



B 25 Starfire
B 44 Shooting Star
MODELS

WORKSHOP MANUAL



WORKSHOP MANUAL

FOR 1969/70 MODELS

B44 SHOOTING STAR 1969

B25 STARFIRE 1969

B44 SHOOTING STAR (U.S.A.) 1970

B25 STARFIRE (U.S.A.) 1970

Service Department
B.S.A. MOTOR CYCLES LTD.
BIRMINGHAM II,

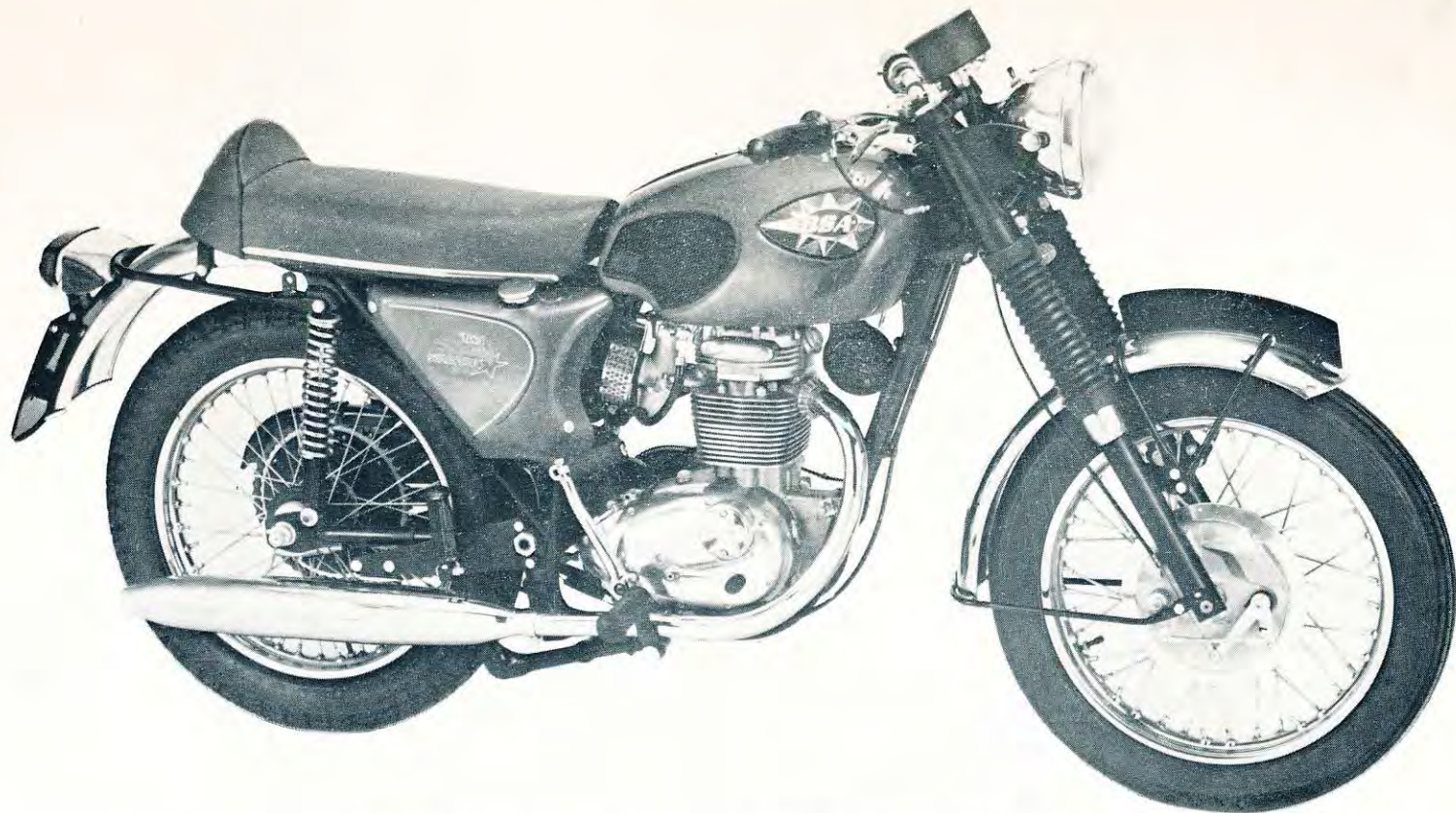
Publication Reference No. 00-4176 October, 1969.

Telephone **021-772-2381**
ARMOURY ROAD

Please Note!

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

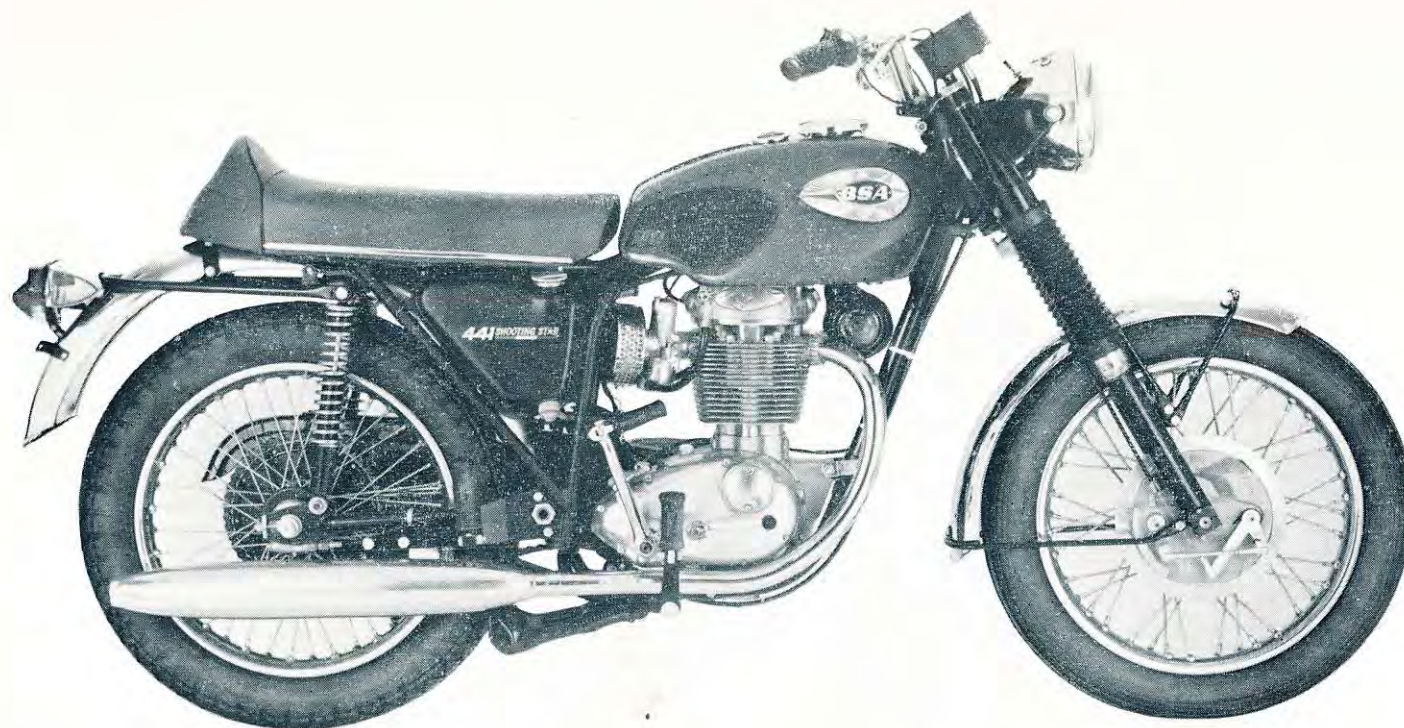
In this respect your attention is drawn to the Terms and Conditions of B.S.A. Guarantee.



