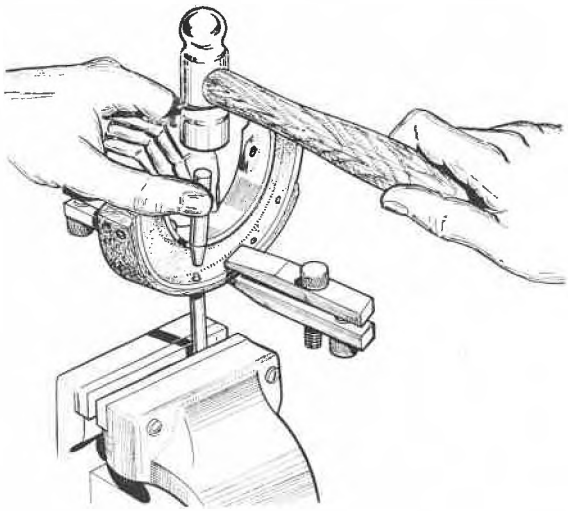


FIG. F.15. *Peening-over rivets.*

When riveting is completed file a good chamfer at each end of the lining to approximately half the depth of the lining, and lightly draw-file the rest of the lining to remove any fraze from the drillings.

REMOVING AND REFITTING TYRES

Tyre Removal

There are a few points about tyres which should be thoroughly understood.

(1) The beads have wire cores which cannot be stretched over the rim without damage.

(2) Removal and replacement will be simple if the beads are pressed right down into the well of the rim except at the point being "worked". The well is the centre section.

(3) The tyre will slip over the rim quicker and damage will be avoided if the beads and levers are lubricated with soapy water.

Unscrew and remove the valve core to deflate the tyre.

Some valve caps are designed for this purpose but, if the cap is plain and a core removal tool is not available, depress the centre of the valve and keep "treading" the tyre to expel the air.

Press each bead off its seat into the well of the rim.

Insert the lever at the valve position, and while levering press the head into the well diametrically opposite the valve.

Commence to remove the first bead. You cannot pull the cover bead at (*A*) over the rim flange until cover bead at (*B*) is pushed off the bead seat (*C*) down into the well (*D*). Then the cover bead at (*A*) comes over the rim flange easily.

Insert the second lever close to the first and prise the bead over the flange holding the free part with the other lever.

Remove one lever and insert further along the tyre continuing every two or three inches until the bead is completely removed (see Fig. F.17).

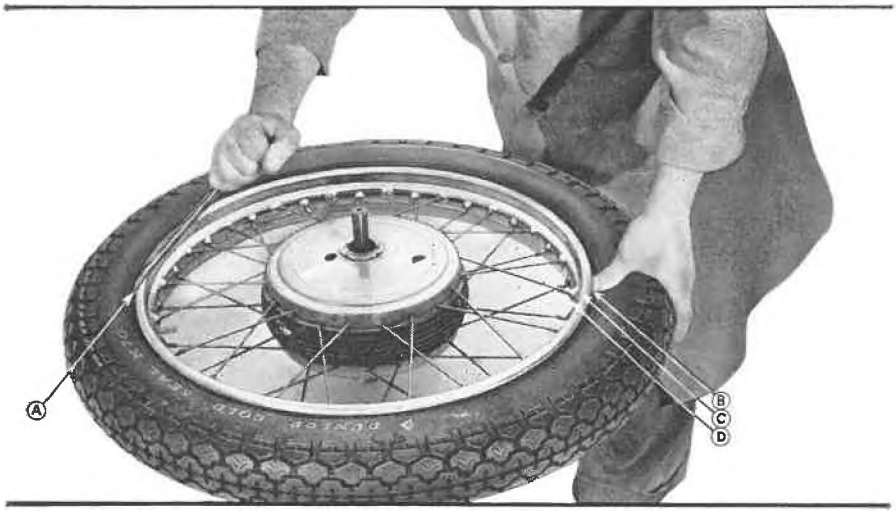


FIG. F.16.

FIG. F.17. *Removing first bead.*

Take care when inserting levers not to pinch the inner tube as this will result in a puncture.

Lift the valve out of the rim and remove the tube.

Stand the wheel upright, insert a lever between the remaining bead and the rim and pull the cover back over the flange as in Fig. F.18. Do not forget to press the bead diametrically opposite the lever into the centre of the rim and to apply a soapy solution to the rim flange.

Before a tyre (new or used) is replaced, it should be carefully checked inside and outside for loose objects or nails, flints, glass and cuts. Do not forget that although there may be nothing outside there could be a nail projecting inside. When repairing a tyre or tube be patient and see that the area of the repair is absolutely clean before applying solution. A rag dampened with gasoline will help to clean the area, but, it must be completely dry before solution is applied.

FIG. F.18.

FIG. F.19. *Cover and tube assembled ready for fitting.*

Remember that when replacing the tyre, it is very easy to cause another puncture by nipping the inner tube with the levers.

Some new tyres have balance adjustment rubbers inside the casing, they are not patches and should not be removed.

When there is a white spot near the bead it should be placed at the valve position or in the case of the rear wheel, midway between the security bolts.

If the spokes have been tensioned, or replaced, see that they are not projecting through the nipples. File flush any that are showing through.

FIG. F.20. *Commencing to fit tyre.*

Replace the rim tape with the rough side next to the rim. Place the tube in the tyre and inflate just sufficient to round it out without stretch.

Too much air makes fitting difficult, and too little will make the tube more liable to be nipped by the levers. Dust the tube and inside the cover with dusting chalk.

Lubricate the cover beads and the rim flanges with a soap and water solution or liquid soap.

Pull the tube slightly out of the cover so that it protrudes about 1″ beyond the beads for about 4″—5″ each side of the valve as in Fig. F.19.

Squeeze the beads together at the valve to prevent the tube slipping back, and offer the cover to the rim as shown in Fig. F.20, at the same time passing the valve through the hole in the rim tape and rim itself.

FIG. F.21. *Fitting the first bead.*

Allow the lower bead to go into the well of the rim and the upper bead to be above the rim flange.

Working from the valve outwards, press the lower bead over the rim flange by hand, moving along in short stretches, and ensuring that the bead lies right down in the well of the rim—this is most important, see Fig. F.21. If necessary use a tyre lever for the last few inches as shown in Fig. F.22.

FIG. F.22. *Completing the fitting of the first bead.*

Turn the wheel over and check that the bead is concentric with the rim before proceding further.

Reverse the wheel again and press the upper bead into the well of the rim diametrically opposite to the valve.

Insert a lever as close as possible to the point where the bead passes over the flange, and lever the bead over at the same time pressing the fitted part into the well of the rim.

Repeat progressively round the tyre until the bead is completely over the flanges, finishing at the valve (see Fig. F.23).

Push the valve inwards to ensure that the tube adjacent to the valve is not trapped under the bead, then pull the valve back firmly into position.

Before inflating, check that the fitting line on the tyre wall just above the bead on each side is concentric with the rim.

If necessary bouce the wheel to help seat the tyre but, see that there is adequate pressure to prevent damaging the tyre or tube and only use moderate force. If the tyre will not seat, it is better to release the pressure, apply soap solution to lubricate and re-inflate.

Inflate to the required pressure and check fitting lines again. Inflation should not be too rapid, particularly at the commencement, to allow the beads to seat correctly on the rim.

See that the valve protrudes squarely through the valve hole before screwing down the knurled nut and replace the dust cap.

SECURITY BOLTS

Security bolts are fitted to the rear wheel to prevent the tyre from "creeping" on the rim when it is subjected to excessive acceleration or braking. Such movement would ultimately result in the valve being torn from the inner tube. There are two security bolts fitted to the rear wheel, which are equally spaced either side of the valve and thereby do not affect the balance of the wheel.

NOTE:—The security bolt nuts must not be over-tightened, otherwise excessive distortion may occur.

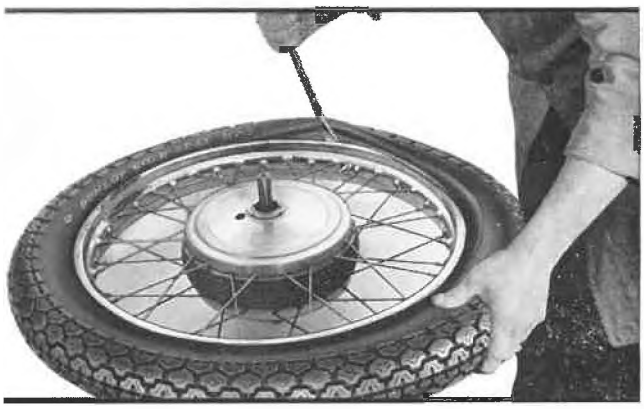


FIG. F.23. *Completing the fitting of the second bead.*

The basic procedure for fitting and removing the tyre is the same, but the following instructions must be followed:—

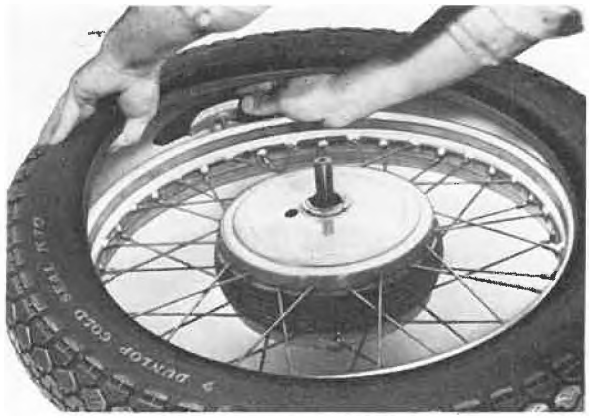


FIG. F.24. *Placing security bolt in position.*

(1) Remove the valve cap and core as described.

(2) Unscrew the security bolt nut and push bolt inside the cover.

(3) Remove the first bead as described.

(4) Remove security bolt from the rim.

(5) Remove the inner tube as described.

(6) Remove the second bead and tyre.

FIG. F.25. *Refitting the second bead with the security bolt in position.*

For refitting the tyre and inner tube:—

(1) Fit the rim tape.

(2) Fit the first bead to the rim without the inner tube inside.

(3) Assemble the security bolt into the rim, putting the nut on to the first few threads (see Fig. F.24).

(4) Partly inflate the inner tube and fit it into the tyre.

(5) Fit the second bead but keep the security bolt pressed well into the tyre as shown in Fig. F.25, and ensure that the inner tube does not become trapped at the edges.

(6) Fit the valve stem nut and inflate the tyre.

(7) Bounce the wheel several times at the point where the security bolt is fitted and then tighten the security bolt nut.

TYRE MAINTENANCE

Always maintain correct inflation pressures (see page GD.9). Use a tyre pressure gauge and check weekly when tyres are cold. The pressures quoted in the GD Section are for a rider of 140 lbs. weight. If the riders weight exceeds 140 lbs., pressure should be increased as follows:

Front Tyre:—Add 1 lb. per square inch for every 28 lbs. above 140 lbs.

Rear Tyre:—Add 1 lb. per square inch for every 14 lbs. above 140 lbs.

SIDECAR ALIGNMENT

Alignment of the front and rear wheels has been described on page F.8, and the two straight-edges used can also be used for aligning the sidecar.

The combination must stand on a flat smooth surface such as concrete; place one of the straight-edges against the front and rear wheels, and the other against the sidecar wheel as Fig. F.26.

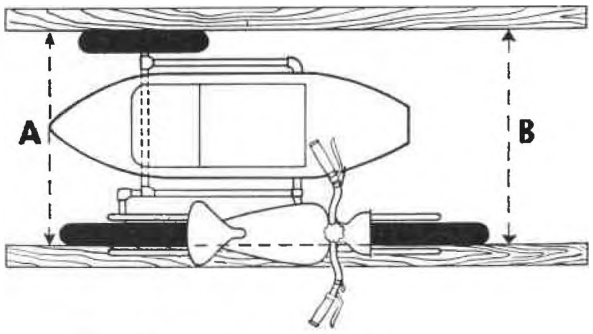


FIG. F.26. *"Toe-in."*

Straighten the front wheel so that it touches the straight-edge at each side or, if the front tyre is of smaller section, the gap is equal each side.

It is of course useless trying to align a sidecar if the front and rear wheels are not in alignment. Now measure the distance between the straight-edges at (*A*) and (*B*). The distance in front at (*B*) should be ⅜″ to ¼″ less than at (*A*). If the alignment is incorrect, adjustment is usually made at the front lower coupling and it is known as "toe-in."

In addition to aligning the wheels horizontally, the machine should also be aligned vertically, if the maximum enjoyment is to be obtained from the outfit.

The machine should "lean out" approximately 1″ from the vertical.

To check, hang a plumb-line from the handlebars, and measure the distance between top and bottom as in Fig. F.27.

Any adjustment necessary is usually carried out at the two upper sidecar connectors. The measurement at (*C*) the top, should be approximately 1″ greater than (*D*) at the bottom and should never be less.

If the machine is leaning inwards, then the couplings must be adjusted to push the machine further out. To do this it may be necessary to move the connections along the sidecar chassis towards the machine, this however will depend on the type of sidecar used.

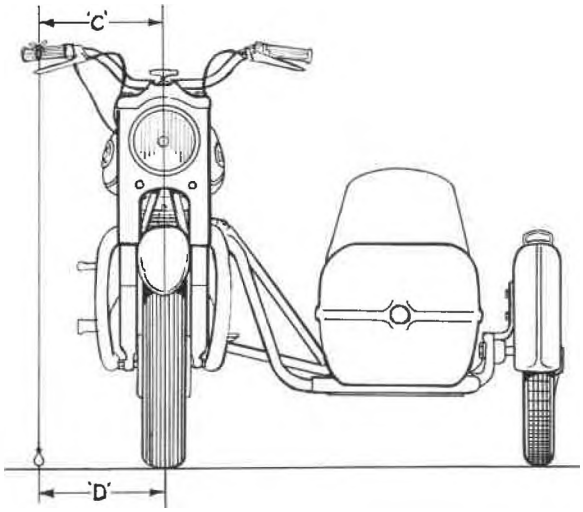


FIG. F.27. *Vertical alignment.*

INDEX

INTRODUCTION

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

The current is then supplied to the ignition system which is controlled by a triple contact breaker driven direct from the exhaust camshaft. The contact breaker feeds three ignition coils, one for each cylinder, and the three condensers are mounted separately in a waterproof pack.

The battery supplies current for the sealed beam headlamp, tail lamp and instruments and warning light in the binnacle. An ammeter is fitted. Twin horns are used with a relay.

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

No emergency start facility is provided. On these models there is however sufficient voltage to start the machine when a discharged battery is in circuit.

BATTERY INSPECTION AND MAINTENANCE

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

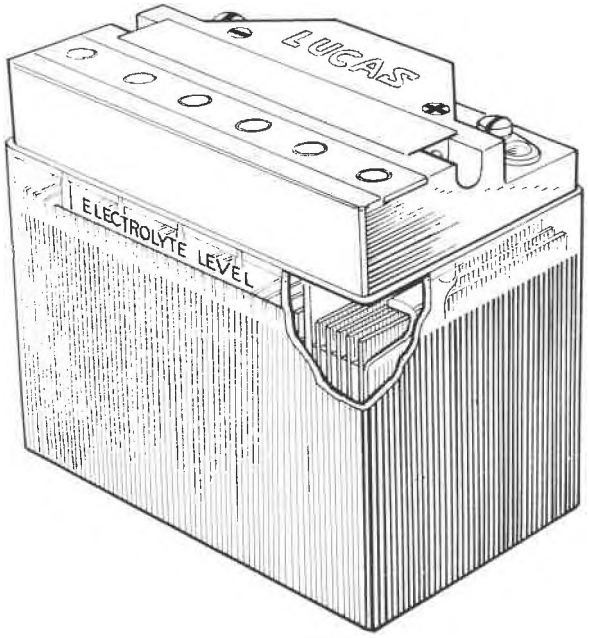


FIG. G.1. *Battery (PUZ5A).*

To prepare a dry-charged battery for service, first discard the vent hole sealing tape and then pour into each cell pure dilute sulphuric acid of appropriate specific gravity to the COLOURED LINE (see table in Part A). Allow the battery to stand for at least one hour for the electrolyte to settle down, thereafter maintain the acid level at the coloured line by adding distilled water. The battery should then receive an initial charge of 1 ampere for approximately three hours prior to fitting to the machine.

G.1. PART A.

Routine Maintenance

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

NOTE:—**On no account should the battery be topped-up to the separator guard but only to the coloured line.**

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

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

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

Specific Gravity of Electrolyte for Filling the Battery

U.K. and climates normally below 90°F. (32.2°C.)		Tropical climates over 90°F. (32.2°C.)	
Filling	Fully charged	Filling	Fully charged
1·260	1·280—1·300	1·210	1·220—1·240

Every 1,000 miles (1,500 km.) or monthly, or more regularly in hot climates the battery should be cleaned as follows. Remove the battery cover and clean the battery top. Examine the terminals: if they are corroded scrape them clean and smear them with a film of petroleum jelly, such as vaseline. Remove the vent plugs and check that the vent holes are clear.

G.1. PART B.

Maximum Permissible Electrolyte Temperature During Charge

Climates normally below 80°F. (27°C.)	Climates between 80–100°F. (27–38°C.)	Climates frequently above 100°F. (38°C.)
100°F. (38°C.)	110°F. (43°C.)	120°F. (49°C.)

Notes

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

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

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

BATTERY CONNECTIONS

It is extremely important that the battery, which is located behind the left side panel, is connected correctly into the circuit to avoid damage to the electrical system. Refer to Fig. G.2 which shows the correct method of connecting the battery.

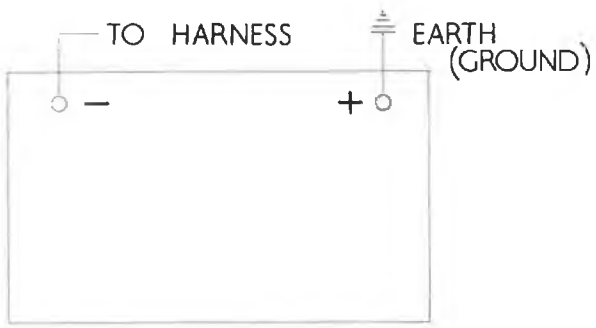


FIG. G.2. *Schematic diagram of 12 volt battery connections. (Note a 35 amp. fuse is incorporated in the negative lead).*

COIL IGNITION SYSTEM

Description

The coil ignition system comprises a 7CA contact breaker in the timing cover driven by the exhaust camshaft feeding three ignition coils fitted into the mounting clamp beneath the twinseat.

The capacitors are fitted into a rubber-covered pack mounted on the plate in front of the battery.

Attention to the contact breaker is covered on page G.7. The ignition coils can be removed, for testing as on page G.6, Part C, merely by disconnecting the terminals, then by slackening off the two clamp bolts, each coil can be removed in turn from the clamp.