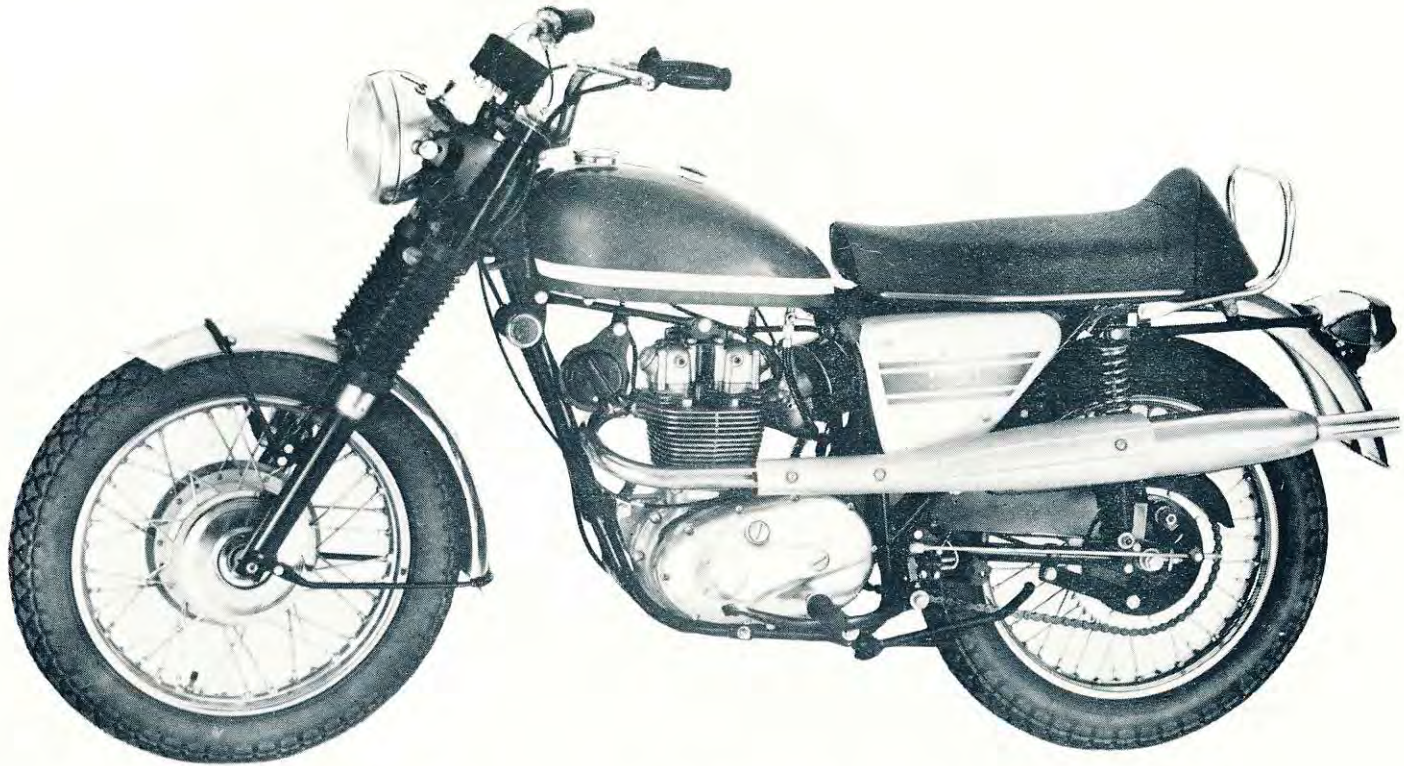
BSA 250 c.c. STARFIRE (1969)



BSA 441 c.c. SHOOTING STAR (1969)



BSA 441 c.c. SHOOTING STAR (U.S.A.) 1970



BSA 250 c.c. STARFIRE (U.S.A.) 1970

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 either basic maintenance or major repair work. The instructions are written in great detail but, because of the specialised skills and the equipment required to carry out some of the described repair work, the inexperienced owner is strongly advised to consult his B.S.A. dealer should he doubt his own ability to carry out a satisfactory job.

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

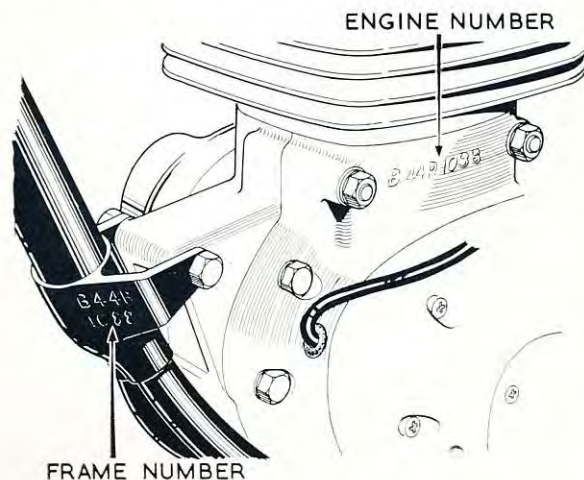
All information and data given in this manual is correct at the time of publication but because of the constant development of B.S.A. motor-cycles, changes in the specifications are inevitable.

Anyone finding this manual to be at variance with the B.S.A. machine in his possession is advised to contact the Service Department, where up-to-date information will be quickly provided.

ENGINE AND FRAME NUMBERS

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

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 front engine mounting lug.



FACTORY SERVICE ARRANGEMENTS

(UNITED KINGDOM)

REPLACEMENT PARTS

B.S.A. replacement parts and exchange units 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. replacement parts.

A complete list of appointed stockists is printed at the end of this manual, and also in every B.S.A. parts catalogue.

REPAIRS

Most appointed B.S.A. dealers are able to carry out 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.

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.

TECHNICAL ADVICE

B.S.A. Service Department staff are experienced 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: 021-772 2381

WORLD SERVICE ARRANGEMENTS

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

The names of these distributors will be found at the back of this manual, and are also listed in all B.S.A. replacement part catalogues.

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:—

CARBURETTER

Amal Limited,
Holdford Road,
Witton,
BIRMINGHAM 6.

CHAINS

Renolds Chains Limited,
Wythenshawe,
MANCHESTER.