The capacitor pack is secured to the plate by two small screws and nuts and after removal and disconnecting of the spade terminals the rubber cover can be pulled away, leaving only the capacitors, each of which is secured by a serrated washer and nut. The coils and capacitors require no attention beyond keeping them clean and the terminals sound.

The best method of approach to a faulty ignition system is that of first checking the low tension circuit for continuity as shown on page G.4, Part A, and then following the procedure laid out on page G.5, Part B, to locate the fault/s).

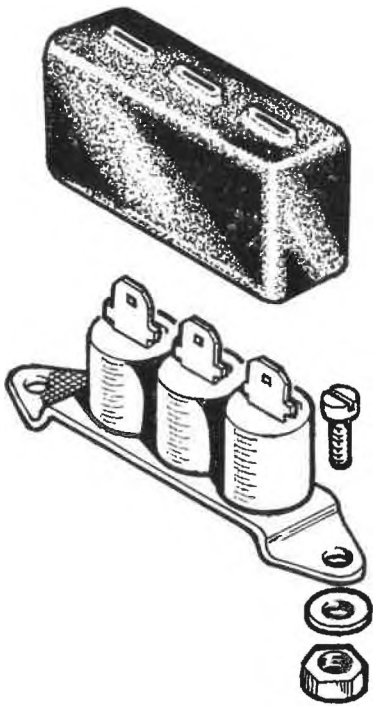


FIG. G.3. *Capacitor pack.*

Failure to locate a fault in the low-tension circuit indicates that the high-tension circuit or sparking plugs are faulty and the procedure detailed on page G.7, Part E, must be followed. Before commencing any of the following tests, however, the contact breaker and sparking plugs must be cleaned and adjusted to eliminate these possible sources of faults.

G.4. PART A.

Checking the Low-tension Circuit for Continuity

Note:—Lucas coils are marked "S.W." and "C.B.", Siba coils are marked "1" instead of "S.W." and "I.S." instead of "C.B.".

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

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

Change the white lead over from S.W." of one coil to the next, repeating the test in turn for the other two coils.

If the ammeter needle does not fluctuate in the described way then a fault in the low-tension circuit is indicated.

First, examine the contact breaker contacts for pitting, piling or presence of oxidation, oil or dirt etc. Clean and ensure that the gap is set correctly to ·014"—·016" (·35—·40 mm.) as described on page B.30.

G.4. PART B.

Fault Finding in the Low-tension Circuit

To trace a fault in the low-tension wiring, turn the ignition switch to "IGN" position and then place a piece of insulating material between all sets of contacts whilst the following test is carried out.

NOTE:—Disconnect the Zener Diode before the test is carried out. To do this remove the brown/white lead from the diode centre terminal.

For this test, it is assumed that the twinseat is removed and the wiring is fully connected as shown in the wiring diagram, page G.23. With the aid of a 0—15 range D.C. voltmeter and two test-prods, make a point to point check along the low-tension circuit starting at the battery and working right through to the ignition coils, stage by stage, in the following manner, referring to the wiring diagram on page G.23.

(1) First, establish that the battery is earthed correctly by connecting the voltmeter across the battery negative terminal and the machine frame earth. No voltage reading indicates that the red earthing lead is faulty. Also, a low reading would indicate a poor battery earth connection or a discharged battery.

(2) Connect the voltmeter in turn between each ignition coil "S.W." terminal and earth and then the right ignition coil "S.W." terminal and earth. No voltage reading indicates a breakdown between the battery and the coil "S.W." terminal, or that the switch connections or ammeter connections are faulty.

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

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

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

(6) Connect the voltmeter across the contact breaker terminal of each coil and earth in turn. No reading on the voltmeter between any one coil and earth indicates that the coil primary winding is faulty and a replacement ignition coil should be fitted.

(7) With insulating material between the three sets of contacts, connect the voltmeter across each set of contacts in turn. No reading between any one set of contacts and earth indicates that there is a faulty connection or the internal insulation has broken down in one of the capacitors.

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

(8) Finally, reconnect the Zener Diode brown/white lead and then connect the voltmeter between the Zener Diode centre terminal (not end terminal) and earth (with ignition "ON"). The voltmeter should read battery volts. If it does not the Zener Diode is faulty and a substitution should be made. Refer to page G.14 for the correct procedure for testing a Zener Diode on the machine. Ignicoil check procedure is given in Part C, below.

G.5. PART C.

Ignition Coils

The ignition coils consist of primary and secondary windings wound concentrically about a laminated soft iron core, the secondary winding being next to the core. The primary winding consists of 280—372 turns of enamel-covered wire and the secondary, some 19,000 turns of much finer wire, also enamel-covered. Each layer is paper-insulated from the next in both primary and secondary windings.

To test the ignition coil on the machine, first ensure that the low-tension circuit is in order as described on page G.4, Part A, then disconnect the high-tension leads from each of the sparking plugs. Turn the ignition switch to the "IGN" position and crank the engine until the contacts (those with the black/white lead from the ignition coil) for the right (No. 1) cylinder are closed. Flick the contact breaker lever open a number of times whilst the high-tension lead from the ignition coil with the black/white lead is held about $\frac{3}{16}$" away from the cylinder head. If the ignition coil is in good condition a strong spark should be obtained. If no spark occurs this indicates the ignition coil to be faulty.

Repeat this test in turn for each of the other coils ensuring that the contacts for the coil being tested are closed. The lead colours at the coils are of course the same at the contacts.

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

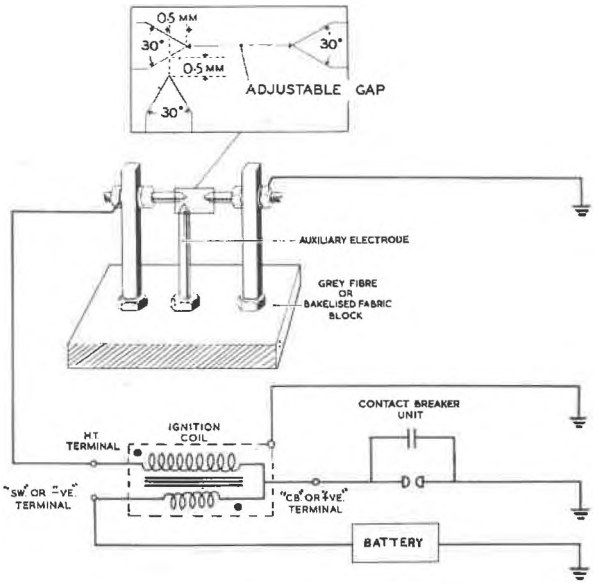


FIG. G.4. *Ignition coil test rig.*

Bench Testing an Ignition Coil

Connect the ignition coil into the circuit shown in Fig. G.4, and set the adjustable gap to 8 mm.

Using a single-lobe contact breaker running at 600 r.p.m. and the coil in good condition, not

more than 5% missing should occur at the spark gap over a period of 15 seconds. The primary winding can be checked for short-circuit coils by connecting an ohmeter across the low-tension terminals. The reading obtained for the 17M12 coil at 20°C. should be within 3·3 ohms minimum and 3·8 ohms maximum.

G.6. PART D.

Contact Breaker

Faults occurring at the contact breaker are in the main due to, incorrect adjustment of the contacts or the efficiency being impaired by piling, pitting or oxidation of the contacts due to oil etc. Therefore, always ensure that the points are clean and that the gap is adjusted to the correct working clearance as described on page B.30.

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

Particular attention is called to the periodic lubrication procedure for the contact breaker which is given on page A.9. When lubricating the parts ensure that no oil or grease gets on to the contacts.

If it is felt that the contacts require surface grinding then the complete contact breaker unit should be removed as described on page B.30 and the moving contacts removed by unscrewing the nut which secures the low-tension lead, removing the lead and nylon bush. The spring and contact point can be removed from the pivot spindle. Repeat this procedure for the other contact points.

Grinding is best achieved by using a fine carborundum stone or very fine emery cloth, afterwards wiping away any trace of dirt or metal dust with a clean petrol/gasoline-moistened cloth. The contact faces should be slightly domed to ensure point contact. There is no need to remove the pitting from the fixed contact.

When reassembling, the nylon bush is fitted through the low-tension connection tab, and through the spring location eye. Apply a smear of grease to the contact breaker cam and moving contact pivot post. Every 3,000 miles and/or contact replacement, apply two drops of clean engine oil to the rear of the three lubricating felt wicks.

G.6. PART E.

Checking the High-tension Circuit

If ignition failure or misfiring occurs, and the fault is not in the low-tension circuit, then check the ignition coils as described on page G.6. If the coils prove satisfactory, ensure that the high-tension cables are not the cause of the fault.

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

SPARKING PLUGS

It is recommended that the sparking plugs be inspected, cleaned and tested every 3,000 miles (4,800 km.) and new ones fitted every 12,000 miles (20,000 km.).

To remove the sparking plugs a box-spanner (13/16″ — 19.5 mm. across flats) should be used and if any difficulty is encountered a small amouut of penetrating oil should be placed at the base of

the sparking plug and time allowed for penetration. When removing the sparking plugs identify each plug with the cylinder from which it was removed so that any faults revealed on examination can be traced back to the cylinder concerned.

Examine each plug for signs of oil fouling. This will be indicated by a wet, shiny, black deposit on the central insulator. This is caused by excessive oil in the combustion chamber during combustion and indicates that the piston rings or cylinder bores are worn.

Next examine the plugs for signs of petrol/gasoline fouling. This is indicated by a dry, sooty, black deposit which is usually caused by over-rich carburation, although ignition system defects such as a discharged battery, faulty contact breaker, coil or condenser defects, or a broken or worn out cable may be additional causes. To rectify this type of fault the above mentioned items should be checked with special attention given to carburation system.

Over-heating of the sparking plug electrodes is indicated by severely eroded electrodes and a white, burned or blistered insulator. This type of fault is usually caused by weak carburation, although plugs which have been operating whilst not being screwed down sufficiently can easily become over-heated due to heat that is normally dissipated through to the cylinder head not having an adequate conducting path. Over-heating is normally symptomised by pre-ignition, short plug life, and "pinking" which can ultimately result in piston crown failure. Unnecessary damage can result from over-tightening the plugs.

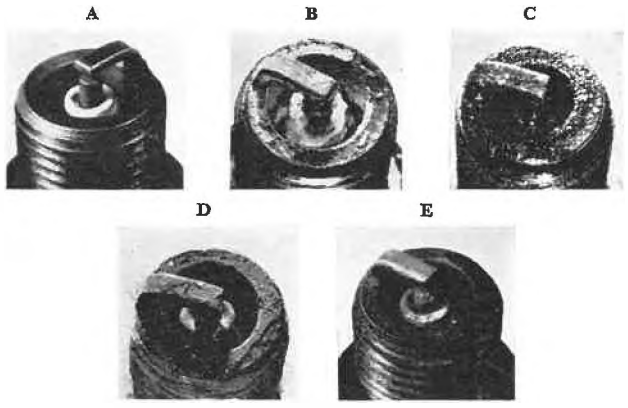


FIG. G.5. *Sparking plug diagnosis.*

A plug of the correct grade will bear a light flaky deposit on the outer rim and earth electrode, and these and the base of the insulator will be light chocolate brown in colour. A correct choice of plug is marked (*A*). (*B*) shows a plug which appears bleached, with a deposit like cigarette ash; this is too "hot-running" for the performance of the engine and a cooler-running type should be substituted. A plug which has been running too "cold" and has not reached the self-cleaning temperature is shown at (*C*). This has oil on the base of the insulator and electrodes, and should be replaced by a plug that will burn off deposits and remove the possibility of a short-circuit.

The plug marked (*D*) is heavily sooted, indicating that the mixture has been too rich, and a further carburation check should be made. At illustration (*E*) is seen a plug which is completely worn out and badly in need of replacement.

To clean the plugs it is preferable to make use of a properly designed proprietary plug cleaner. The maker's instructions for using the cleaner should be followed carefully.

When the plugs have been carefully cleaned, examine the central insulators for cracking and the centre electrode for excessive wear. In such cases the plugs have completed their useful life and new ones should be fitted.

Finally, before refitting the sparking plugs the electrodes should be adjusted to the correct gap setting of ·020″ (·5 mm.). Before refitting sparking plugs the threads should be cleaned by means of a wire brush and a minute amount of graphite grease smeared on to the threads. This will prevent any possibility of thread seizure occurring.

If the ignition timing and carburation settings are correct and the plugs have been correctly fitted, but over-heating still occurs then it is possible that carburation is being adversely affected by an air leak between the carburetter, manifold and the cylinder head. This possibility must be checked thoroughly before taking any further action. When it is certain that none of the above mentioned faults are the cause of over-heating then the plug type and grade should be considered.

Normally the type of plugs quoted in General Data are satisfactory for general use of the machine but in special isolated cases, conditions may demand a plug of a different heat range. Advice is readily available to solve these problems from the plug manufacturer who should be consulted.

NOTE:—If the air filter has been removed it will affect the carburation of the machine and hence may adversely affect the grade of sparking plugs fitted.

CHARGING SYSTEM

Description

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

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

To locate a fault in the charging circuit, first test the alternator as described on page G.10, Part B. If the alternator is satisfactory, the fault must lie in the charging circuit, hence the rectifier must be checked as given on page G.11, Part C, and then the wiring and connections as shown in Part D, page G.13.

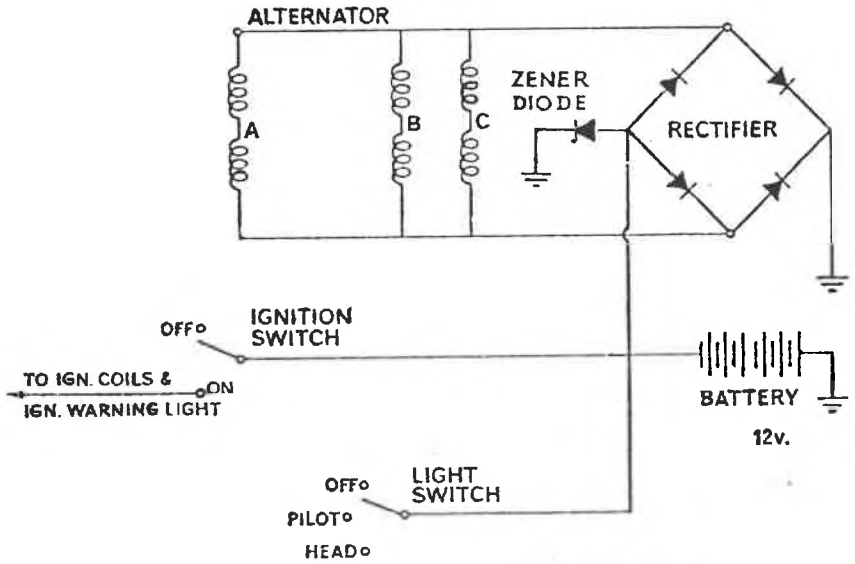


FIG. G.6. *Schematic diagram of* 12 *volt charging circuit with single charge rate and Zener Diode.*

G.8. PART A.

Checking the D.C. Output at Rectifier

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

Disconnect the brown/blue centre lead at rectifier. Connect D.C. ammeter (0—15 amp.) in series between the centre lead of rectifier and brown/blue main lead. Start the engine and run it at approximately 3,000 r.p.m. (equivalent to 45 m.p.h. in top gear).

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

A single charge rate is used and irrespective of switch positions the minimum D.C. input to the battery at 3,000 r.p.m. should be 10 amps.

G.9. PART B.

Checking the Alternator Output

Disconnect the three alternator output cables above the engine and run the engine at 3,000 r.p.m. (equivalent to 45 m.p.h. in top gear).

Connect an A.C. voltmeter (0—15 volts) with 1 ohm load resistor in parallel with each of the alternator leads in turn as shown in the table below and observe the volmeter readings. A suitable 1 ohm load resistor can be made from a piece of Nichrome wire as shown on page G.13, Part E.

	Alternator output minimum A.C. volts at 3,000 r.p.m.		
RM20 Stator 47209 (12 volt)	Green/ white and green/ black connected 5·0	Green/ white and green/ yellow connected 8·0	Green/ white, green/ black and green/ yellow connected 10·0

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

(1) If the readings are all equal to or higher than those quoted then the alternator is satisfactory.

(2) A low reading on any group of coils indicates either that the leads concerned are chafed or damaged due to rubbing on the chains or that some turns of the coils are short-circuited.

(3) Low readings for all parts of the test indicates either that the green/white lead has become chafed or damaged due to rubbing on the chain(s) or that the rotor has become demagnetised. If the latter case applies, check that this has not been caused by a faulty rectifier or that the battery is of incorrect polarity, and only then fit a new rotor.

(4) A zero reading for any group of coils indicates that a coil has become disconnected, is open circuit, or is earthed.

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

If any of the above mentioned faults occur, always check the stator leads for possible chain damage before attempting repairs or renewing the stator.

G.9. PART C.

Rectifier Maintenance and Testing

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

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

When tightening the rectifier securing nut, hold the spanners as shown in Fig. G.7 for if the plates are twisted, the internal connections will be broken. Note that the circles marked on the fixing bolt and nut indicate that the thread form is UN.F. (¼" diameter).

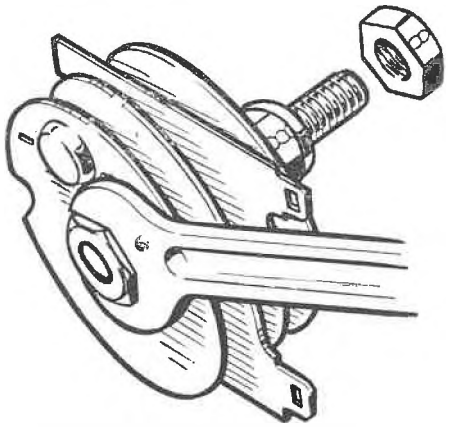


FIG. G.7. *Refitting the rectifier*

Testing the Rectifier

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

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

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

With the engine running at approximately 3,000 r.p.m. (approximately 45 m.p.h. in top gear) observe the voltmeter readings. The reading obtained should be at least 7·5 volt minimum.

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

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

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

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

Bench Testing the Rectifier

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

Connect the rectifier to a 12 volt battery and 1 ohm load resistor, and then connect the D.C. voltmeter in the V2 position, as shown in Fig. G.8. Note the battery voltage (should be 12 volt) and then connect the voltmeter in V1 position whilst the following tests are conducted.