ELECTRICAL EQUIPMENT

Joseph Lucas Limited,
Gt. Hampton Street,
BIRMINGHAM 18.

Wipac Group Sales Limited,
London Road,
BUCKINGHAM.

REAR DAMPERS

Girling Limited,
Birmingham Road,
WEST BROMWICH, Staffs.

SPARKING PLUG

Champion Sparking Plug Co. Ltd.,
Feltham,
MIDDLESEX.

SPEEDOMETER

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 at the two U.S.A. factory branches are experienced 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.

WORLD DISTRIBUTORS
PREPARING THE MACHINE

REMOVING THE MOTOR-CYCLE FROM THE CASE

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

Pprise off the top boards with a suitable pinch bar and take out the top packing material. Take off one side of the case and carefully withdraw the machine. Make absolutely certain that you have all the loose parts before discarding the wrappings and retain the TEST CARD in case you may find it necessary to report any loss of parts or damage during transit.

Put the machine on to its centre stand, place a strong support under the engine and proceed to fit the loose components.

FITTING THE HANDLEBAR AND CONTROLS

Place the handlebar in position and fit the clamp brackets loosely. When a suitable position has been determined, the four clamp fixing bolts can be tightened.

Fit the clutch lever, exhaust valve lifter lever, front brake lever and the throttle control, but do not tighten the fixing screws until they have each been comfortably positioned on the handlebar.

Any adjustments to the control cables can be made at a later stage. Secure the speedometer with its two nuts, bolts and washers and connect the cable and light lead.

FITTING THE FRONT MUDGUARD AND WHEEL

Place the front mudguard between the fork legs and assemble the stays making sure that each nut and bolt is tightened securely. Place the wheel between the forks and locate the brake anchor, now whilst holding the wheel against the right-hand fork leg, fit and fully tighten the right-hand fork leg cap.

Depress the forks once or twice to enable the left-hand fork end to position itself on the spindle before finally tightening the end cap bolts. If this precaution is not observed, the fork leg may be clipped out of position and will not function correctly.

Connect the front brake cable.

The machine support can now be removed from below the engine.

FITTING THE DUAL SEAT AND HANDRAIL

First assemble the large bracket on to the seat base plate, using the two nuts and washers. Note that the bracket is correctly fitted when the more acutely angled portion is on the right-hand side.

Engage the clip below the dual seat at the front with the frame tie-bar. Loosen the damper top fixing bolts sufficient to allow the ends of the seat bracket to locate over the bolts, directly behind the nuts and washers. Whilst pressing down on the seat, tighten both fixing bolts firmly. Fit the handrail to frame and mudguard brackets.

REAR LIGHT

The rear light assembly is fixed at the front by one nut with a large washer and at the support bracket by two nuts and bolts.

FITTING THE SILENCER

Fit the silencer complete with heat shield on to the end of the exhaust pipe and locate its fixing bracket behind the pillion footrest bracket. Secure the brackets together at the rear by two nuts and bolts and tighten the silencer end clip on to the exhaust pipe.

The brackets are secured at the pillion footrest brackets or to a bracket on the rear sub-frame down tube.

FITTING THE FOOTRESTS AND REAR BRAKE PEDAL

The pillion footrests are pre-assembled to their anchor bolts and should each be secured to the brackets by one nut with spring washer. The plain washers should be fitted between the anchor bolt and its bracket. Fit brake pedal and replace brake rod, check for adjustment.

Fit the front footrests on to the frame lugs. On the right-hand side the fixing is by one long bolt with washers and a nut. A special lockwasher, spring washer and a nut (left-hand thread) is used on the left-hand side to secure the footrest on to its stud. Set both footrests to the desired height before tightening the nuts.

KICKSTART AND GEAR-CHANGE LEVER

Secure the kickstart lever with cotter pin fitted from the rear, tighten with nut and washer, fit gear-change lever with bolt and washer.

SPARKING PLUG AND TOOLS

Take out and discard the plastic plug from the sparking plug hole, fit the sparking plug and connect the high-tension lead. The type of plug supplied with the machine is best suited to all-round operating conditions and should not be changed without the advice of a plug specialist.

Place the tools, instruction manual and other literature into the toolbox.

BATTERY

The battery is supplied in a dry-charged condition and must not be filled unless it is known that the machine is to be sold within a few days.

Only half a turn is required to release the sidecover fasteners and on removal of the cover, it will be seen that the battery is securely mounted in a carrier alongside the toolbox.

To fill and charge the battery

All plates in the 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 one part of concentrated sulphuric acid into three parts of distilled water (by volume) or of S.G. 1·210 by adding one part of concentrated sulphuric acid to four 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 chart).

| | TEMPERATE Climates ordinarily below 80°F. (27°C.) shade temperature | TROPICAL Climates frequently above 80°F. (27°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 & 1·290 (at 60°F.) | 1·210 & 1·230 (at 60°F.) |

- (1) Batteries which have been stored at a 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 per cent charged, but if time permits a freshening charge of four hours at the normal recharge rate would be beneficial. If the acid level rises after this freshening charge restore levels by syphoning off excess acid.

Note:—Recharge rate 1·0 ampere.

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

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Because the engine and transmission of the B44 and the B25 models are of different specification, it has been found necessary to divide the data into two sections, one for each model. All other data however, is applicable to both models.

ENGINE (B44)

PISTON

| | |
|-------------------------------------|--------------------------------|
| Material | “Lo-Ex” aluminium |
| Compression ratio | 9·4 : 1 |
| Clearance (bottom of skirt) | ·003"—·0035" (·0762—·0889 mm.) |
| Clearance (top of skirt) | ·006"—·0065" (·0524—·1651 mm.) |

(both measured on major axis)

PISTON RINGS

| | |
|--|--------------------------------|
| Material—compression (top) | Brico 8 |
| Material—compression (centre) | Brico 8 |
| Material—scraper | Brico BSS5004 |
| Width—compression (top and centre) | ·0625" (1·5875 mm.) |
| Width—scraper | ·125" (3·175 mm.) |
| Depth | ·120"—·127" (3·048—3·2258 mm.) |
| Clearance in groove | ·001"—·003" (·0254—·0762 mm.) |
| Fitted gap (maximum) | ·014" (·3556 mm.) |
| Fitted gap (minimum) | ·009" (·2283 mm.) |

OIL PUMP

| | |
|---|----------------------|
| Pump body material | Zinc base alloy |
| Type | Dougle gear |
| Drive ratio | 1 : 4 |
| Non-return valve spring (free length) | ·5" (12·7 mm.) |
| Non-return valve spring ball (diameter) | ·25" (6·35 mm.) |
| Oil pressure release valve spring (free length) | ·6094" (15·4781 mm.) |
| Oil pressure release valve ball (diameter) | ·3125" (7·9375 mm.) |

CAMSHAFT

| | |
|---|-------------------------------------|
| Journal diameter (left- and right-hand) | ·7480"—·7485" (18·9992—19·0119 mm.) |
| Cam lift (inlet) | ·345" (8·763 mm.) |
| Cam lift (exhaust) | ·336" (8·534 mm.) |
| Base circle radius | ·906" (23·0124 mm.) |