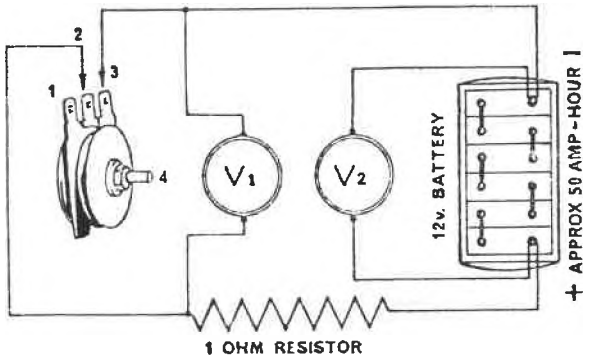


FIG. G.8. *Bench testing the rectifier.*

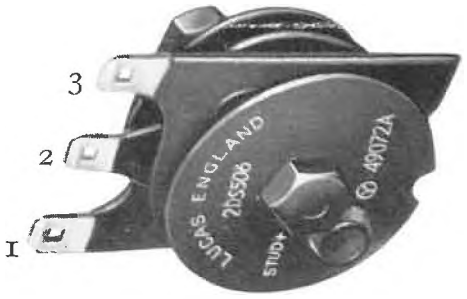


FIG. G.9. *Rectifier (showing terminal connections for bench tests* 1 *and* 2).

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

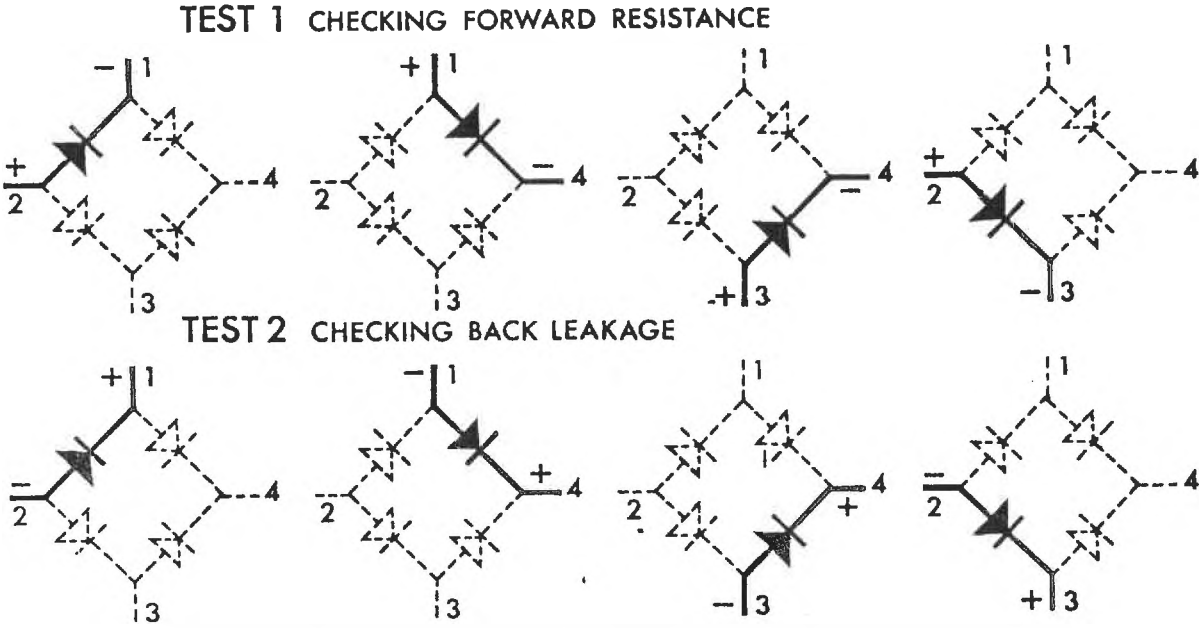


FIG. G.10. *Rectifier test sequence for checking forward resistance and back leakage.*

TEST 1.
With the test leads, make the following connections but keep the testing time as short as possible to avoid over-heating the rectifier cell: (*a*) 1 and 2; (*b*) 1 and 4; (*c*) 3 and 4; (*d*) 3 and 2. Each reading should not be greater than 2·5 volts with the battery polarity as shown.

TEST 2.
Reverse the leads or battery polarity and repeat Test 1. The readings obtained should not be more than 1·5 volts below battery voltage (V_2) (*i.e.*, 10·5 volts minimum).

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

G.11. PART D.

Checking the Charging Circuit for Continuity

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

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

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

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

(2) If not voltage is present at the rectifier central terminal (brown/white), check the voltage at the ammeter terminal. If satisfactory, it indicates that the brown/white wire is open circuit. If not, the ammeter is open circuit.

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

G.12. PART E.

Constructing a 1 ohm Load Resistor

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

A suitable resistor can be made from 4 yards (3¾ metres) of 18 s.w.g. (·048″, *i.e.*, 1·2 mm. diameter) Nichrome wire by bending it into two equal parts and calibrating it as follows.

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

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

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

ZENER DIODE CHARGE CONTROL

Description

The Zener Diode output regulating system uses all the coils of the six-coil alternator connected permanently across the rectifier, provides automatic control of the charging current. It will only operate successfully where it is connected in parallel with the battery as shown in the wiring diagram on page G.23. The Diode is connected direct to the centre terminal of the rectifier.

Assuming the battery is in a low state of charge its terminal voltage (the same voltage is across the Diode) will also be low, therefore the maximum charging current will flow into the battery from the alternator. At first none of the current is by-passed by the Diode because of it being non-conducting due to the low battery terminal volts. However, as the battery is quickly restored to a full state of charge, the system voltage

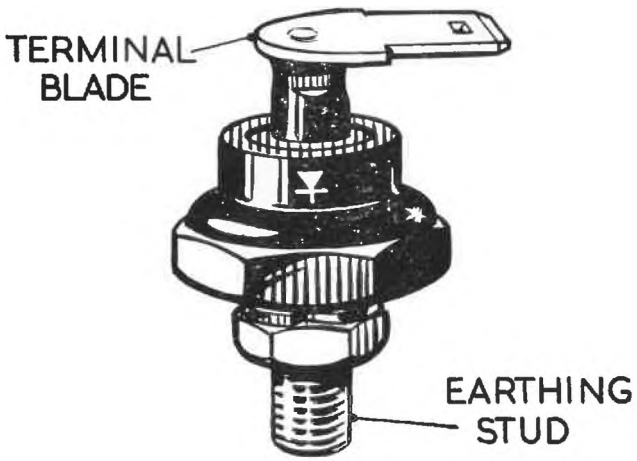


FIG. G.11. *Zener Diode.*

rises until at 13·5 volts the Zener Diode becomes partially conducting, thereby proving an alternative path for a small part of the charging current. Small increases in battery voltage result in large increases in Zener conductivity until, at approximately 15 volts about 5 amperes of the alternator output is by-passing the battery. The battery will continue to receive only a portion of the alternator output as long as the system voltage is relatively high.

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

If the electrical loading is sufficient to cause the system voltage to fall to 13·5 volts, the Zener Diode will revert to a high resistance state of non-conductivity and the full generated output will go to meet the demands of the battery.

With the specially designed heat sink the Zener Diode is able to absorb the full output of the alternator.

Maintenance
Provided a firm flat "metal to metal" contact is maintained between the base of the Diode and the surface of the heat sink, to ensure adequate heat flow, no maintenance will be necessary. Ensure that the earth connection to the diode is a good one.

ZENER DIODE CHARGING REGULATOR

(Procedure for testing on the machine)

Test Procedure
The test procedure given below can be used when it is required to check the performance of the Zener Diode type ZD715 whilst it is in position on the machine. It is essential that the battery is in a good state of charge otherwise the tests below will not be accurate. If in doubt, substitute a battery that is fully charged.

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

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

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

(3) Start the engine, ensure that all lights are off, and gradually increase engine speed while at the same time observing both meters:—
(*a*) The series connected ammeter must indicate zero amps, up to 12·75 volts, which will be indicated on the shunt connected voltmeter as engine speed is slowly increased.
(*b*) Increase engine speed still further, until

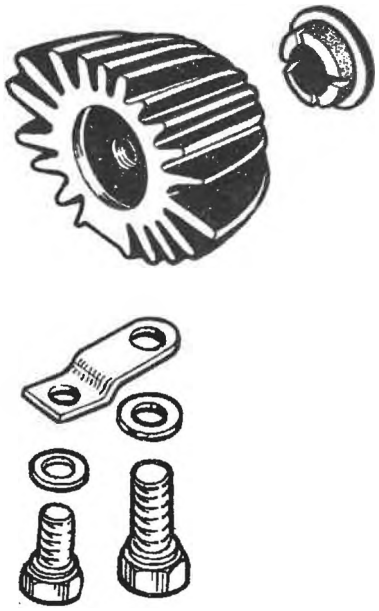


FIG. G.12. *Heat sink assembly.*

Zener current indicated on ammeter is 2·0 amp. At this value the Zener voltage should be 13·5 volts to 15·3 volts.

TEST CONCLUSIONS

If the ammeter in Test (*a*) registers any current at all before the voltmeter indicates 13·0 volts, then a replacement Zener Diode must be fitted.

If Test (*a*) is satisfactory but in Test (*b*) a higher voltage than that stated is registered on the voltmeter, before the ammeter indicates 2·0 amp, then a replacement Zener Diode must be fitted.

ZENER DIODE LOCATION

The Zener Diode is mounted on a bracket below the headlamp, the bracket being bolted to the fork middle lug. The aluminium heat sink is finned to assist cooling. The order of assembly is shown in Fig. G.12.

To remove diode only, disconnect the brown/white double "Lucar" connector from the diode. Remove the black plastic plug from the heat sink (see Fig. G.12) and unscrew the "Nyloc" nut which secures the diode. When refitting, the diode nut must be tightened with extreme care.

To remove the finned heat sink, remove the front bolt from the retaining bracket. A double red earth (ground) wire is attached at this point.

Do not attach the earth (ground) leads between the diode body and heat sink.

ELECTRIC HORN

Description

Twin windtone horns are fitted together with a relay to absorb the considerable voltage drop which would otherwise overload the circuit wiring when the horns are used. The method of operation is that twin electromagnets attract a steel diaphragm. The magnetic circuit is made self-interrupting by contacts which can be adjusted externally. As the points close, the diaphragm reverts to its original position causing the note to be emitted. The tone is improved by the trumpet-shaped sound chamber.

If the horns fail to work, check that the mountings are secure and check the horn wiring connections. Check the battery for state of charge, since a low supply voltage at the horn will affect adversely the horn performance. Ensure that the relay connections are sound (the relay is mounted beneath the twinseat, adjacent to the rectifier) test the horn relays as follows.

(1) Eliminate the horn push circuit by earthing W1 terminal (see Fig. G.13) with a temporary wire. If the horns then operate, check the horn push and associated wiring.

(2) Having carried out Test 1 and the horns still fail to operate, apply a direct feed to the horns with a temporary link between relay terminals C1 and C2. If the horns then operate, a faulty 6RA relay is indicated.

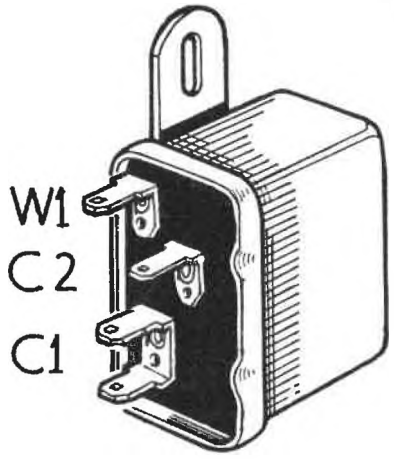


FIG. G.13. *Horn relay.*

If the above checks are made and the fault persists, then adjust the horns as follows.

Horn Adjustment
During adjustment it is advisable to depress the horn push for only a fraction of a second at a time. It is not necessary to remove the horns for adjustment. There is a plastic domed cover, secured by two Phillips-headed screws, on each horn. These covers must be removed to gain access to the adjustment screw. This is clarified by Fig. G.14.

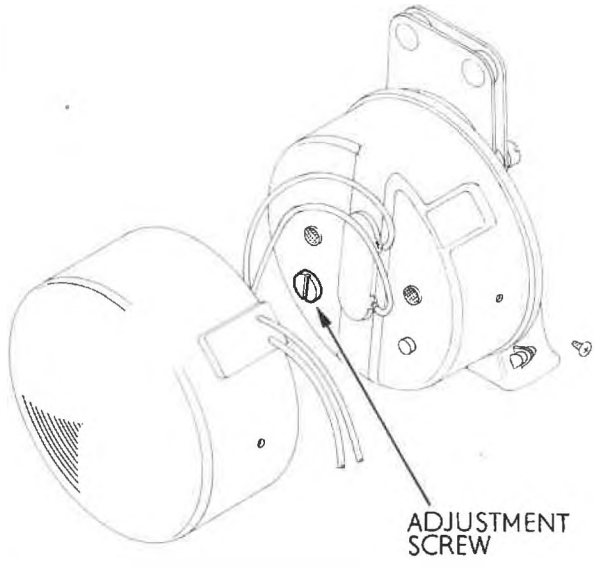


FIG. G.14. *Horn adjusting screw.*

Turn the screw clockwise or anti-clockwise a quarter turn at a time until the loudest clear note is delivered. The operation should be repeated for the second horn. Finally, refit both covers and screws.

HEADLAMP

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

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

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

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

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

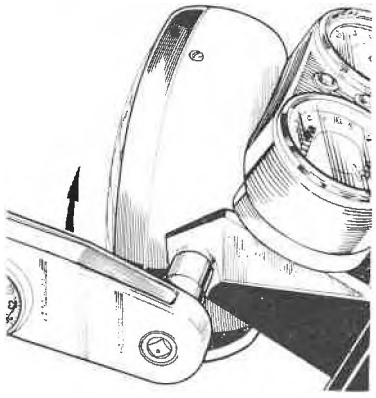


FIG. G.15. *The headlight adjustable mountings.*

The headlamp must therefore be set so that the main beam is directed straight ahead and parallel with the road when the motor-cycle is fully loaded. To achieve this, place the machine on a level road pointing towards a wall at a distance of 25 feet away, with a rider and passenger, on the machine, slacken the two pivot bolts at either side of the headlamp and tilt the headlamp until the beam is focused at approximately two feet—six inches from the base of the wall. Do not forget that the headlamp should be on "full beam" lighting during this operation.

REMOVING AND REFITTING THE HEADLAMP

Disconnect the battery at the fuse holder. Remove the pivot bolts and washers and collect the plastic spacers. The headlamp complete can then be lifted away from the fork and the four leads parted at the snap connectors. Note for refitting that the leads connect colour to colour. The headlamp is now free to be removed.

When refitting, set the headlamp main beam and tighten the headlamp pivot bolts to the torque setting given on page J.1.

TAIL AND STOP LAMP UNIT

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

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

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

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

FUSES

If the fuse fails, it indicates a fault in the electrical circuit which must be rectified before the fuse is replaced. Spare fuses should always be carried.

FIG. G.16. *The in-line fuse dismantled.*

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

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

IGNITION SWITCH

The 45SA ignition switch incorporates a "barrel" type lock as fitted. These locks use individual "Yale"-type keys and render the ignition circuit inoperative when the switch is turned off and the

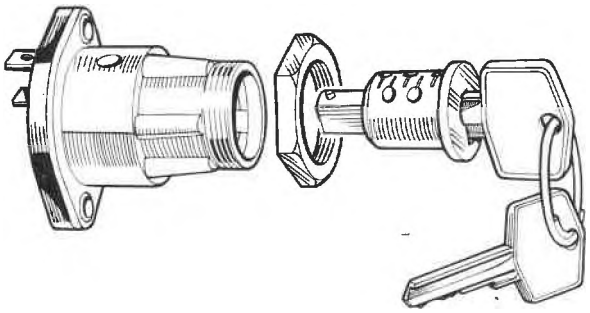


FIG. G.17.

key removed. It is advisable for the owner to note the number stamped on the key to ensure a correct replacement in the event of the key being lost.

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

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

IGNITION CUT-OUT "KILL" BUTTON

An emergency cut-put "kill" button is provided. This is mounted on the right handlebar and can be used to stop or "kill" the engine. Always ensure that the ignition is turned off after the engine is stopped in this fashion. Although the A75 uses only one type of cut-out-button, other models use a button of identical appearance but with internal connections arranged differently. It is therefore essential for the correct replacement to be used, this being ordered by reference to the replacement parts catalogue.

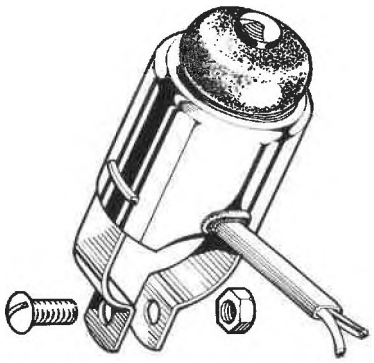


FIG. G.18.

WARNING LAMPS AND AMMETER

The blue or green warning light is used to indicate headlamp high beam and the red, a lack of oil pressure though it acts also as an ignition warning. The latter is operated by a pressure switch screwed into the crankcase below the rear of the oil filter compartment. The red light should extinguish at 7 lb. sq./in. pressure. If it is required to change a warning light bulb, access is most easily gained by releasing the headlamp from its brackets (page G.17) whereupon the bulb holder can be pulled gently downwards and the bulb changed. The warning light bodies are a push-fit into the binnacle.

Note that the leads for the high beam warning light are blue/white tracer, and for the oil pressure warning light white/blue tracer.

The ammeter is merely pushed home into the binnacle and only the leads need to be disconnected prior to removal.

CAPACITOR IGNITION (Model 2MC) ALTERNATIVE SYSTEM

(USING LARGE CAPACITOR FOR OPERATING WITH OR WITHOUT BATTERY)

The Lucas motor-cycle capacitor system has been developed to enable machines to be run with or without a battery. The rider therefore has the

choice of running with normal battery operation or running without battery if desires (*e.g.*, competing in trials or other competative events) and for emergency operation in case of battery failure.

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

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

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

Also with this system alternator timing is much less critical. Provided the centres of the rotor and stator poles are roughly in line in the fully retarded position (*i.e.*, as normal battery) emergency start condition which is 30° past magnetic neutral, satisfactory starting will be obtained. Furthermore any auto-advance angle and speed characteristics may be used and perfect running ignition performance achieved.

Identification of Capacitor Terminals

The 2MC capacitor is an electroclytic (polarised) type and care must be taken to see that the correct wiring connections are made when fitting. Spare Lucar connectors are supplied to assist in connecting up. Looking at the terminal end of the unit it will be seen that there are two sizes of Lucar connector. The small $\frac{3}{16}$" Lucar is the **positive** (earth) terminal the rivet of which is marked with a spot of red paint. The double ¼" Lucar forms the **negative** terminal.