CAMSHAFT BEARING BUSHES

| | |
|---|-------------------------------------|
| Bore diameter—fitted (left- and right-hand) | ·7492"—·7497" (19·0297—19·04238 mm) |
| Outside diameter (left- and right-hand) | ·908"—·909" (23·0632—23·0886 mm.) |
| Camshaft clearance (left- and right-hand) | ·0007"—·0017" (·01778—·04318 mm.) |

VALVES

| | | |
|---------------------------------|---------------|-----------------------|
| Seat angle (inclusive) | 90° | |
| Head diameter (inlet) | 1·535"—1·540" | (38·9890—39·1160 mm.) |
| Head diameter (exhaust) | 1·407"—1·412" | (35·737—35·864 mm.) |
| Stem diameter (inlet) | ·3095"—·3100" | (7·861—7·874 mm.) |
| Stem diameter (exhaust) | ·3090"—·3095" | (7·848—7·861 mm.) |

VALVE GUIDES

| | | |
|--|-----------------|-----------------------|
| Material | Phosphor-bronze | |
| Bore diameter | ·3120"—·3130" | (7·9248—7·950 mm.) |
| Outside diameter | ·5005"—·5010" | (12·7127—12·7254 mm.) |
| Length | 1·859" | (47·2186 mm.) |
| Cylinder head interference fit | ·0015"—·0025" | (·0381—·0635 mm.) |

VALVE SPRINGS

| | | |
|-------------------------------|--------|---------------|
| Free length (inner) | 1·500" | (38·10 mm.) |
| Free length (outer) | 1·670" | (42·418 mm.) |
| Fitted length (inner) | 1·218" | (30·9372 mm.) |
| Fitted length (outer) | 1·312" | (33·3248 mm.) |

VALVE TIMING

Tappets set to ·015" (·381 mm.) for checking purposes only:—

| | |
|---------------------------------|-----|
| inlet opens b.t.d.c. | 51° |
| inlet closes a.b.d.c. | 68° |
| exhaust closes b.b.d.c. | 78° |
| exhaust closes a.t.d.c. | 37° |

TAPPET CLEARANCE (Cold)

| | | |
|-----------------|-------|-------------|
| Inlet | ·008" | (·2032 mm.) |
| Exhaust | ·010" | (·254 mm.) |

IGNITION TIMING

| | | |
|---|-------|-------------|
| Piston position (b.t.d.c.) fully advanced .. | ·265" | (6·731 mm.) |
| Crankshaft position (b.t.d.c.) fully advanced | 28° | |
| Contact breaker gap setting | ·015" | (·381 mm.) |

SPARK PLUG

| | | |
|---------------------------------------|-------------------|-----------------|
| Type | Champion N4 | |
| Gap setting (minimum/maximum) | ·020"—·025" | (·508—·635 mm.) |
| Thread size | 14 mm. diameter × | (19·05 mm.) |
| | ·75" reach | |

CYLINDER BARREL

| | |
|------------------------------|--------------------------------------|
| Material | Aluminium with austenitic iron liner |
| Bore size (standard) | 79 mm. |
| Stroke | 90 mm. |
| Oversizes | .010" & .020" (.254 & .508 mm.) |

CYLINDER HEAD

| | |
|---------------------------|---------------------|
| Material | Aluminium alloy |
| Inlet port size | 1.125" (28.575 mm.) |
| Exhaust port size | 1.25" (31.75 mm.) |

CARBURETTER

| | |
|--|--|
| Type | Amal 930/38 (concentric float chamber) |
| Main jet | 240 |
| Pilot jet | 25 †622/107 |
| Needle jet size | .106" (2.7152 mm.) |
| Needle position | 1 |
| Throttle valve | 3½ |
| Nominal choke size | 30 mm. |
| Throttle slide return spring (free length) | 2.5" (63.5 mm.) |

BEARING DIMENSIONS

| | |
|--|---|
| Clutch roller (25) | .1875" × .1875" (4.7025 × 4.7025 mm.) |
| Connecting rod big-end bush (bore) | 1.7701"—1.7706" (44.9605—44.9732 mm.) |
| Connecting rod big-end roller (24) | .250" dia. × .250" (6.35 × 6.35 mm.) |
| Connecting rod small-end bush (bore) | .7503"—.7506" (19.0576—19.0652 mm.) |
| Crankpin diameter | 1.2698"—1.2700" (32.253—32.258 mm.) |
| Crankcase bearing (drive-side) | 25 × 62 × 17 mm. |
| Crankcase bearing (gear-side) | 25 × 62 × 17 mm. |
| Flywheel shaft diameter: | |
| (drive-side and gear-side) | .9841"—.9844" (24.9961—25.0038 mm.) |
| Gearbox layshaft bearings: | |
| Gearbox layshaft diameter: | |
| (drive-side and gear-side) | 0.5" × .625" × .8125" (12.7 × 15.875 × 20.6375 mm.) |
| Gearbox layshaft diameter: | |
| (drive-side and gear-side) | .6245"—.625" (15.8623—15.8750 mm.) |
| Gearbox mainshaft bearing: | |
| (drive-side) | 30 × 62 × 16 mm. |
| (gear-side) | .625" × 1.5625" × .4375" (15.875 × 39.2875 × 11.1125 mm.) |
| Gearbox mainshaft diameter: | |
| (drive-side) | .7485"—.749" (19.0119—19.0246 mm.) |
| (gear-side) | .6245"—.625" (15.8623—15.8750 mm.) |
| Gearbox sleeve pinion: | |
| (internal diameter) | .752"—.753" (19.1008—19.1262 mm.) |
| (external diameter) | 1.179"—1.180" (29.9466—29.9720 mm.) |
| Gudgeon pin diameter | .750"—.7502" (19.05—19.055 mm.) |

†Denotes 1970 model

TRANSMISSION (B44)

CLUTCH

| | |
|---|--------------------------------------|
| Type | Multi-plate with integral cush drive |
| Number of plates: | |
| driving (bonded segments) | 4 |
| driven (plain) | 5 |
| Overall thickness of driving plate and segments | ·167" (4·242 mm.) |
| Clutch springs | 4 |
| Free length of springs | 1·65685" (42·0687 mm.) |
| Clutch push rod (length) | 9·0" (228·6 mm.) |
| Clutch push rod (diameter) | ·1875" (4·7025 mm.) |

GEAR RATIOS

| | |
|------------------|-------|
| Gearbox: | |
| (top) | 1·0 |
| (third) | 1·24 |
| (second) | 1·65 |
| (first) | 2·65 |
| Overall: | |
| (top) | 5·14 |
| (third) | 6·39 |
| (second) | 8·45 |
| (first) | 13·62 |

SPROCKETS

| | |
|--------------------|----------|
| Engine | 28 teeth |
| Clutch | 52 teeth |
| Gearbox | 17 teeth |
| Rear wheel | 47 teeth |