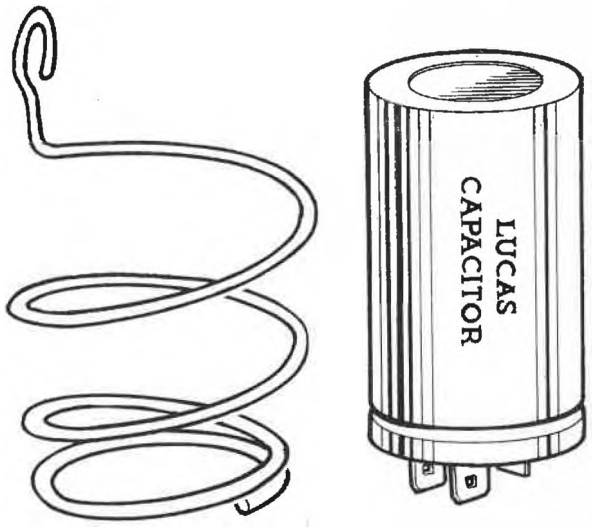


FIG. G.19.
Motor cycle capacitor Model 2MC

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

Storage Life of Model 2MC Capacitor

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

Testing

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

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

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

(*c*) Then connect the voltmeter leads to the capacitor and note the instantaneous reading. This should not be less than 8·0 volts for a serviceable unit.

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

Wiring and Installation

The capacitor is fitted into the spring and should be mounted with its terminals downwards. The capacitor negative terminal **and** Zener Diode must be connected to the rectifier centre (D.C.) terminal (brown/white) ,and the positive terminal must be connected to the centre bolt earthing terminal (see capacitor ignition diagram Fig. G.20).

The mounting spring should be attached to any convenient point near the battery carrier.

Service Notes

Before running a 2MC equipped machine with the battery disconnected it is essential that the **battery negative lead be insulated** to prevent it from reconnecting and shorting to earth (frame of machine). Otherwise, the capacitor will be ruined. This can be done by removing the fuse from its holder and replacing it with a length of ¼″ diameter dowel rod or other insulating medium.

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

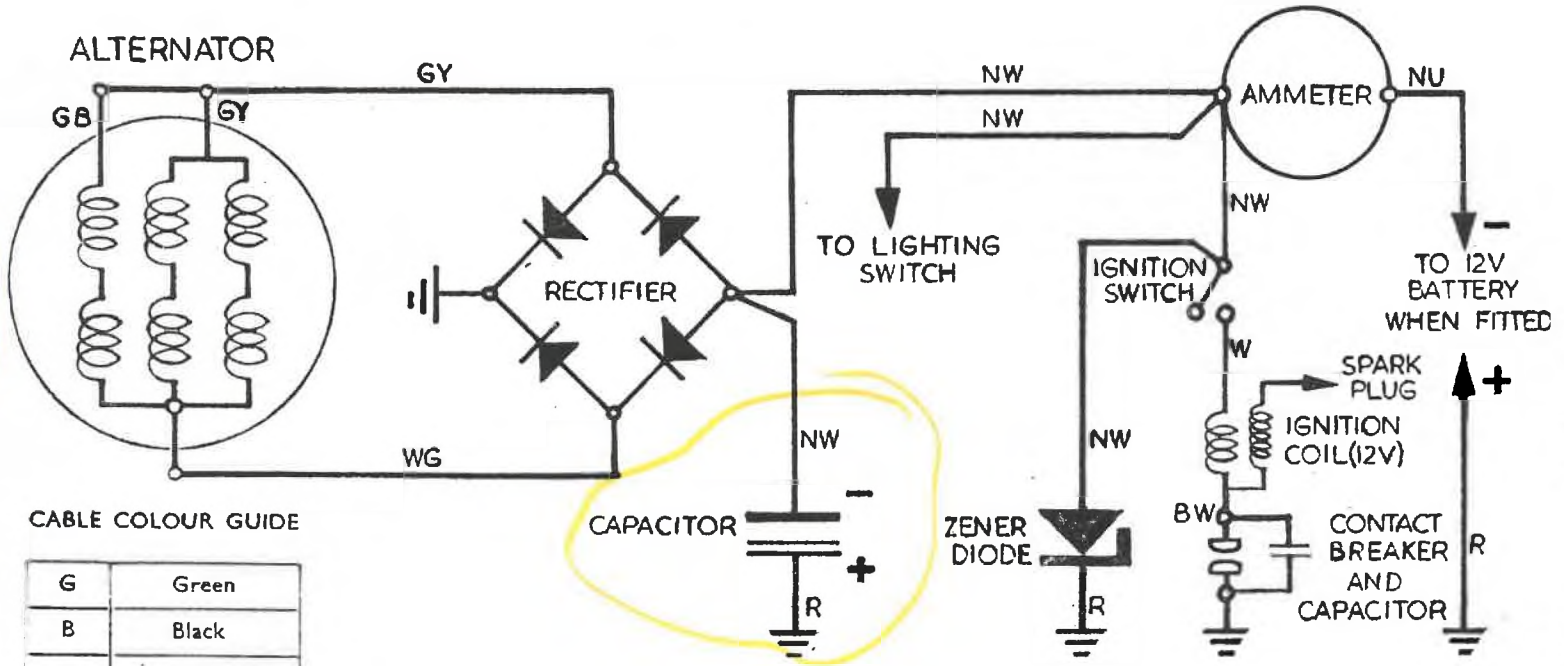
A capacitor kit is available under part No. 00–4402.

Do not run the machine with the Zener Diode disconnected, as the 2MC capacitor will be damaged due to excessive voltage.

Should the engine fail to start without the battery, substitute a new 2MC capacitor. If the engine still refuses to start, check the wiring between the capacitor and rectifier for possible open or short-circuit conditions. Also check the earth connections.

If difficulty is encountered in starting with a battery fitted, disconnect the 2MC capacitor to eliminate the possibility of a short-circuit.

USING LARGE CAPACITOR FOR OPERATING WITH OR WITHOUT BATTERY



CABLE COLOUR GUIDE

G	Green
B	Black
R	Red
Y	Yellow
N	Brown
W	White
U	Blue

FIG. G.20. *Capacitor ignition diagram.*

BASIC MOTOR-CYCLE CIRCUIT

	LUCAS PART NO.
2MC capacitor	54170009
Mounting spring (horizontal boltfixing)	54483156
Mounting spring (vertical boltfixing)	54483155

ALTERNATOR AND STATOR DETAILS

(SPECIFICATIONS AND
OUTPUT FIGURES)

Model	System Voltage	Ignition Type	Alternator Type	Stator Number
A75	12 volts	Coil	RM.20 (encapsulated)	47209

Stator Number	System Voltage	D.C. input to battery amp. at 3,000 r.p.m.	Alternator output Minimum A.C. volts at 3,000 r.p.m.		
			A	B	C
47209	12 volts	9·5 (Diode disconnected)	5	8	10

Alternator Lead Connections

A — Green/white and green/black.
B — Green/white and green/yellow.
C — Green/white and green/black—green/yellow connected.

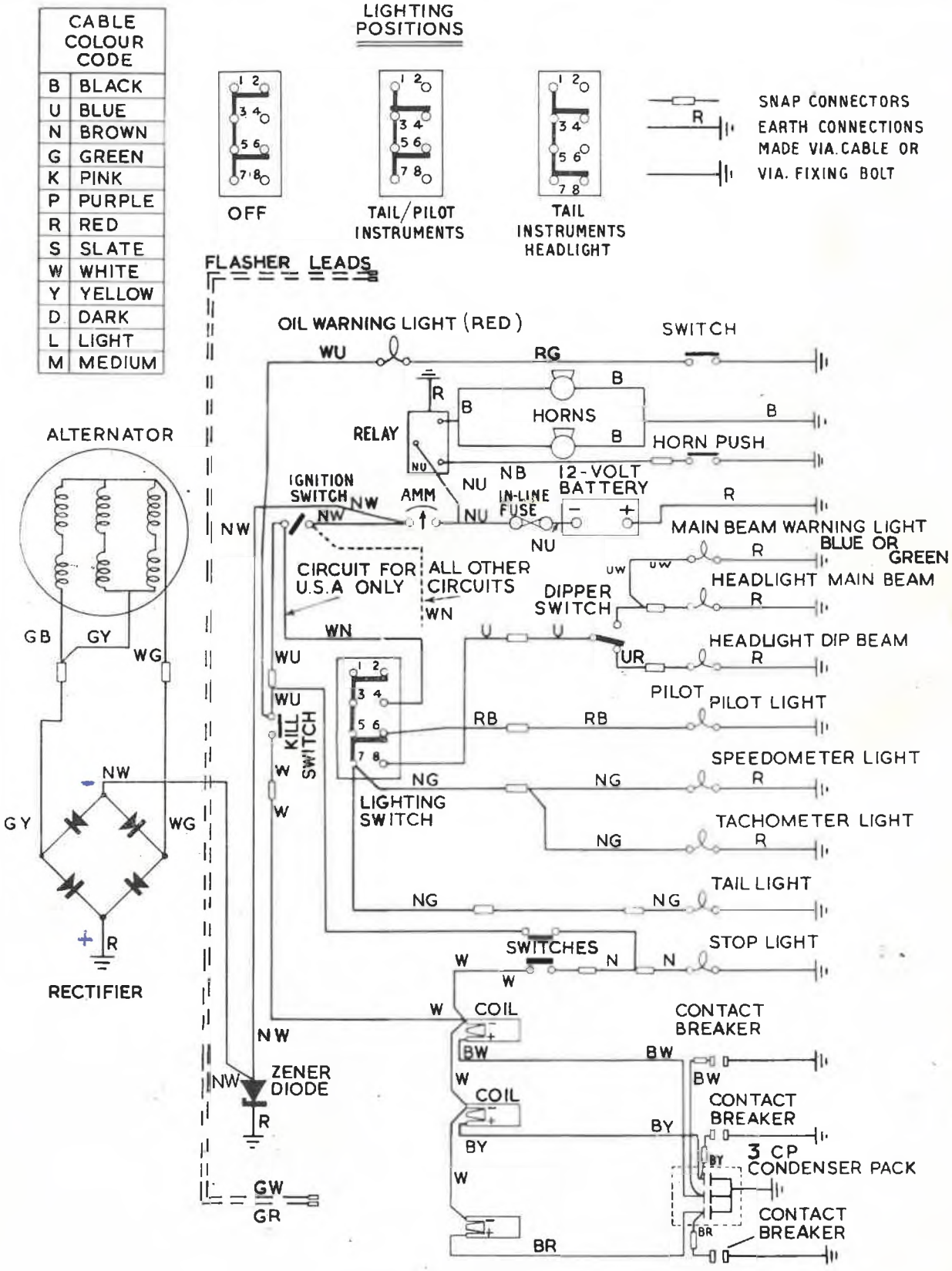


FIG. G.21. *Wiring diagram.*

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LUBRICATION

An early indication that the chain is being starved of oil is the appearance at the joints of a reddish-brown deposit and this should be taken as a warning that there is something amiss with the lubrication.

For primary chain lubrication refer to page A.11.

REAR CHAIN LUBRICATION

Just inside the oil tank there is a drip-feed arrangement fed from the return oil pipe, this is in the form of a spring, and a screw with a taper on the end. This screws down into a tapered hole, thus regulating the amount of oil which passes down a tube to the back brake anchor plate from here it drips on to the lower run of the chain.

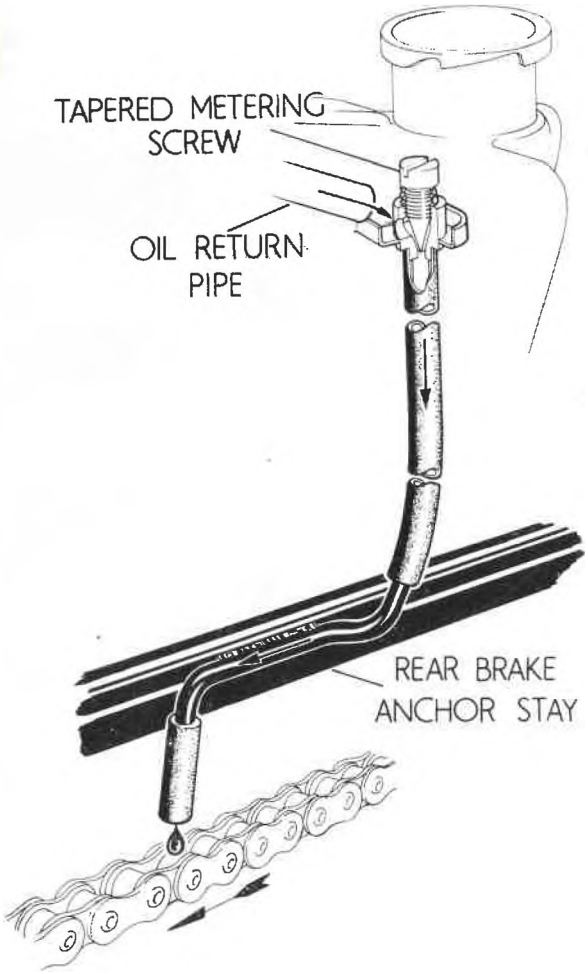

FIG. H.1. *Rear chain drip-feed system.*

The chain should not need any lubrication other than this method but it is important not to let too much oil drip on to the chain as it will throw off on to the rear tyre and become very dangerous.

CHAIN ADJUSTMENT

To adjust the rear chain slacken off the wheel nuts and brake anchor nuts. Now to tighten the chain screw the adjuster nut further on to the adjuster bolt, evenly on both sides of the machine to slacken the chain the procedure should be reversed.

When the chain is adjusted correctly there should be 1½″ total up and down movement at a point half-way between the two sprockets.

Now tighten the wheel nuts and brake anchor strap nuts and check wheel adjustment described on page F.7.

For primary chain adjustment refer to page B.28.

CHAIN MEASUREMENT

It is useful to know the extent of wear, and a simple test for this consists of measuring the chain with an ordinary foot-rule, steel for preference. Wear up to ¼″ per foot of chain length is accomodated by the depth of hardening of the bearing surfaces, and when this limit is reached the chain should be replaced.

With a new ⅝″ pitch chain, 16 pitches will come to the 10″ mark on the rule, and a sufficiently accurate check for subsequent wear is to take a limit of 10-7/32″ for 16 pitches. For a ⅜″ pitch chain, 24 pitches of a new chain will come to the 9″ mark on the rule, and the limit of $9\frac{3}{16}$″ for 24 pitches should be taken as the maximum permissible wear for this size of chain.

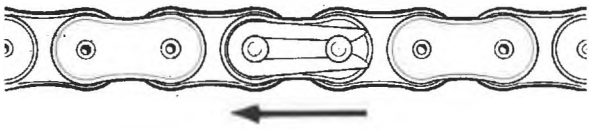

FIG. H.2. *Spring link.*

Naturally, the test should be made carefully to obtain an accurate result. The chain is first washed in kerosene to ensure that all joints are free, and laid unlubricated on a flat board. If it is anchored at one end by a nail the necessary tension to pull it out to its fullest extent can be applied with one hand, while mearing between the centres of the bearing pins.

It is important to note that the closed end of the spring clip must point in the direction of chain travel.

If it is found that the chain is still serviceable but the full amount of adjustment has been taken up, then the chain length should be reduced by either one or two pitches as detailed below.

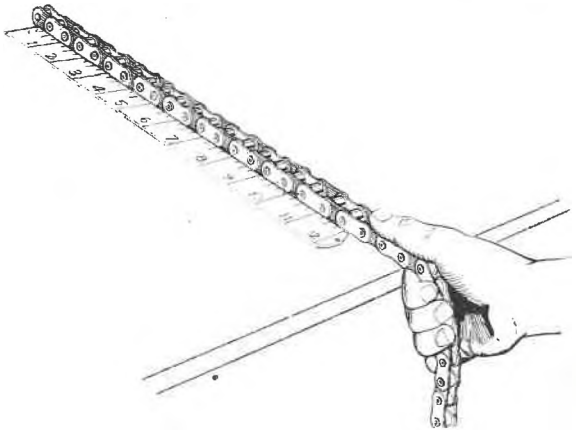

FIG. H.3. *Measuring the chain.*

CHAIN ALTERATIONS AND RENEWALS

The illustrations show temporary repairs on the roadside; for permanent repairs, the parts should be replaced by a riveted outer link.

To **SHORTEN** a chain containing **an EVEN number of pitches:** remove the parts shown (*A*) Fig. H.4, replace by cranked double link and single connecting link, parts shown (*B*) Fig. H.4.

To **SHORTEN** a chain containing **an ODD number of pitches:** remove the parts shown (*C*) Fig. H.4, replace by single connecting link and inner link, parts shown (*D*) Fig. H.4.

To **REPAIR** a chain with a broken roller or inner link, remove the parts shown (*E*) Fig. H.4, replace by two single connecting links and one inner link, parts shown (*F*) Fig. H.4.

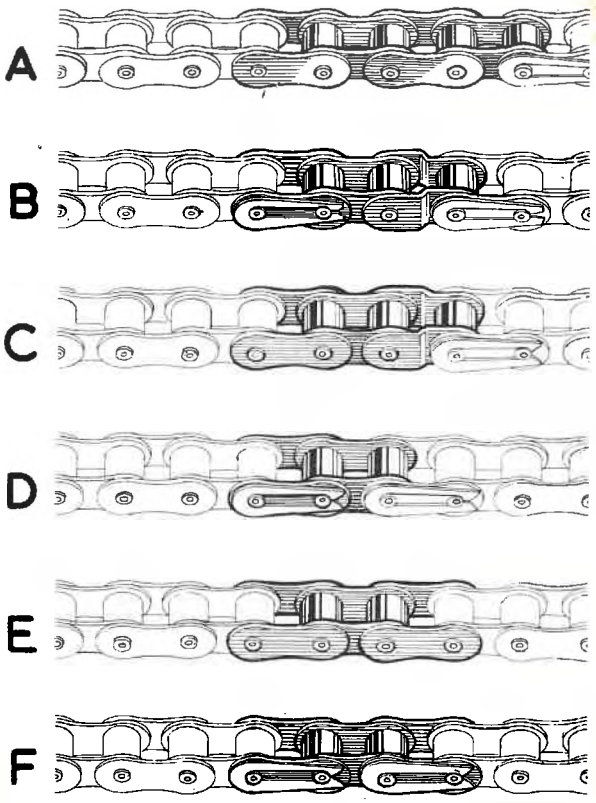

FIG. H.4.

CHAIN AND SPROCKET INSPECTION

Chain sprockets on a new machine should be correctly aligned but malalignment may arise in use. This may be due perhaps to slackened nuts, incorrect reassembly after say, an emergency repair, or minor spills. A periodical alignment check is therefore desirable, and is most easily done when the machine is undergoing overhaul as removal of adjacent components facilitates the job.

A straight-edge across the sides of the teeth on the two sprockets should touch at four points, in any position of rotation of the sprockets. If the latter are in correct alignment, the inner plates of the chain will be slightly polished equally on their inner sides and this is not detrimetal. Hoever, if one side shows considerably more wear than the other it indicates that the shafts are not parrallel (as viewed from the above) or not in the same plane (as viewed from the back of the machine). If the inner plates on both sides of the chain show real wear as opposed to polishing, particularly after a comparatively short mileage, it is probable that one sprocket is further out on its shaft than the other.

Sprockets which are excessively worn assume a "hooked" appearance, as shown below. When they are replaced check the new ones for accuracy. A new chain should fit completely round the teeth with a snug fit, neither too slack nor having a tight "springy" feel. The sprocket bore must be concentric, otherwise the chain will tend to slacken and tighten as the sprockets are rotated.

With the sprocket in position, a pointer fitted adjacent to the teeth edges will detect such faults, and if any show up, the sprocket should be rejected, assuming that the wobble is not caused by a bent shaft. Failure to correct such faults will cause the chain to wear quickly and unevenly.

The standard method of coupling a chain is by a spring connecting link, which is simple and effective. On normal touring machines it is completely reliable but nevertheless should receive regular inspection, particularly in the case of fast roadster and sidecar machines where full power is often "turned on."

It may be advisable on such machines to replace the spring link at say 5,000 mile intervals, the reason being that, of necessity, the detachable plate on this link has to be a free-fit, and under heavy load some wear must occur, thus throwing an undue proportion of the load on to the opposite (fixed) plate of the link. It is important to note that the closed end of the spring clip must point in the direction of chain travel.

For competition machines a riveted link should be substituted for the spring link in the primary chain. On racing types the rear chain should also be riveted. This procedure involves a little extra trouble, but is a worthwhile insurance against losing a spring clip at a critical moment.

FIG. H.5. *Worn sprocket.*

Listed below are the recommended torque wrench settings for critical bolts and nuts. Over-tightening or non-uniform tightening of the cylinder head and barrel nuts for instance, can cause distortion, resulting in loss of compression, increased engine wear, and poor fuel economy.

Application	Thread	T.P.I.	Hex. A/F	Torque	
				ft./lbs.	kg./m.
Alternator rotor nut ..	0·4375″ UN.F.	20	0·9375″	50	6·9
Clutch centre nut	0·5625″ UN.F.	18	0·875″	60	8·29
Connecting rod nuts (S.L.)	0·3125″ UN.F.	24	0·50″	17½—18½	2·4—2·5
Crankcase junction bolts ..	0·3125″ UN.C.	18	0·50″	15	2·074
Crankcase junction stud nuts	0·3125″ UN.F.	24	0·50″	15	2·074
Cylinder barrel nuts ..	0·375″ UN.F.	24	0·5625″	20—22	2·76—3·042
Cylinder head bolts ..	0·3125″ UN.F.	24	0·50″	18	2·48
Cylinder head stud nuts ..	0·375″ UN.F.	24	0·5625″	18	2·48
Engine sprocket nut ..	0·75″ UN.F.	20	1·125″	58—63	8·02—8·7
Fork bottom yoke pinch bolts	0·375″ UN.F.	24	0·5625″	23—25	3·2—3·45
Fork top cap nuts	1·0625″ UN.S.	28	1·50″	75—80	10·36—11·06
Fork top yoke pinch bolt ..	0·375″ UN.F.	24	0·5625″	23—25	3·2—3·45
Front wheel spindle cap bolt	0·3125″ UN.F.	24	0·50″	23—25	3·2—3·45
Kickstart ratchet nut ..	0·5625″ UN.F.	18	0·9375″	40—45	5·5—6·2
Main bearing cap nuts (S.L.)	0·375″ UN.F.	24	0·5625″	17½—18½	2·4—2·5
Rocker box bolts	0·25″ UN.C.	20	0·4375″	6	·83
Rocker box stud nuts ..	0·25″ UN.F.	28	0·493″	6	·83
Shock absorber nut ..	0·625″ UN.F.	18	0·9375″	75—80	10·36—11·06
Stator mounting nuts (S.L.)	0·3125″ UN.F.	24	0·445″	8	1·1
Zener Diode nut	0·25″ UN.F.	28	0·4375″	2—2·3	·28—·31
Headlamp mounting bolts..	0·3125″ W.F.	26	0·525″	10	1·4
Gearbox Sprocket nut ..	1·250″ UN.S.	28	1·675″	58	8·02

Abbreviations:

A/F	Across Flats.
S.L.	Self-locking.
T.P.I.	Threads Per Inch.
UN.C. ..	Unified Coarse.
UN.F. ..	Unified Fine.
UN.S.	Unified Special.
W.F.	Whitworth Form.

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ENGINE:

FRONT FORKS AND FRAME:

ENGINE

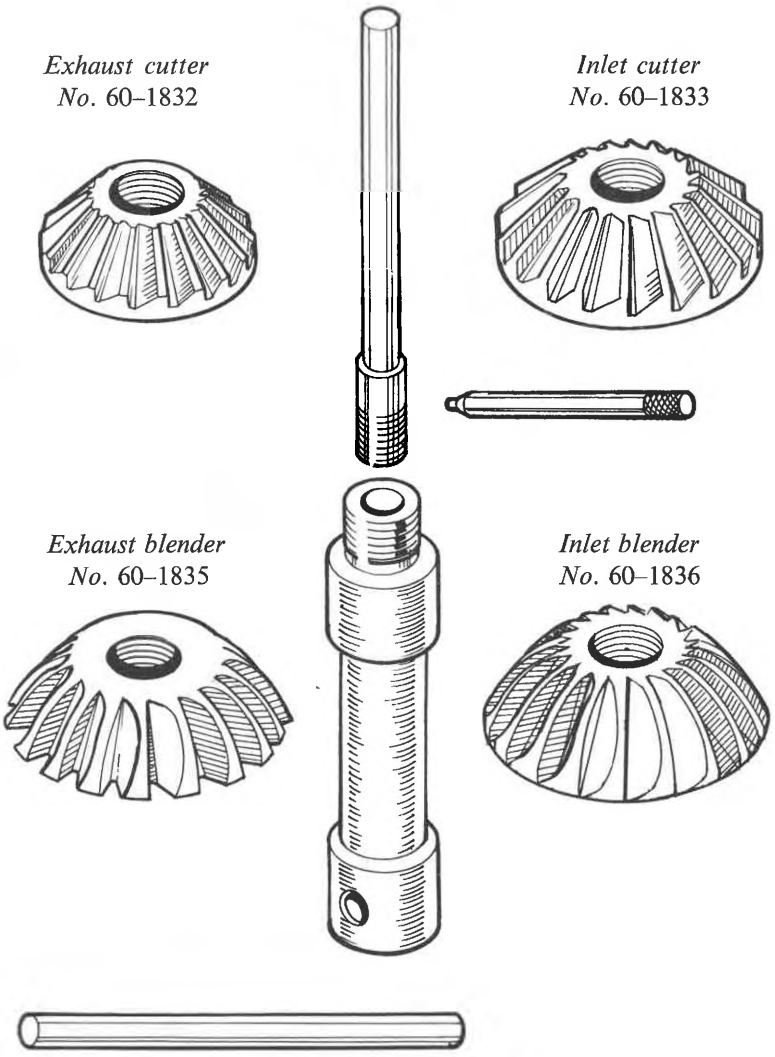

FIG. K.1.
Valve seat cutter No. 60–1863.
Holder and pilot set.

FIG. K.2.
Valve grinding tool No. 61–5035.

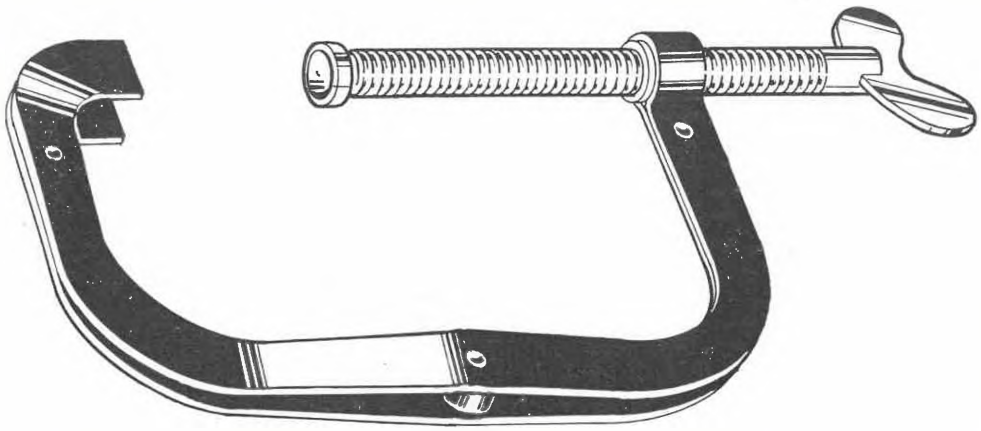

FIG. K.3.
Valve spring compressor No. 61–3341.

FIG. K.4.
Rocker spindle oil seal compressor No. 60–2221.

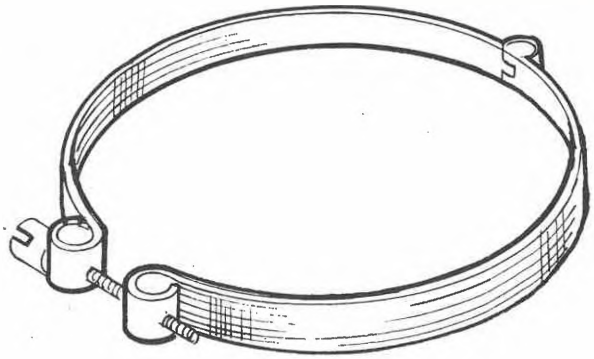

FIG. K.5.
Piston ring slipper No. 61–6031 (3 *per set*).

FIG. K.6.
Contact breaker cam extractor No. 60–782.

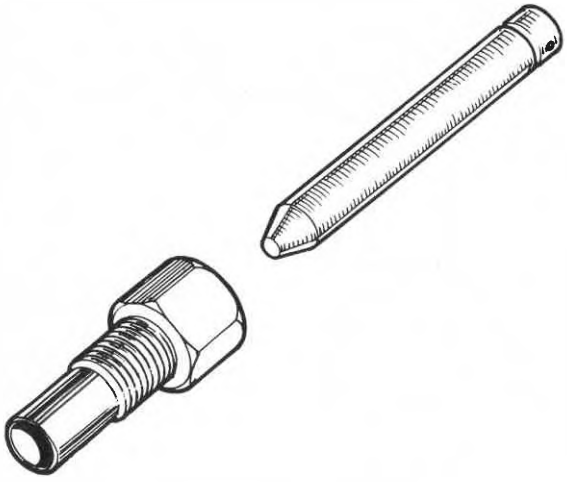

FIG. K.7.
Ignition timing plug and body No. 60–1858

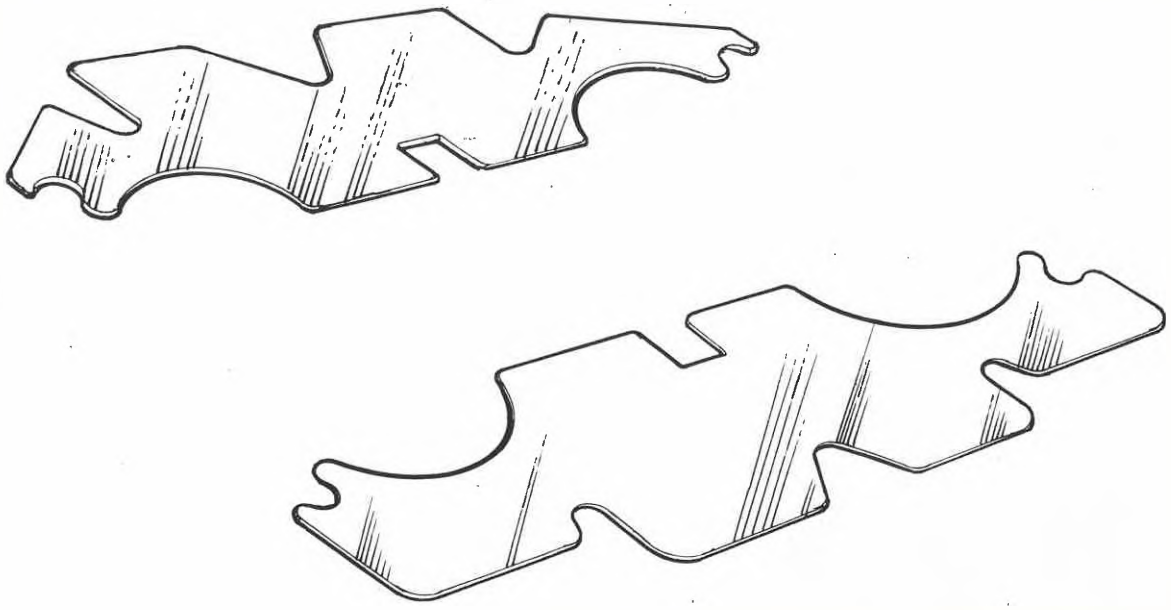

FIG. K.8.
Crankcase baffles. No. 60–2211 (*front*). *No.* 60–2212 (*rear*).

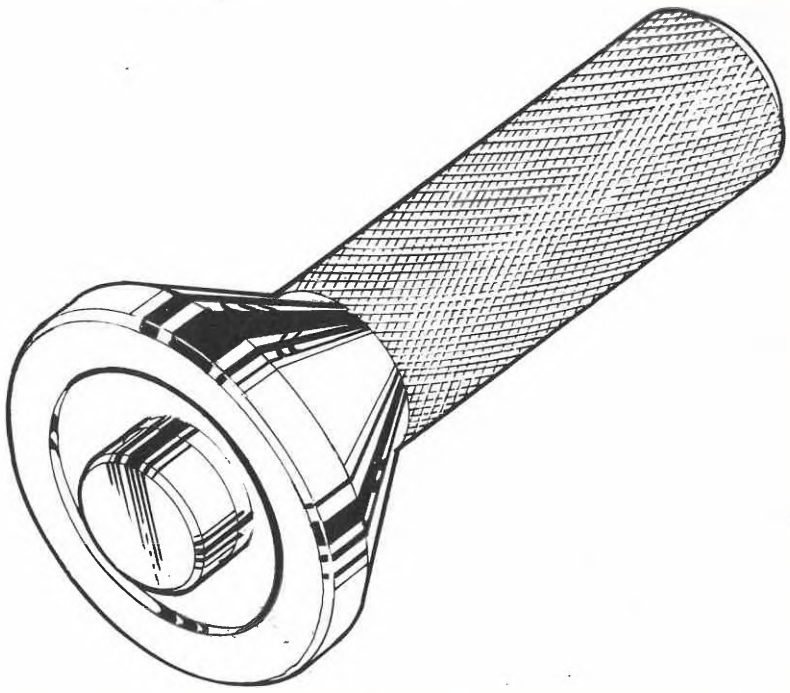

FIG. K.9.
Punch for crankcase bearing drive-side No. 61–6021.

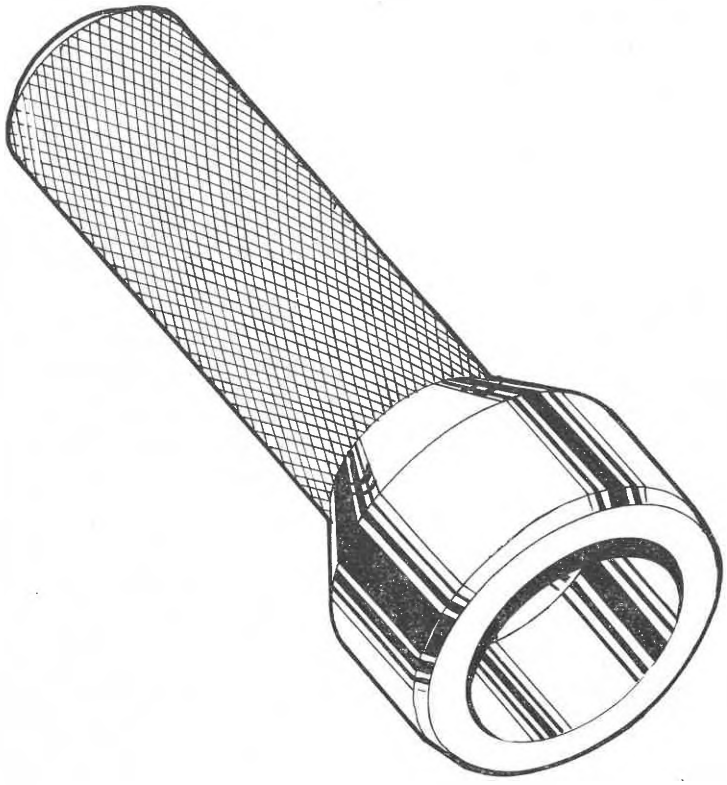

FIG. K.10.
Timing-side outer bearing drift
No. 61–6020.

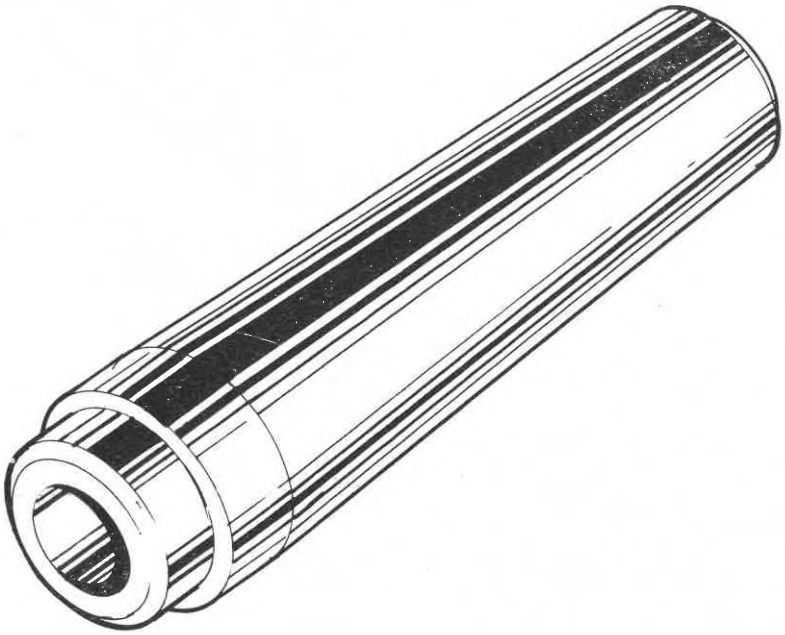

FIG. K.11.
Gearbox top gear bearing drift
No. 61–6026.