CHAIN SIZES

| | |
|----------------------|-------------------------|
| Primary | Duplex ·375" × 72 links |
| Transmission | 0·625" × 100 links |

ENGINE (B25)

PISTON

| | |
|--------------------------------------|-----------------------------------|
| Material | “Lo-Ex” aluminium |
| Compression ratio | 10 : 1 |
| Clearance: | |
| (bottom of skirt) | ·0023"—·0028" (·05842—·07112 mm.) |
| (top of skirt) | ·0042"—·0053" (·10668—·13462 mm.) |
| <i>(both measured on major axis)</i> | |

PISTON RINGS

| | |
|--------------------------------------|---------------------------------|
| Material: | |
| compression (top) | Brico BSS5004 |
| compression (centre) | Brico 8 |
| scraper | Brico BSS5004 |
| Width: | |
| compression (top and centre) | ·0625" (1·5875 mm.) |
| scraper | ·125" (3·175 mm.) |
| Depth: | |
| compression (top and centre) | ·108"—·114" (2·7432—2·8956 mm.) |
| scraper | ·094"—·100" (2·3876—2·540 mm.) |
| Clearance in groove | ·001"—·003" (·0254—·0762 mm.) |
| Fitted gap: | |
| (maximum) | ·013" (·3302 mm.) |
| (minimum) | ·009" (·2283 mm.) |

OIL PUMP

| | |
|---|----------------------|
| Pump body material | Zinc base alloy |
| Type | Double gear |
| Drive ratio | 1 : 4 |
| Non-return valve spring (free length) | ·625" (15·875 mm.) |
| Non-return valve spring ball (diameter) | ·25" (6·35 mm.) |
| Oil pressure release valve spring (free length) | ·6094" (15·4781 mm.) |
| Oil pressure release valve ball (diameter) | ·3125" (7·9375 mm.) |

CAMSHAFT

| | |
|---|-------------------------------------|
| Journal diameter (left- and right-hand) | ·7480"—·7485" (18·9992—19·0119 mm.) |
| Cam lift: | |
| (inlet) | ·345" (8·763 mm.) |
| (exhaust) | ·336" (8·534 mm.) |
| Base circle radius | ·906" (23·0124 mm.) |

CAMSHAFT BEARING BUSHES

| | |
|--------------------------------|--------------------------------------|
| Bore diameter (fitted) | ·7492"—·7497" (19·0297—19·04238 mm.) |
| Outside diameter | ·908"—·909" (23·0632—23·0886 mm.) |
| Camshaft clearance | ·0007"—·0017" (·01778—·04318 mm.) |

VALVES

| | | |
|--------------------------------|---------------|-----------------------|
| Seat angle (inclusive) | 90° | |
| Head diameter: | | |
| (inlet) | 1·450"—1·455" | (36·830—36·957 mm.) |
| (exhaust) | 1·312"—1·317" | (33·3248—33·4518 mm.) |
| Stem diameter: | | |
| (inlet) | ·3095"—·3100" | (7·861—7·874 mm.) |
| (exhaust) | ·3090"—·3095" | (7·848—7·861 mm.) |

VALVE GUIDES

| | | |
|--|---------------|-----------------------|
| Material | Hidurel 5 | |
| Bore diameter | ·3120"—·3130" | (7·9248—7·950 mm.) |
| Outside diameter | ·5005"—·5010" | (12·7127—12·7254 mm.) |
| Length | 1·844" | (46·8376 mm.) |
| Cylinder head interference fit | ·0015"—·0025" | (·0381—·0635 mm.) |

VALVE SPRINGS

| | | |
|-----------------|--------|---------------|
| Free length: | | |
| (inner) | 1·400" | (35·56 mm.) |
| (outer) | 1·750" | (44·45 mm.) |
| Fitted length: | | |
| (inner) | 1·262" | (32·0548 mm.) |
| (outer) | 1·370" | (34·798 mm.) |

VALVE TIMING

Tappets set to ·015" (·381 mm.) for checking purposes only:—

| | |
|---------------------------------|-----|
| inlet opens b.t.d.c. | 51° |
| inlet closes a.b.d.c. | 68° |
| exhaust opens b.b.d.c. | 78° |
| exhaust closes a.t.d.c. | 37° |

TAPPET CLEARANCE (Cold)

| | | |
|-----------------|-------|-------------|
| Inlet | ·008" | (·2032 mm.) |
| Exhaust | ·010" | (·254 mm.) |

IGNITION TIMING

| | | |
|---|-------|--------------|
| Piston position (b.t.d.c.) fully advanced .. | ·342" | (8·6868 mm.) |
| Crankshaft position (b.t.d.c.) fully advanced | 37° | |
| Contact breaker gap setting | ·015" | (·381 mm.) |

SPARK PLUG

| | | |
|---------------------|-----------------------------|-------------|
| Type | Champion N3 | |
| Gap setting: | | |
| (minimum) | ·020" | (·508 mm.) |
| (maximum) | ·025" | (·635 mm.) |
| Thread size | 14 mm. dia. × ·75" reach | (19·05 mm.) |

CYLINDER BARREL

| | |
|------------------------------|--------------------------------------|
| Material | Aluminium with austenitic iron liner |
| Bore size (standard) | 67 mm. |
| Stroke | 70 mm. |
| Oversizes | 1/2 mm. and 1 mm. |

CYLINDER HEAD

| | |
|---------------------------|---------------------|
| Material | Aluminium alloy |
| Inlet port size | 1.125" (28.575 mm.) |
| Exhaust port size | 1.25" (31.75 mm.) |

CARBURETTER

| | | |
|--|------------|--------------|
| Type (concentric float chamber) | Amal 928/7 | †Amal R928/4 |
| Main jet | 170 | |
| Pilot jet | 25 | †622/107 |
| Needle jet size | .106" | (2.7152 mm.) |
| Needle position | 1 | |
| Throttle valve | 3 | |
| Nominal choke size | 28 mm. | |
| Throttle slide return spring (free length) | 2.5" | (63.5 mm.) |

BEARING DIMENSIONS

| | | |
|--|--------------------------|----------------------------------|
| Clutch roller (25) | .1875" × .1875" | (4.7025 × 4.7025 mm.) |
| Connecting rod big-end bearing (running clearance) | .0005"—.0015" | (.0127—0.0381 mm.) |
| Connecting rod big-end (crank diameter) | 1.4375"—1.4380" | (36.5125—36.5252 mm.) |
| Crank undersizes | .010", .020", .030" | (.254, .508, .762 mm.) |
| Connecting rod small-end bush (bore) | .6890"—.6894" | (17.5006—17.6108 mm.) |
| Crankcase bearing : | | |
| (drive-side) | 25 × 62 × 17 mm. | |
| (gear-side) | 25 × 62 × 17 mm. | |
| Crankshaft diameter: | | |
| (drive-side and gear-side) | .9841"—.9844" | (24.9961—25.0038 mm.) |
| Gearbox layshaft bearings: | | |
| (drive-side and gear-side) | 0.5" × .625" × .8125" | (12.7 × 15.875 × 20.6375 mm.) |
| Gearbox layshaft diameter: | | |
| (drive-side and gear-side) | .6245"—.625" | (15.8623—15.8750 mm.) |
| Gearbox mainshaft bearing: | | |
| (drive-side) | 30 × 62 × 16 mm. | |
| (gear-side) | .625" × 1.5625" × .4375" | (15.875 × 39.2875 × 11.1125 mm.) |
| Gearbox mainshaft diameter: | | |
| (drive-side) | .7485"—.749" | (19.0119—19.0246 mm.) |
| (gear-side) | .6245"—.625" | (15.8623—15.8750 mm.) |
| Gearbox sleeve pinion: | | |
| (internal diameter) | .752"—.753" | (19.1008—19.1262 mm.) |
| (external diameter) | 1.179"—1.180" | (29.9466—29.9720 mm.) |
| Gudgeon pin diameter | .6882"—.6885" | (17.4803—17.4879 mm.) |