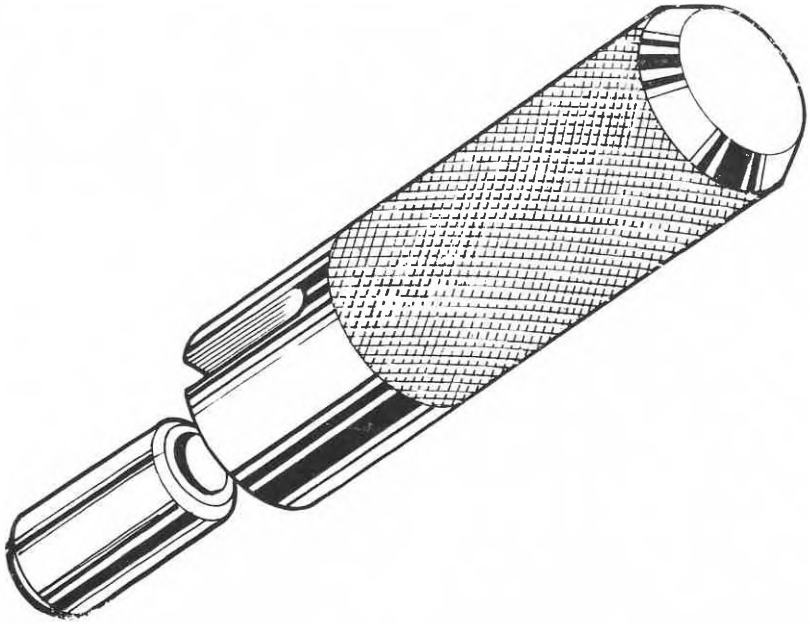

FIG. K.12. *Timing-side crankshaft pinion drift and guide No.* 61–6024.

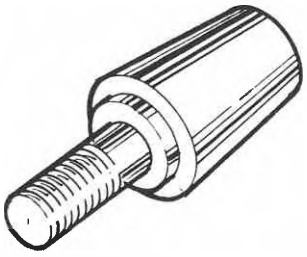

FIG. K.13.
Camshaft oil seal protector No. 60–1810.

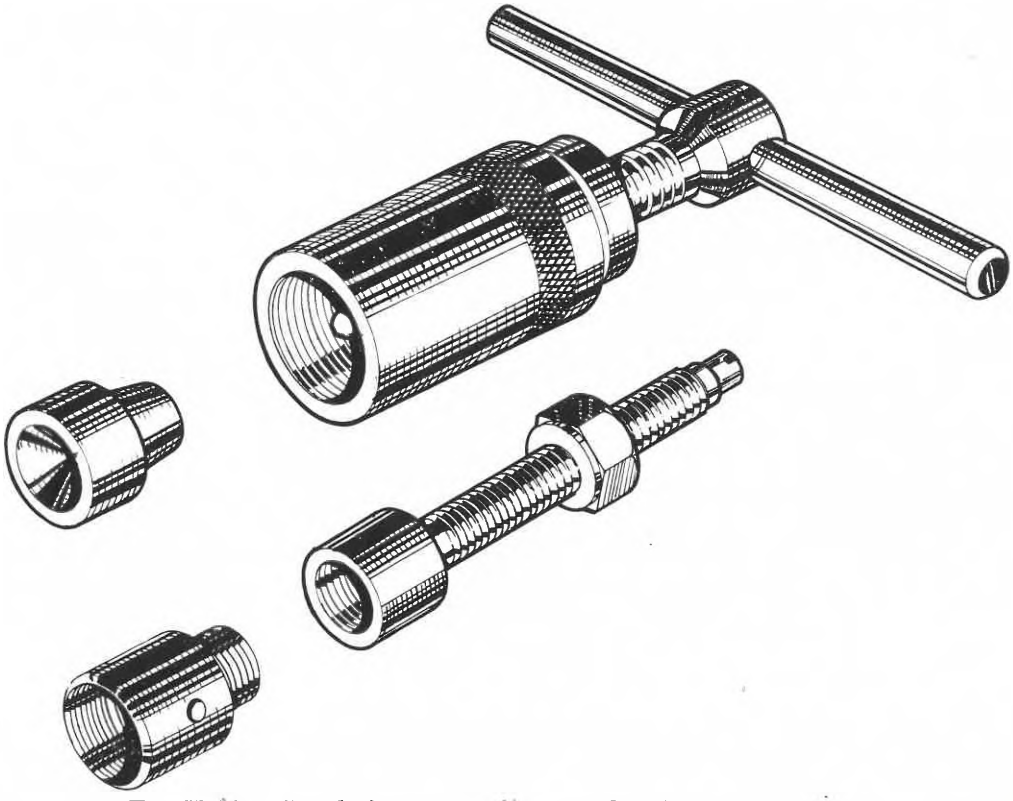

FIG. K.14. *Camshaft pinion extractor and replacer No.* 60–2213.

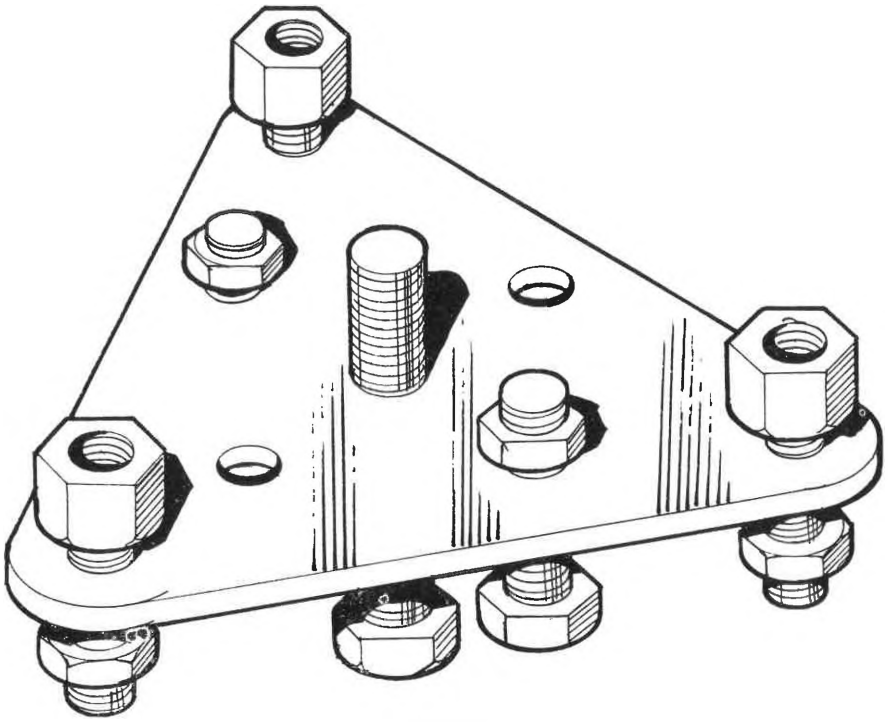

FIG. K.15.
Timing-side crankcase and engine sprocket extractor No. 61–6046.

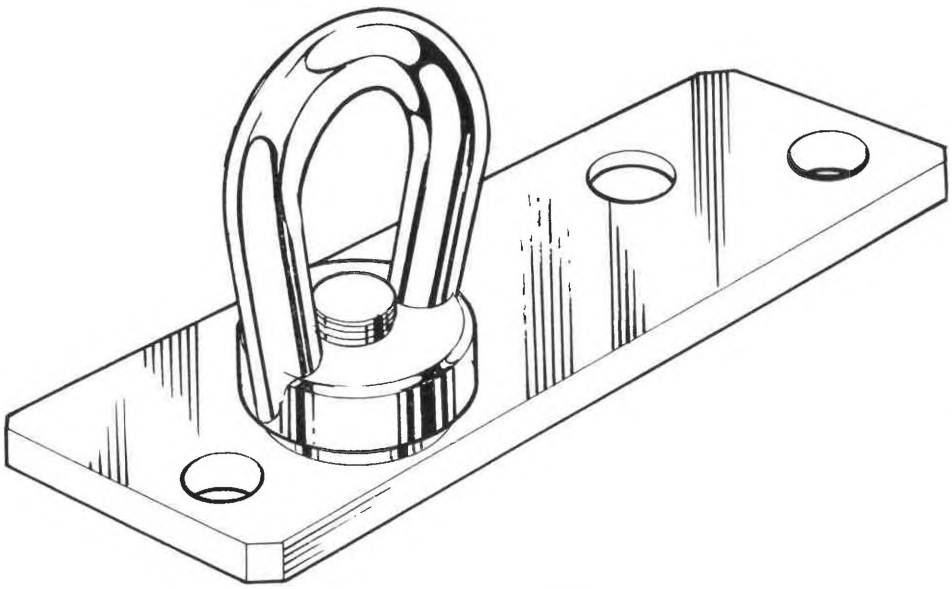

FIG. K.16. *Engine lifting attachment No.* 61–6002.

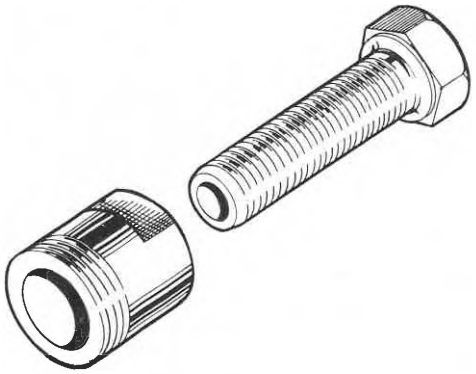

FIG. K.17.
Shock absorber hub extractor No. 60–1862.

FIG. K.18.
Shock absorber nut oil seal protector No. 61–6051.

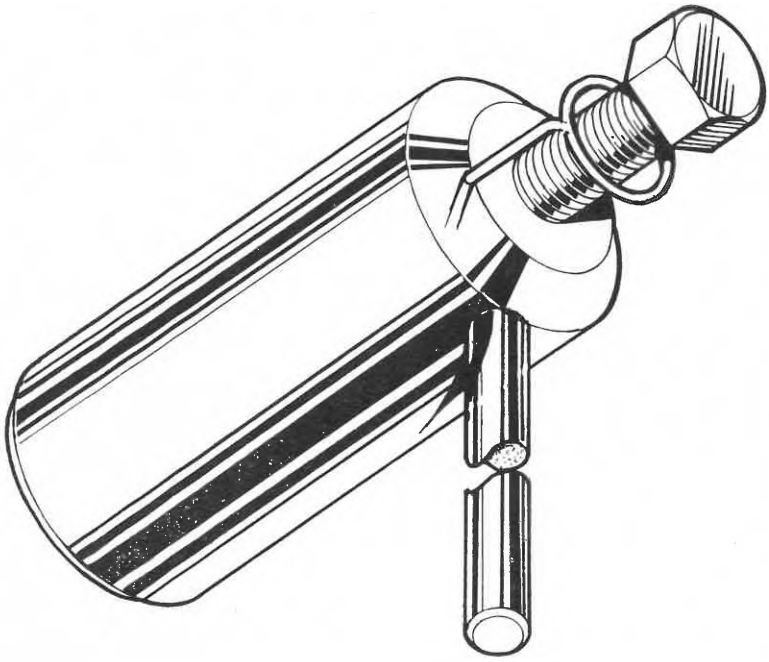

FIG. K.19.
Crankshaft pinion extractor No. 61–6019.

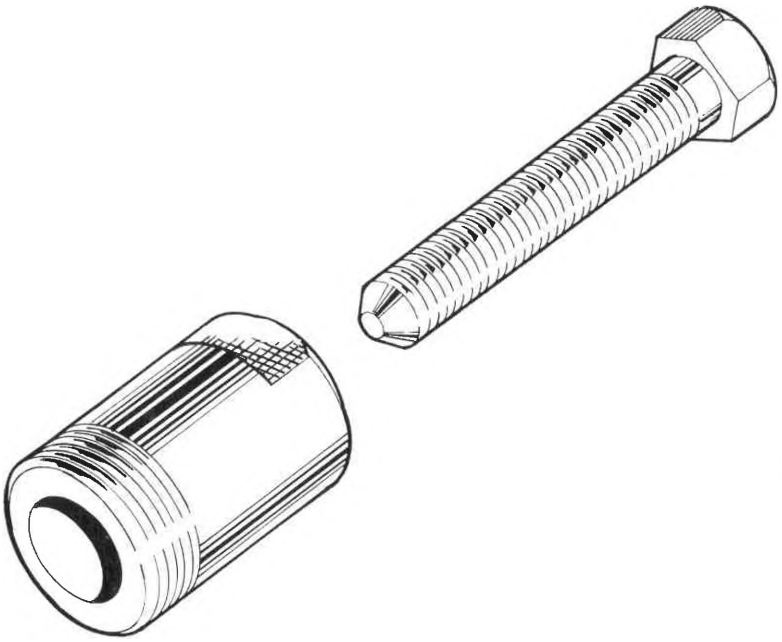

FIG. K.20.
Clutch hub extractor No. 60–1860.

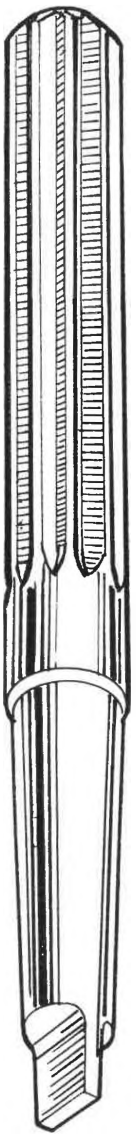

FIG. K.21.
Reamer for top gear bush No. 61–6010.

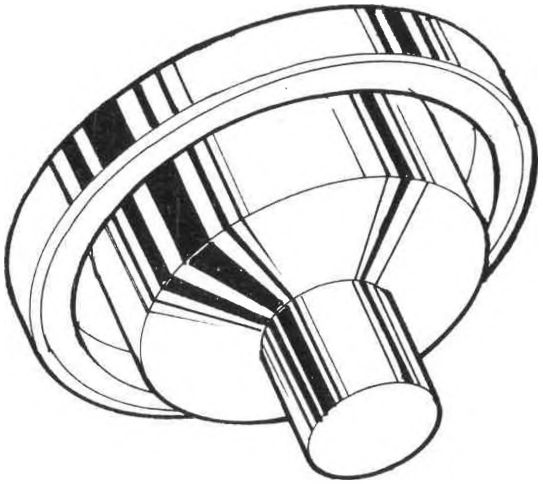

FIG. K.22.
Alignment gauge for Borg and Beck clutch No. 61–6042.

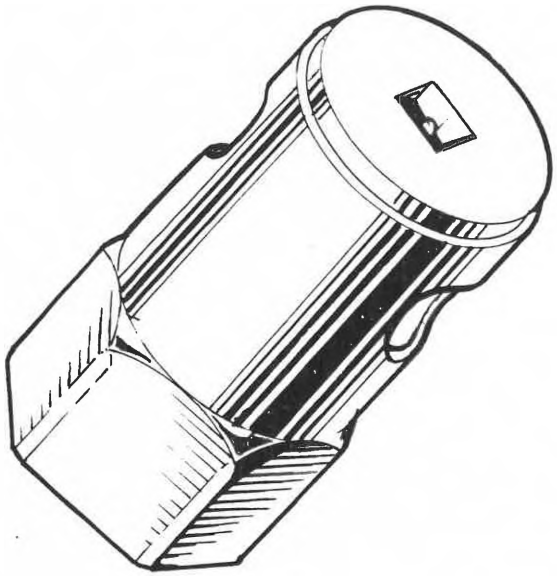

FIG. K.23.
Gearbox sprocket nut box spanner
No. 61–6061.

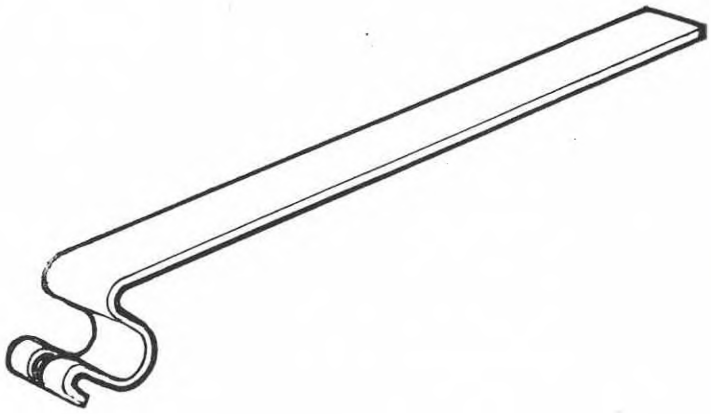

FIG. K.24.
Throttle rod assembly tool
No. 60–1865.

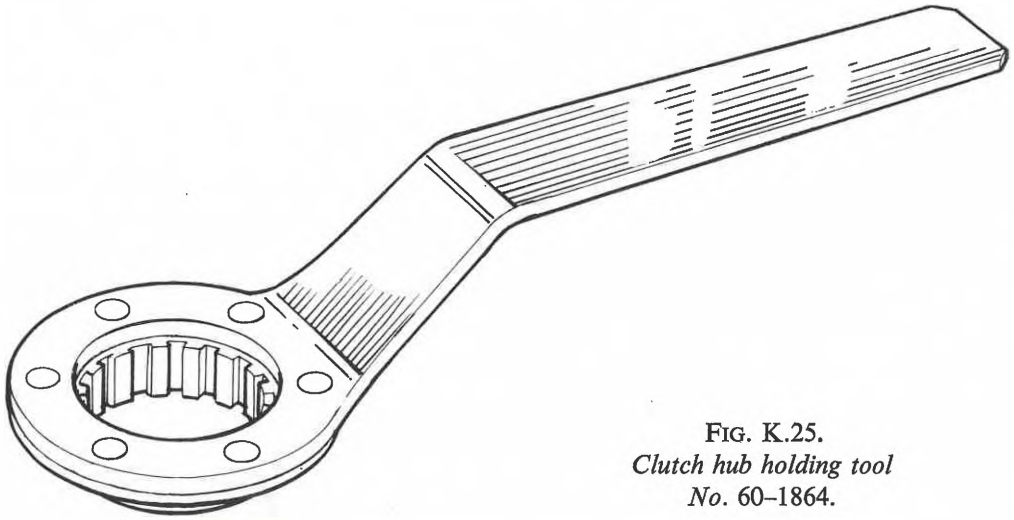

FIG. K.25.
Clutch hub holding tool
No. 60–1864.

FRONT FORKS

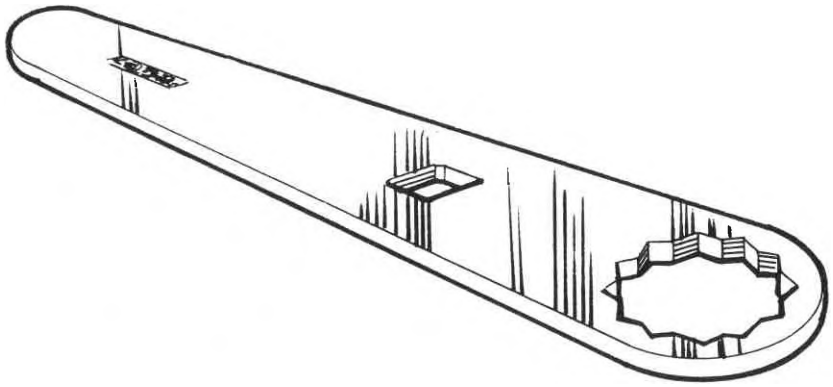

FIG. K.26.
Fork top nut spanner No. 60–779.

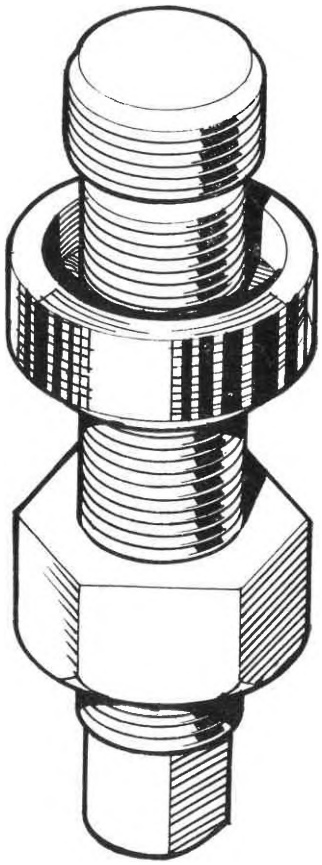

FIG. K.27.
Fork leg remover and replacer No. 61–3824.

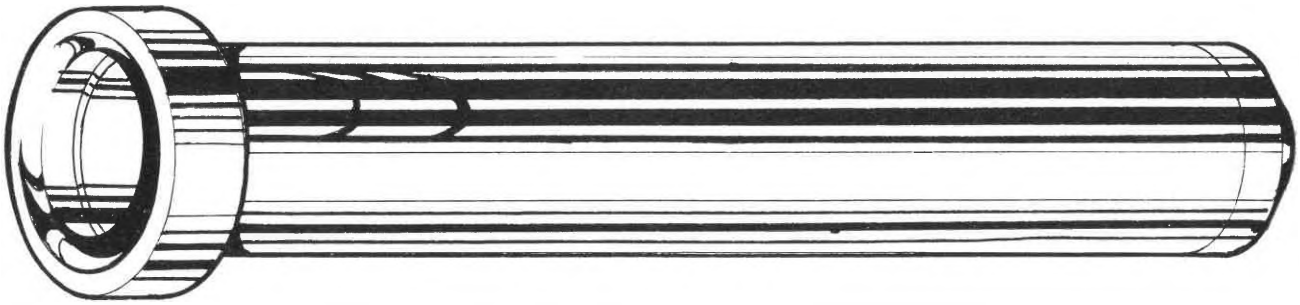

FIG. K.28. *Fork column bottom cone fitting tool No.* 60–2218.

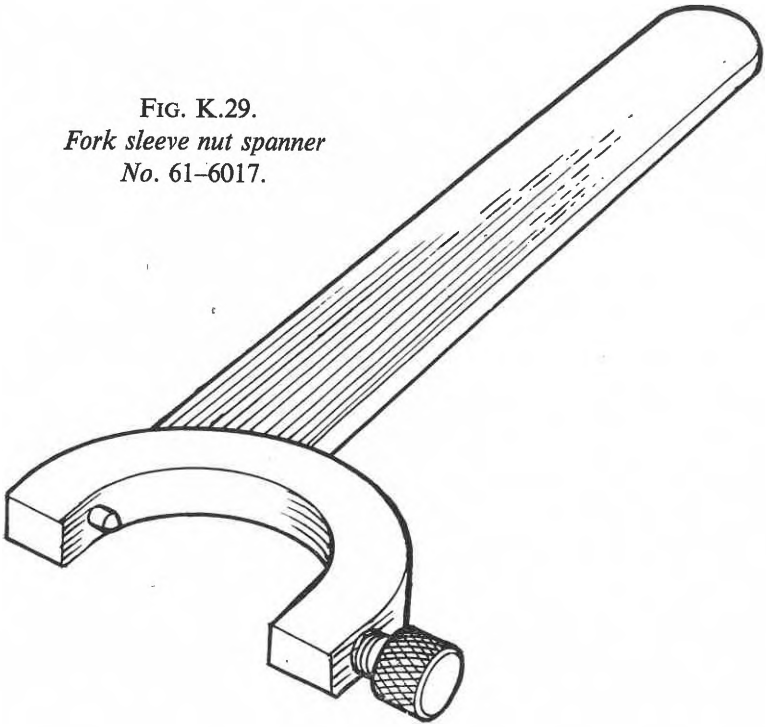

FIG. K.29.
Fork sleeve nut spanner No. 61–6017.

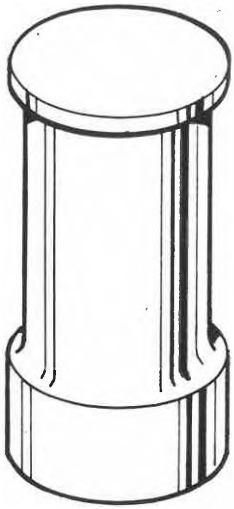

FIG. K.30.
Oil seal assembly tool No. 61–3007.

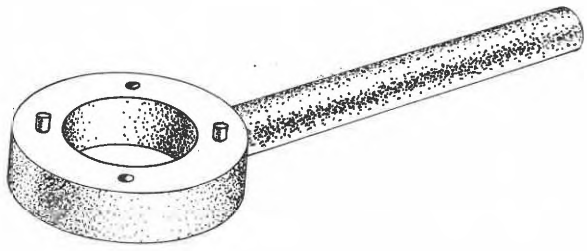

FIG. K.31.
Wheel bearing retainer peg spanner No. 61–3694.

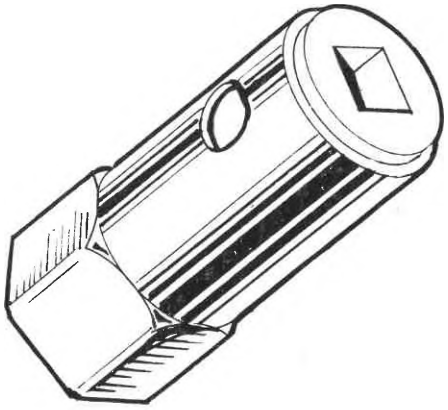

FIG. K.32.
Front brake plate nut box spanner No. 61–6062.

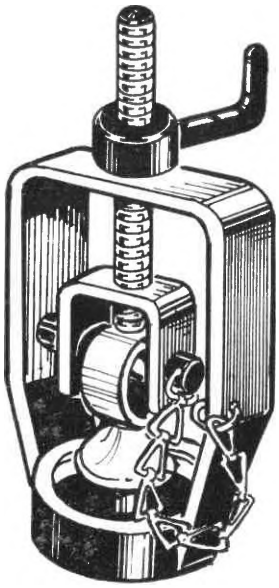

FIG. K.33.
Damper dismantling and assembly tool No. 61–3503.

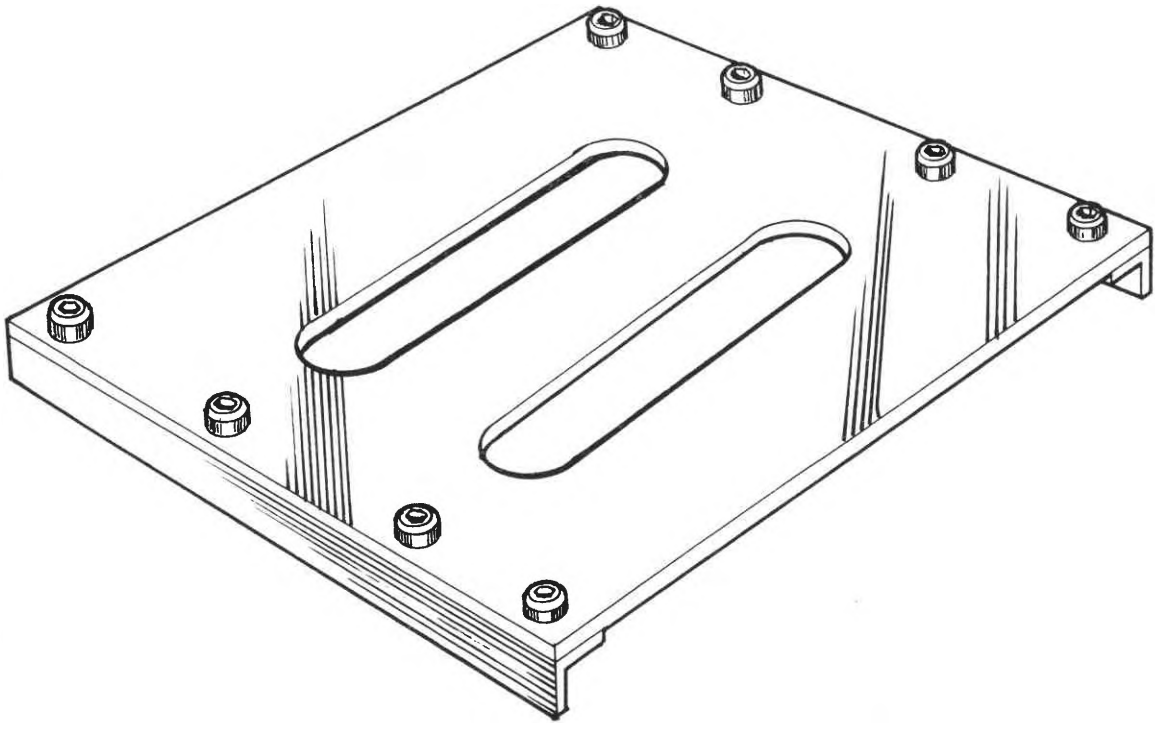

FIG. K.34. *Fork alignment gauge No.* 61–6025.

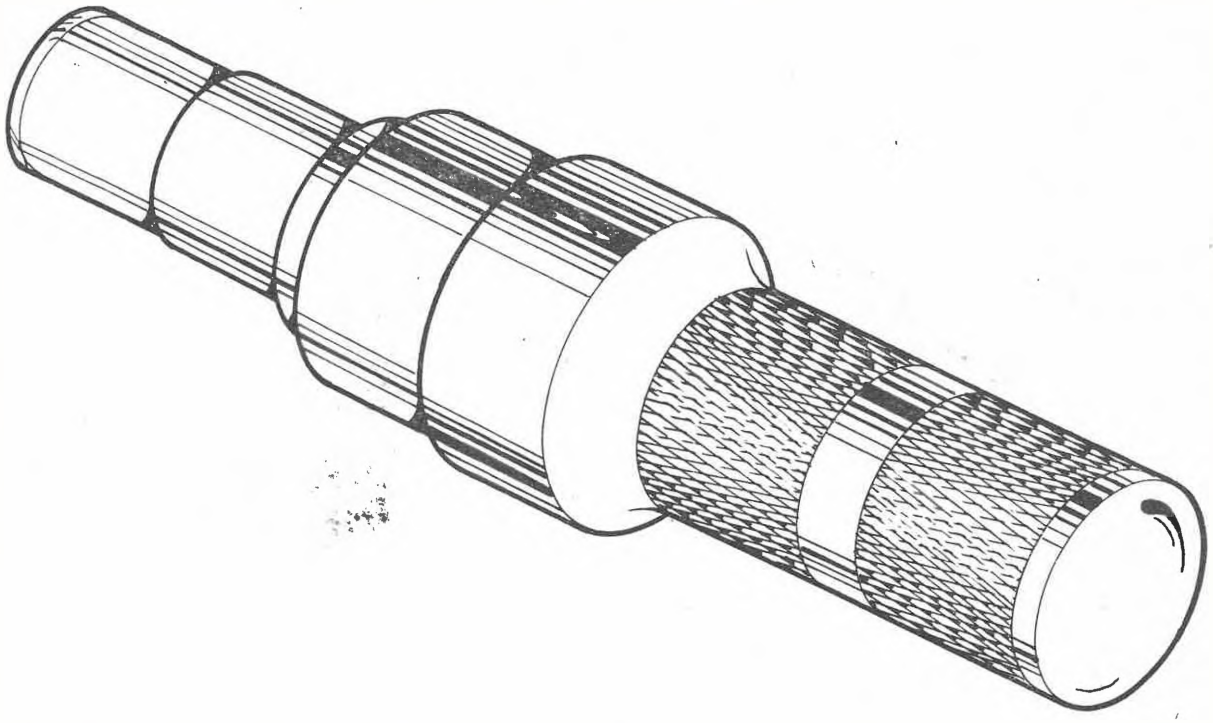

FIG. K.35.
Swinging arm bush assembly tool
No. 61-6050.

INDEX

INCHES TO MILLIMETRES — UNITS

Inches	0	10	20	30	40
0		254.0	508.0	762.0	1016.0
1	25.4	279.4	533.4	787.4	1041.4
2	50.8	304.8	558.8	812.8	1066.8
3	76.2	330.2	584.2	838.2	1092.2
4	101.6	355.6	609.6	863.6	1117.6
5	127.0	381.0	635.0	889.0	1143.0
6	152.4	406.4	660.4	914.4	1168.4
7	177.8	431.8	685.8	939.8	1193.8
8	203.2	457.2	711.2	965.2	1219.2
9	228.6	482.6	736.6	990.6	1244.6

ONE INCH — 25.399978 millimetres.

ONE METRE — 39.370113 inches.

ONE MILE — 1.6093 kilos.

ONE KILO — .62138 miles.

DECIMALS TO MILLIMETRES — FRACTIONS

1/1000	
Inches	Mm.
.001	.0254
.002	.0508
.003	.0762
.004	.1016
.005	.1270
.006	.1524
.007	.1778
.008	.2032
.009	.2286

1/100	
Inches	Mm.
.01	.254
.02	.508
.03	.762
.04	1.016
.05	1.270
.06	1.524
.07	1.778
.08	2.032
.09	2.286

1/10	
Inches	Mm.
.1	2.54
.2	5.08
.3	7.62
.4	10.16
.5	12.70
.6	15.24
.7	17.78
.8	20.32
.9	22.86

FRACTIONS TO DECIMALS AND MILLIMETRES

FRACTIONS			DECIMALS	MM.
		1/64	.015625	.3969
	1/32		.03125	.7937
		3/64	.046875	1.1906
1/16			.0625	1.5875
		5/64	.078125	1.9844
	3/32		.09375	2.3812
		7/64	.109375	2.7781
1/8			.125	3.1750
		9/64	.140625	3.5719
	5/32		.15625	3.9687
		11/64	.171875	4.3656
3/16			.1875	4.7625
		13/64	.203125	5.1594
	7/32		.21875	5.5562
		15/64	.234375	5.9531
1/4			.25	6.3500
		17/64	.265625	6.7469
	9/32		.28125	7.1437
		19/64	.296875	7.5406
5/16			.3125	7.9375
		21/64	.328125	8.3344
	11/32		.34375	8.7312
		23/64	.359375	9.1281
3/8			.375	9.5250
		25/64	.390625	9.9219
	13/32		.40625	10.3187
		27/64	.421875	10.7156
7/16			.4375	11.1125
		29/64	.453125	11.5094
	15/32		.46875	11.9062
		31/64	.484375	12.3031
1/2			.5	12.7000

FRACTIONS			DECIMALS	MM.
		33/64	.515625	13.0969
	17/32		.53125	13.4937
		35/64	.546675	13.8906
9/16			.5625	14.2875
		37/64	.578125	14.6844
	19/32		.59375	15.0812
		39/64	.609375	15.4781
5/8			.625	15.8750
		41/64	.640625	16.2719
	21/32		.65685	16.6687
		43/64	.671875	17.0656
11/16			.6875	17.4625
		45/64	.703125	17.8594
	23/32		.71875	18.2562
		47/64	.734375	18.6531
3/4			.75	19.0500
		49/64	.765625	19.4469
	25/32		.78125	19.8437
		51/64	.796875	20.2406
13/16			.8125	20.6375
		53/64	.828125	21.0344
	27/32		.84375	21.4312
		55/64	.859375	21.8281
7/8			.875	22.2250
		57/64	.890625	22.6219
	29/32		.90625	23.0187
		59/64	.921875	23.4156
15/16			.9375	23.8125
		61/64	.953125	24.2094
	31/32		.96875	24.6062
		63/64	.984375	25.0031
1				25.4000

MILLIMETRES TO INCHES — UNITS

MM.	0	10	20	30	40
0		.39370	.78740	1.18110	1.57480
1	.03937	.43307	.82677	1.22047	1.61417
2	.07874	.47244	.86614	1.25984	1.65354
3	.11811	.51181	.90551	1.29921	1.69291
4	.15748	.55118	.94488	1.33858	1.73228
5	.19685	.59055	.98425	1.37795	1.77165
6	.23622	.62992	1.02362	1.41732	1.81103
7	.27559	.66929	1.06299	1.45669	1.85040
8	.31496	.70866	1.10236	1.49606	1.88977
9	.35433	.74803	1.14173	1.53543	1.92914

MM.	50	60	70	80	90
0	1.96851	2.36221	2.75591	3.14961	3.54331
1	2.00788	2.40158	2.79528	3.18891	3.58268
2	2.04725	2.44095	2.83465	3.22835	3.62205
3	2.08662	2.48032	2.87402	3.26772	3.66142
4	2.12599	2.51969	2.91339	3.30709	3.70079
5	2.16536	2.55906	2.95276	3.34646	3.74016
6	2.20473	2.59843	2.99213	3.38583	3.77953
7	2.24410	2.63780	3.03150	3.42520	3.81890
8	2.28347	2.67717	3.07087	3.46457	3.85827
9	2.32284	2.71654	3.11024	3.50394	3.89764

MILLIMETRES TO INCHES — FRACTIONS

1/1000	
MM.	INCHES
0.001	.000039
0.002	.000079
0.003	.000118
0.004	.000157
0.005	.000197
0.006	.000236
0.007	.000276
0.008	.000315
0.009	.000354

1/100	
MM.	INCHES
0.01	.00039
0.02	.00079
0.03	.00118
0.04	.00157
0.05	.00197
0.06	.00236
0.07	.00276
0.08	.00315
0.09	.00354

1/10	
MM.	INCHES
0.1	.00394
0.2	.00787
0.3	.01181
0.4	.01575
0.5	.01969
0.6	.02362
0.7	.02756
0.8	.03150
0.9	.03543

LETTER	SIZE	LETTER	SIZE
A	.234	N	.302
B	.238	O	.316
C	.242	P	.323
D	.246	Q	.332
E	.250	R	.339
F	.257	S	.348
G	.261	T	.358
H	.266	U	.368
I	.272	V	.377
J	.277	W	.386
K	.281	X	.397
L	.290	Y	.404
M	.295	Z	.413

DRILL SIZES

NUMBER	SIZE	NUMBER	SIZE	NUMBER	SIZE	NUMBER	SIZE
1	.2280	14	.1820	27	.1440	40	.0980
2	.2210	15	.1800	28	.1405	41	.0960
3	.2130	16	.1770	29	.1360	42	.0935
4	.2090	17	.1730	30	.1285	43	.0890
5	.2055	18	.1695	31	.1200	44	.0860
6	.2040	19	.1660	32	.1160	45	.0820
7	.2010	20	.1610	33	.1130	46	.0810
8	.1990	21	.1590	34	.1110	47	.0785
9	.1960	22	.1570	35	.1100	48	.0760
10	.1935	23	.1540	36	.1065	49	.0730
11	.1910	24	.1520	37	.1040	50	.0700
12	.1890	25	.1495	38	.1015	51	.0670
13	.1850	26	.1470	39	.0995	52	.0635