†Denotes 1970 model

TRANSMISSION (B25)

CLUTCH

| | |
|---|--------------------------------------|
| Type | Multi-plate with integral cush drive |
| Number of plates: | |
| driving (bonded segments) | 4 |
| driven (plain) | 5 |
| Overall thickness of driving plate and segments | ·167" (4·242 mm.) |
| Clutch springs | 4 |
| Free length of springs | 1·65685" (42·0687 mm.) |
| Clutch push rod: | |
| (length) | 9·0" (228·6 mm.) |
| (diameter) | ·1875" (4·7025 mm.) |

GEAR RATIOS

| | |
|------------------|-------|
| Gearbox: | |
| (top) | 1·0 |
| (third) | 1·24 |
| (second) | 1·65 |
| (first) | 2·65 |
| Overall: | |
| (top) | 6·92 |
| (third) | 8·61 |
| (second) | 11·40 |
| (first) | 18·36 |

SPROCKETS

| | |
|--------------------|----------|
| Engine | 23 teeth |
| Clutch | 52 teeth |
| Gearbox | 16 teeth |
| Rear wheel | 49 teeth |

CHAIN SIZES

| | |
|----------------------|-------------------------|
| Primary | Duplex ·375" × 70 links |
| Transmission | 0·625" × 100 links |

FRAME AND FITTINGS

FRONT FORKS

| | |
|-------------------------------|-------------------------------------|
| Type | Coil spring (hydraulically damped) |
| Springs: | |
| free length | 10.75"—10.875" (273.05—276.225 mm.) |
| spring rate | 34 lb./in. |
| number of coils | 20½ |
| colour identification | Red/green |

REAR DAMPERS

| | |
|-------------------------------|------------------------------------|
| Type | Coil spring (hydraulically damped) |
| Springs: | |
| free length | 8.40" (213.36 mm.) |
| spring rate | 100 lb./in. |
| colour identification | Green/pink |

SWINGING ARM

| | |
|--------------------------|-----------------------------------|
| Bush type | Bonded rubber |
| Bush diameter | 1.250"—1.253" (31.75—31.8262 mm.) |
| Housing diameter | 1.247"—1.248" (31.673—31.699 mm.) |
| Interference fit | .002"—.006" (.0508—.1524 mm.) |
| Spindle diameter | .810"—.811" (20.570—20.595 mm.) |

FORK BUSHES

| | |
|-------------------------------|-------------------------------------|
| Material | Sintered bronze |
| Outer diameter: | |
| (top) | 1.498"—1.499" (38.49—38.074 mm.) |
| (bottom) | 1.4935"—1.4945" (35.648—35.674 mm.) |
| Inner diameter: | |
| (top) | 1.3065"—1.3075" (33.185—33.21 mm.) |
| (bottom) | 1.2485"—1.2495" (31.7—31.73 mm.) |
| Working clearance: | |
| (top) | 0.0035"—0.0050" (.0889—.127 mm.) |
| (bottom) | 0.0035"—0.0065" (.0889—.1651 mm.) |
| Length: | |
| (top) | 1" (25.4 mm.) |
| (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) | WM2-18 |
| (rear) | WM2-18 |
| Spoke sizes: | |
| front (right-hand, outer) 10 | 8 s.w.g. × 4.6875" (4.064 × 119.062 mm.) |
| front (right-hand, inner) 10 | 8 s.w.g. × 4.7187" (4.064 × 119.856 mm.) |
| front (left-hand) 20 | 8 s.w.g. × 5.532" (4.064 × 140.493 mm.) |
| rear (short) 20 | 10 s.w.g. × 7.375" (3.251 × 187.352 mm.) |
| rear (long) 20 | 10 s.w.g. × 7.4375" (3.251 × 188.9125 mm.) |

WHEEL BEARINGS

| | | | | | | |
|------------------------------|----|----|----|----|----|-----------------------------------|
| Front (left- and right-hand) | .. | .. | .. | .. | .. | 20×47×14 mm. ball journal |
| Rear (left- and right-hand) | .. | .. | .. | .. | .. | ·875"×2"×·5625" single seal |
| Rear brake drum | .. | .. | .. | .. | .. | ·875"×2"×·5625" double seal |
| Spindle diameter: | | | | | | |
| (front) | .. | .. | .. | .. | .. | ·7868"—·7873" (19·98—19·997 mm.) |
| rear (left-hand) | .. | .. | .. | .. | .. | ·8745"—·8750" (22·212—22·225 mm.) |
| rear (right-hand) | .. | .. | .. | .. | .. | ·685"—·686" (17·399—17·424 mm.) |

BRAKES

| | | | | | | |
|-----------------------------------|----|----|----|----|----|----------------------|
| Front: | | | | | | |
| (diameter) | .. | .. | .. | .. | .. | 7" (177·8 mm.) |
| (width) | .. | .. | .. | .. | .. | 1·5625" (39·687 mm.) |
| Rear: | | | | | | |
| (diameter) | .. | .. | .. | .. | .. | 7" (177·8 mm.) |
| (width) | .. | .. | .. | .. | .. | 1·125" (28·575 mm.) |
| Lining thickness (front and rear) | .. | .. | .. | .. | .. | ·15625" (3·9687 mm.) |
| Lining area, sq./in. (sq.cm.): | | | | | | |
| front | .. | .. | .. | .. | .. | 22·6 (148·770) |
| rear | .. | .. | .. | .. | .. | 15·48 (99·84) |

TYRES

| | | | | | | |
|-----------|----|----|----|----|----|-------------------------------|
| Size: | | | | | | |
| (front) | .. | .. | .. | .. | .. | 3·25"×18" (82·55×457·2 mm.) |
| (rear) | .. | .. | .. | .. | .. | 3·50"×18" (88·9×457·2 mm.) |
| Pressure: | | | | | | |
| (front) | .. | .. | .. | .. | .. | 16 p.s.i. (1·125 kg./sq. cm.) |
| (rear) | .. | .. | .. | .. | .. | 22 p.s.i. (1·195 kg./sq. cm.) |

ELECTRICAL EQUIPMENT (12 volt)

| | | | | | | |
|-----------------------------------|----|----|----|----|----|----------------------|
| Battery | .. | .. | .. | .. | .. | Lucas PUZ5A |
| Coil | .. | .. | .. | .. | .. | Lucas MA12 |
| Contact breaker unit (B44 models) | .. | .. | .. | .. | .. | Lucas 54041124 (6CA) |
| Generator | .. | .. | .. | .. | .. | Lucas RM21 |
| Generator output | .. | .. | .. | .. | .. | 115 watt |
| Horn (Clearhooter) | .. | .. | .. | .. | .. | HF80 |
| Rectifier | .. | .. | .. | .. | .. | Lucas 2DS506 |
| Zener diode | .. | .. | .. | .. | .. | Lucas ZD715 |
| Bulbs: | | | | | | |
| headlamp (main) | .. | .. | .. | .. | .. | 50/40 watt |
| headlamp (pilot) | .. | .. | .. | .. | .. | 6 watt |
| main beam indicator | .. | .. | .. | .. | .. | 2 watt |
| stop/tail lamp | .. | .. | .. | .. | .. | 6/21 watt |

CAPACITIES

| | | |
|-------------------------------|--------------------|----------------|
| Fuel tank | 3¼ galls./3⅞ U.S. | (14¾ litres) |
| Oil tank | 4 pints/4.8 U.S. | (2.273 litres) |
| Gearbox | 0.5 pint/0.6 U.S. | (.264 litres) |
| Primary chaincase | 0.25 pint/0.3 U.S. | (.142 litres) |
| Front fork (each leg) | 0.34 pint/0.4 U.S. | (.1893 litres) |

BASIC DIMENSIONS

| | | |
|--------------------------|-----|--------------|
| Wheelbase | 53" | (134.62 cm.) |
| Overall length | 83" | (210.82 cm.) |
| Handlebar width | 27" | (68.58 cm.) |
| Seat height | 31" | (787.4 cm.) |
| Ground clearance | 7" | (17.78 cm.) |
| Overall height | 42" | (106.68 cm.) |

WEIGHTS

| | | |
|---|----------|-------------|
| Machine unladen (B44) | 320 lbs. | (145 kg.) |
| Machine unladen (B25) | 302 lbs. | (137 kg.) |
| Engine/gearbox unit—less carburetter (B44) .. | 85 lbs. | (39 kg.) |
| Engine/gearbox unit—less carburetter (B25) .. | 77 lbs. | (34.92 kg.) |

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ROUTINE LUBRICATION

Ref. No.

Weekly:

- 2 Check oil level in tank.
- 7 Grease brake pedal pivot.
- 4 Oil exposed cables and control rod joints.

Every 500 miles (800 km.):

- 10 Check oil level in primary chaincase.

Every 2,000 miles (3,200 km.):

- 2 Drain and refill the oil tank.
- 9 Check oil level in gearbox.
- 2 Clean the oil filters.
- Examine pump ball valve.
- Grease centre stand.
- Lubricate prop stand (oil).

Ref. No.

- 11 Oil front brake cam spindle.
- 5 Grease rear brake cam spindle.
- 1 Lubricate rear chain.

Every 5,000 miles (8,000 km.):

- 6 Grease speedometer drive cable.
- 3 Lubricate contact breaker cam.
- 3 Lubricate auto-advance mechanism.
- 9 Drain and refill gearbox.
- 10 Drain and refill primary chaincase.

Every 10,000 miles (16,000 km.):

- 8 Drain and refill front forks.
- Grease wheel bearings.
- Grease steering head bearings.

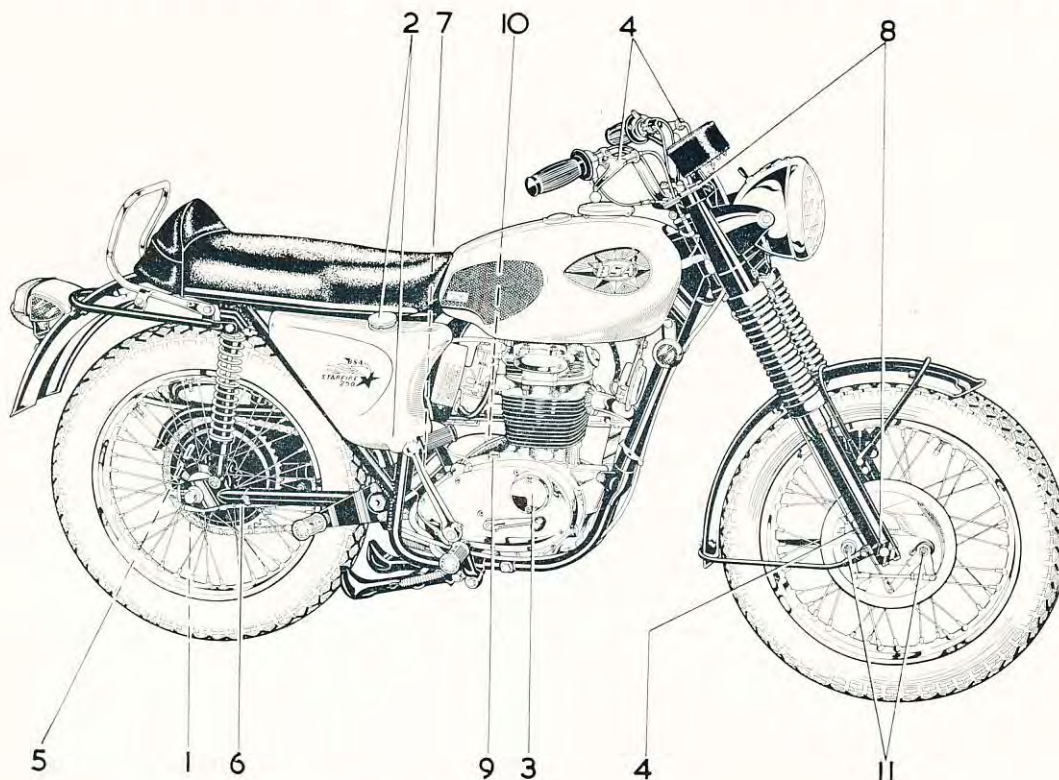


FIG. A1. Key lubrication points.

(Dotted lines refer to left side of machine).

RECOMMENDED LUBRICANTS

| ENGINE OILS | | | GEARBOX OILS | OIL Front Forks and Primary Chain | GREASE |
|-------------|-------------------------|--------------------------|----------------------------------|---|------------------------------------|
| Brand | Summer | Winter | | | |
| MOBIL OIL | Super | Super | Mobilube GX.90 | Arctic | Mobilgrease MP |
| SHELL | X100-40 | X100-30 | Spirax 90E.P. | X100-20W | Retinax A |
| CASTROL | XL | XL | Hypcy 90.EP | Castrolite | Castrolase LM |
| ESSO | Esso Motor Oil 40/50 | Esso Motor Oil 20W/30 | Gear Oil EP.90 | Esso Motor Oil 20/30W | Esso Multi- purpose Grease H |
| B.P. | S.A.E. 40 | S.A.E. 30 | B.P. Gear Oil 90.EP | S.A.E. 20W | Energrease L2 |
| REGENT | Havoline S.A.E. 40 | Havoline S.A.E. 30 | Multigrade Lubricant 90.EP | Havoline S.A.E. 20W | Marfak Multipurpose 2 |

The choice of the lubricant grade 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 climatic 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.