WIRE GAUGES

No. of Gauge	Imperial Standard Wire Gauge		Brown & Sharpe's American Wire Gauge	
	INCHES	MILLIMETRES	INCHES	MILLIMETRES
0000	.400	10.160	.460	11.684
000	.372	9.448	.410	10.404
00	.348	8.839	.365	9.265
0	.324	8.299	.325	8.251
1	.300	7.620	.289	7.348
2	.276	7.010	.258	6.543
3	.252	6.400	.229	5.827
4	.232	5.892	.204	5.189
5	.212	5.384	.182	4.621
6	.192	4.676	.162	4.115
7	.176	4.470	.144	3.664
8	.160	4.064	.128	3.263
9	.144	3.657	.114	2.906
10	.128	3.251	.102	2.588
11	.116	2.946	.091	2.304
12	.104	2.641	.081	2.052
13	.092	2.336	.072	1.827
14	.080	2.032	.064	1.627
15	.072	1.828	.057	1.449
16	.064	1.625	.051	1.290
17	.056	1.422	.045	1.149
18	.048	1.219	.040	1.009
19	.040	1.016	.035	.911
20	.036	.914	.032	.811
21	.032	.812	.028	.722
22	.028	.711	.025	.643
23	.024	.609	.023	.573
24	.022	.558	.020	.511
25	.020	.508	.018	.454
26	.018	.457	.016	.404
27	.0164	.416	.014	.360
28	.0148	.375	.012	.321
29	.0136	.345	.011	.285
30	.0124	.314	.010	.254

B.S.F. SCREW THREADS

DIA. OF BOLT (INCH)	THREADS PER INCH	DIA. TAP DRILL (INCH)	CORE DIA.	AREA AT THD. ROOT SQ. IN.	PITCH DIAMETER NUT MAX.	PITCH DIAMETER NUT MIN.	PITCH DIAMETER BOLT MAX.	PITCH DIAMETER BOLT MIN.	HEX. FLATS (MEAN)	HEX. CORNERS	NUT THICKNESS (MEAN)
7/32	28	.1770	.1731	.0235	.2018	.1980	.1960	.1922	.412	.48	.166
1/4	26	.2055	.2007	.0316	.2313	.2274	.2254	.2215	.442	.51	.195
9/32	26	.238	.2320	0423	.2625	.0586	.2565	.2527			
5/16	22	.261	.2543	.0508	.2897	.2854	.2834	.2791	.522	.61	.245
3/8	20	.316	.3110	.0760	.3495	.3450	.3430	.3385	.597	.69	.307
7/16	18	3/8	.3664	.1054	.4086	.4039	.4019	.3372	.707	.82	.370
1/2	16	27/64	.4200	.1385	.4670	.4620	.4600	.4550	.817	.95	.432
9/16	16	.492	.4825	.1828	.5295	.5245	.5225	.5175	.917	1.06	.495
5/8	14	35/64	.5335	.2235	.5866	.5813	.5793	.5740	1.006	1.17	.557
11/16	14	39/64	.5960	.2790	.6491	.6438	.6418	.6365	1.096	1.27	.620
3/4	12	21/32	.6433	.3250	.7044	.6986	.6966	.6908	1.196	1.39	.682
13/16	12	23/32	.7058	.3913	.7669	.7611	.7591	.7533			
7/8	11	25/32	.7586	.4520	.8248	.8188	.8168	.8108	1.296	1.50	.745
1	10	57/64	.8719	.5971	.9443	.9380	.9360	.9297	1.474	1.71	.870
1-1/8	9	1	.9827	.7585	1.0626	1.0559	1.0539	1.0472	1.664	1.98	.995
1-1/4	9	1-1/8	1.1077	.9637	1.1876	1.1809	1.1789	1.1722	1.852	2.15	1.115
1-3/8	8	1-15/64	1.2149	.1593	1.3041	1.2970	1.2950	1.2879	2.042	2.37	1.240
1-1/2	8	1.358	1.3399	.4100	1.4291	1.4220	1.4200	1.4129	2.210	2.56	1.365
1-5/8	8	1-31/64	1.4649	1.6854	1.5541	1.5470	1.5450	1.5379	2.400	2.78	1.400

B.S.W. SCREW THREADS

DIA. OF BOLT (INCH)	THREADS PER INCH	DIA. TAP DRILL (INCH)	CORE DIA.	AREA AT THD. ROOT SQ. IN.	PITCH DIAMETER NUT MAX.	PITCH DIAMETER NUT MIN.	PITCH DIAMETER BOLT MAX.	PITCH DIAMETER BOLT MIN.	HEX. FLATS (MEAN)	HEX. CORNERS	NUT THICKNESS (.005)
1/4	20	.1968	.1860	.0272	.2245	.2200	.2180	.2135	.522	.61	.245
5/16	18	1/4	.2412	.0458	.2836	.2789	.2769	.2722	.597	.69	.307
3/8	16	5/16	.2950	.0683	.3420	.3370	.3350	.3300	.707	.82	.370
7/16	14	23/64	.3460	.0940	.3991	.3938	.3918	.3865	.817	.95	.432
1/2	12	13/32	.3933	.1215	.4544	.4486	.4466	.4408	.917	1.06	.495
9/16	12	15/32	.4558	.1632	.5169	.5111	.5091	.5033	1.006	1.17	.557
5/8	11	17/32	.5086	.2032	.5748	.5688	.5668	.5608	1.096	1.27	.620
11/16	11	37/64	.5711	.2562		.6313	.6293		1.196	1.39	.682
3/4	10	41/64	.6219	.3038	.6943	.6880	.6860	.6797	1.296	1.50	.745
13/16	10	45/64	.6844	.3679		.7506	.7485				
7/8	9	3.4	.7327	.4216	8126	.8059	.8039	.7972	1.474	1.71	.870
15/16	9	13/16	.7952	.4966		.8684	.8664				
1	8	55/64	.8399	.5540	.9291	.9220	9200	.9129	1.664	1.93	.995

B.S.C. SCREW THREADS

DIA. OF BOLT (INCH)	THDS. PER INCH		PITCH (INCH)	DEPTH OF THREAD (INCH)	BASIC DIAMETERS (INCH)		
	NORMAL SERIES	20 T.P.I. SERIES			MAJOR	EFFECTIVE	MINOR
1/8	40		0.02500	0.0133	0.1250	0.1117	0.0984
5/32	32		0.03125	0.0166	0.1563	0.1397	0.1231
3/16	32		0.03125	0.0166	0.1875	0.1709	0.1543
7/32	26		0.03846	0.0205	0.2188	0.1983	0.1778
1/4	26		0.03846	0.0205	0.2500	0.2295	0.2090
9/32	26		0.03846	0.0205	0.2813	0.2608	0.2403
5/16	26		0.03846	0.0205	0.3125	0.2920	0.2715
3/8	26		0.03846	0.0205	0.3750	0.3545	0.3340
7/16	26		0.03846	0.0205	0.4375	0.4170	0.3965
		20	0.05000	0.0266	0.4375	0.4109	0.3843
1/2	26		0.03846	0.0205	0.5000	0.4795	0.4590
		20	0.05000	0.0266	0.5000	0.4734	0.4468
9/16	26		0.03846	0.0205	0.5625	0.5420	0.5215
		20	0.05000	0.0266	0.5625	0.5359	0.5093
5/8	26		0.03846	0.0205	0.6250	0.6045	0.5840
		20	0.05000	0.0266	0.6250	0.5984	0.5718
11/16	26		0.03846	0.0205	0.6875	0.6670	0.6465
		20	0.05000	0.0266	0.6875	0.6609	0.6343
3/4	26		0.03846	0.0205	0.7500	0.7295	0.7090
		20	0.05000	0.0266	0.7500	0.7234	0.6968

B.A. SCREW THREADS

NO.	DIA. OF BOLT	THDS. PER INCH	DIA. TAP DRILL	CORE DIA.	AREA AT THD. ROOT SQ. IN.	PITCH DIAMETER NUT MAX.	PITCH DIAMETER NUT MIN.	PITCH DIAMETER BOLT MAX.	PITCH DIAMETER BOLT MIN.	HEX. FLATS	HEX. CORNERS	NUT THICKNESS
0	.2362	25.4	.1960	.1890	.0281	.2165	.2126	.2126	.2087	.413	.47	.236
1	.2087	28.2	.1770	.1661	.0217	.1908	.1875	.1873	.1838	.365	.43	.209
2	.1850	31.4	.1520	.1468	.0169	.1693	.1659	.1659	.1626	.324	.37	.185
3	.1614	34.8	.1360	.1269	.0126	.1472	.1441	.1441	.1409	.282	.33	.161
4	.1417	38.5	.1160	.1106	.0096	.1290	.1261	.1261	.1231	.248	.29	.142
5	.1260	43.0	.1040	.0981	.0075	.1147	.1119	.1119	.1091	.220	.25	.126
6	.1102	47.9	.0935	.0852	.0057	.1000	.0976	.0976	.0953	.193	.22	.110
7	.0984	52.9	.0810	.0738	.0045	.0893	.0869	.0869	.0845	.172	.20	.098
8	.0866	59.1	.0730	.0663	.0034	.0785	.0764	.0764	.0742	.152	.18	.087
9	.0748	65.1	.0635	.0564	.0025	.0675	.0656	.0656	.0636	.131	.15	.075
10	.0669	72.6	.0550	.0504	.0021		.0587	.0587		.117	.14	.067
11	.0591	81.9	.0465	.0445	.0016					.103	.12	.059
12	.0511	90.9	.0400	.0378	.0011					.090	.10	.051
13	.0472	102.0	.0360	.0352	.0010					.083	.09	.047
14	.0394	109.9	.0292	.0280	.0006					.069	.08	.039
15	.0354	120.5	.0260	.0250	.0005					.061	.07	.035
16	.0311	133.3	.0225	.0220	.0004							

MILES PER GALLON (IMPERIAL) TO LITRES PER 100 KILOMETRES

10	28.25	15	18.83	20	14.12	25	11.30	30	9.42	35	8.07	40	7.06	50	5.65	60	4.71	70	4.04
10½	26.90	15½	18.22	20½	13.78	25½	11.08	30½	9.26	35½	7.96	41	6.89	51	5.54	61	4.63	71	3.98
11	25.68	16	17.66	21	13.45	26	10.87	31	9.11	36	7.85	42	6.73	52	5.43	62	4.55	72	3.92
11½	24.56	16½	17.12	21½	13.14	26½	10.66	31½	8.97	36½	7.74	43	6.57	53	5.33	63	4.48	73	3.87
12	23.54	17	16.61	22	12.84	27	10.46	32	8.83	37	7.63	44	6.42	54	5.23	64	4.41	74	3.82
12½	22.60	17½	16.14	22½	12.55	27½	10.27	32½	8.69	37½	7.53	45	6.28	55	5.13	65	4.35	75	3.77
13	21.73	18	15.69	23	12.28	28	10.09	33	8.56	38	7.43	46	6.14	56	5.04	66	4.28	76	3.72
13½	20.92	18½	15.27	23½	12.02	28½	9.91	33½	8.43	38½	7.34	47	6.01	57	4.96	67	4.22	77	3.67
14	20.18	19	14.87	24	11.77	29	9.74	34	8.31	39	7.24	48	5.89	58	4.87	68	4.16	78	3.62
14½	19.48	19½	14.49	24½	11.53	29½	9.58	34½	8.19	39½	7.15	49	5.77	59	4.79	69	4.10	79	3.57

GALLONS (IMPERIAL) TO LITRES

	0	1	2	3	4	5	6	7	8	9	
—		4.546	9.092	13.638	18.184	22.730	27.276	31.822	36.368	40.914	—
10	45.460	50.005	54.551	59.097	63.643	68.189	72.735	77.281	81.827	86.373	10
20	90.919	95.465	100.011	104.557	000.000	113.649	118.195	122.741	127.287	131.833	20
30	136.379	140.924	145.470	150.016	000.000	159.108	163.645	168.200	172.746	177.292	30
40	181.838	186.384	190.930	195.476	200.022	204.568	209.114	213.660	218.206	222.752	40
50	227.298	231.843	236.389	240.935	245.481	250.027	254.573	259.119	263.605	268.211	50
60	272.757	277.303	281.849	286.395	290.941	295.487	300.033	304.579	309.125	313.671	60
70	318.217	322.762	327.308	331.854	336.400	340.946	345.492	350.038	354.584	359.130	70
80	363.676	368.222	372.768	377.314	381.860	386.406	390.952	395.498	400.044	404.590	80
90	409.136	413.681	418.227	422.773	427.319	431.865	436.411	440.957	445.503	450.049	90

PINTS TO LITRES

	0	1	2	3	4	5	6	7	8
—	—	.568	1.136	1.705	2.273	2.841	3.410	3.978	4.546
¼	.142	.710	1.279	1.846	2.415	2.983	3.552	4.120	4.688
½	.284	.852	1.420	1.989	2.557	3.125	3.694	4.262	4.830
¾	.426	.994	1.563	2.131	2.699	3.267	3.836	4.404	4.972

POUNDS PER SQUARE INCH TO KILOGRAMS PER SQUARE CENTIMETRE

	0	1	2	3	4	5	6	7	8	9	
—		0.070	0.141	0.211	0.281	0.352	0.422	0.492	0.562	0.633	—
10	0.703	0.773	0.844	0.914	0.984	1.055	1.125	1.195	1.266	1.336	10
20	1.406	1.476	1.547	1.617	1.687	1.758	1.828	1.898	1.969	2.039	20
30	2.109	2.179	2.250	2.320	2.390	2.461	2.531	2.601	2.672	2.742	30
40	2.812	2.883	2.953	3.023	3.093	3.164	3.234	3.304	3.375	3.445	40
50	3.515	3.586	3.656	3.726	3.797	3.867	3.937	4.007	4.078	4.148	50
60	4.218	4.289	4.359	4.429	4.500	4.570	4.640	4.711	4.781	4.851	60
70	4.921	4.992	5.062	5.132	5.203	5.273	5.343	5.414	5.484	5.554	70
80	5.624	5.695	5.765	5.835	5.906	5.976	6.046	6.117	6.187	6.257	80
90	6.328	6.398	6.468	6.538	6.609	6.679	6.749	6.820	6.890	6.960	90

FOOT POUNDS TO KILOGRAMETRES

	0	1	2	3	4	5	6	7	8	9	
—		0.138	0.277	0.415	0.553	0.691	0.830	0.968	1.106	1.244	—
10	1.383	1.521	1.659	1.797	1.936	2.074	2.212	2.350	2.489	2.627	10
20	2.765	2.903	3.042	3.180	3.318	3.456	3.595	3.733	3.871	4.009	20
30	4.148	4.286	4.424	4.562	4.701	4.839	4.977	5.116	5.254	5.392	30
40	5.530	5.668	5.807	5.945	6.083	6.221	6.360	6.498	6.636	6.774	40
50	6.913	7.051	7.189	7.328	7.466	7.604	7.742	7.881	8.019	8.157	50
60	8.295	8.434	8.572	8.710	8.848	8.987	9.125	9.263	9.401	9.540	60
70	9.678	9.816	9.954	10.093	10.231	10.369	10.507	10.646	10.784	10.922	70
80	11.060	11.199	11.337	11.475	11.613	11.752	11.890	12.028	12.166	12.305	80
90	12.443	12.581	12.719	12.858	12.996	13.134	13.272	13.411	13.549	13.687	90

MILES TO KILOMETRES

	0	1	2	3	4	5	6	7	8	9	
—		1.609	3.219	4.828	6.437	8.047	9.656	11.265	12.875	14.484	—
10	16.093	17.703	19.312	20.922	22.531	24.140	25.750	27.359	28.968	30.578	10
20	32.187	33.796	35.406	37.015	38.624	40.234	41.843	43.452	45.062	46.671	20
30	48.280	49.890	51.499	53.108	54.718	56.327	57.936	59.546	61.155	62.765	30
40	64.374	65.983	67.593	69.202	70.811	72.421	74.030	75.639	77.249	78.858	40
50	80.467	82.077	83.686	85.295	86.905	88.514	90.123	91.733	93.342	94.951	50
60	96.561	98.170	99.780	101.389	102.998	104.608	106.217	107.826	109.436	111.045	60
70	112.654	114.264	115.873	117.482	119.092	120.701	122.310	123.920	125.529	127.138	70
80	128.748	130.357	131.967	133.576	135.185	136.795	138.404	140.013	141.623	143.232	80
90	144.841	146.451	148.060	149.669	151.279	152.888	154.497	156.107	157.716	159.325	90

POUNDS TO KILOGRAMS

	0	1	2	3	4	5	6	7	8	9	
—		0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082	—
10	4.536	4.990	5.443	5.897	6.350	6.804	7.257	7.711	8.165	8.618	10
20	9.072	9.525	9.079	10.433	10.886	11.340	11.793	12.247	12.701	13.154	20
30	13.608	14.061	14.515	14.968	15.422	15.876	16.329	16.783	17.237	17.690	30
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226	40
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762	50
60	27.216	27.669	28.123	28.576	29.030	29.484	29.937	30.391	30.844	31.298	60
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834	70
80	36.287	36.741	37.195	37.648	38.102	38 855	39.009	39.463	39.916	40.370	80
90	40.823	41.277	41.731	42.184	42.638	43.091	43.545	43.998	44.452	44.906	90

UNIFIED SCREW THREADS

FINE (UN.F.)

Diameter (inch)	Threads Per Inch	Depth of Thread (inch)	Basic Dimensions (inch)		
			Major Dia.	Effective Dia.	Minor Dia.
1/4	28	0·0217	0·2457	0·2241	0·2022
5/16	24	0·0254	0·3078	0·2824	0·2569
3/8	24	0·0254	0·3703	0·3449	0·3194
7/16	20	0·0305	0·4321	0·4016	0·3710
1/2	20	0·0305	0·4946	0·4641	0·4334
9/16	18	0·0341	0·5568	0·5227	0·4886
5/8	18	0·0341	0·6193	0·5852	0·5511
1	28	0·0219	0·9955	0·9736	0·9517
1 1/4	28	0·0251	1·250	1·2202	1·2144

COARSE (UN.C.)

1/4	20	0·0304	0·2448	0·2145	0·1839
5/16	18	0·0338	0·3070	0·2722	0·2391
3/8	16	0·0382	0·3690	0·3309	0·2925
1/2	13	0·0471	0·4930	0·4460	0·3988
9/16	12	0·0535	0·5625	0·5064	0·4554
7/8	16	0·0426	0·8735	0·8328	0·7921
1	16	0·0407	0·9985	0·9554	0·9170

PUBLISHED BY SERVICE DEPARTMENT, B.S.A. MOTOR CYCLES LTD, ARMOURY ROAD, BIRMINGHAM 11, ENGLAND.
Printed in England at the B.S.A. Press.