Note:—During factory testing the engine is run on a mineral-base oil and a similar type of oil **must** be used thereafter. If it is desired to change to a vegetable-base oil, the engine lubricating system must be thoroughly cleansed of the previous lubricant. If the two types of oil are mixed, an emulsion will be formed which may damage the engine. A vegetable-base oil **must not** be used in the primary chaincase, because of the possible harmful effects on the electrical equipment.

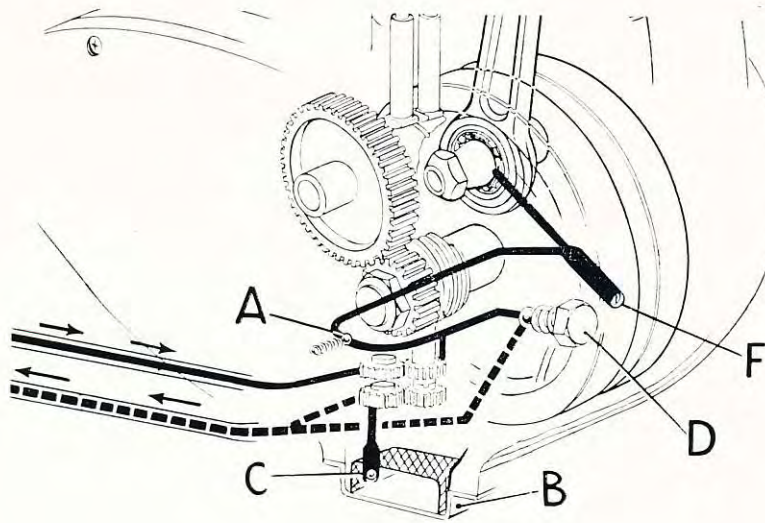
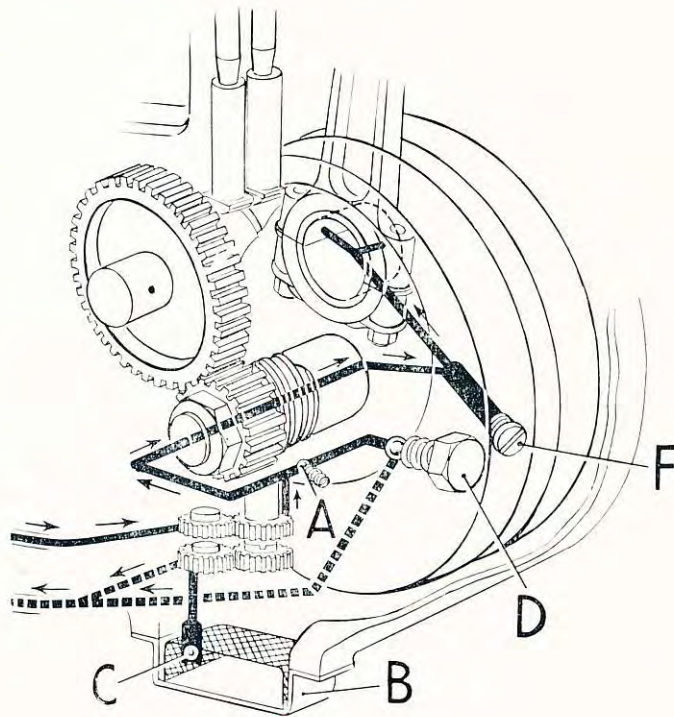


FIG. A2. Engine lubrication diagram showing the ball valves (top B25, bottom B44).

THE LUBRICATION SYSTEM

The engine lubrication system is of the dry sump type, *i.e.*, the oil is fed by gravity from a tank to a double-gear pump situated in the crankcase base at the right-hand side (see Fig. A2).

The top set of gears in the pump draws oil from the tank through a gauze filter and circulates it under pressure, past a pressure release valve (*D*), a non-return valve (*A*) and through the drilled crankshaft to the big-end bearing. Excess oil is thrown off by centrifugal force, on to the cylinder walls, the underside of the piston (to lubricate the gudgeon pin) and fills various wells to lubricate the camshaft and gears.

After lubricating the various internal components of the engine, the oil drains down into the crankcase.

From here the lower, and larger set of pump gears, draws oil from the gauze sump filter through another non-return valve (*C*) and pumps it back to the tank at a greater rate than that of the feed side. This ensures that the sump never floods; hence the term "dry sump."

The oil return pipe is tapped at the crankcase union to provide a supply of oil at low pressure to the valve rocker gear.

On B44 models, this pipe is connected by means of a twin union to the left-hand side of the rocker box. The B25 model use a common rocker oil supply, there being only one oil pipe union at the rocker box.

The oil is fed through the rocker shafts, lubricating the rocker ball pins, adjuster screws and finally the tappets as it drains back into the crankcase.

Changing the oil and cleaning the filters

The oil in new or reconditioned engines should be changed at 250, 500 and 1,000 mile (400, 800, 1,500 km.) intervals during the running-in period and thereafter as stated on page A2.

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

The oil tank filter is screwed into the lower right-hand corner of the tank (see Fig. A3). Obtain a suitable receptacle with a piece of stiff material to use as a chute, unscrew the filter (which has a normal right-hand thread) and allow the oil to drain. Wash the filter thoroughly in petrol and allow to dry.

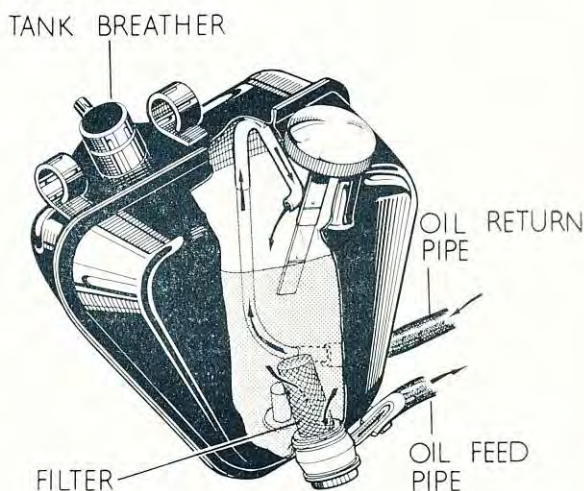


FIG. A3. Oil tank and filter.

Lean the machine towards the right-hand side to drain off any remaining oil in the tank.

Again using a suitable receptacle to catch the oil, unscrew the four self-locking nuts holding the sump filter to the crankcase and remove the filter. Also disconnect the supply and scavenge pipes at the crankcase union (one nut).

Allow the oil to drain, wash the filter thoroughly in petrol, and clean off the old jointing material from the filter and crankcase. If there is any sign of damage to the old gasket, replace it on re-assembly. On 1970 models the plate and filter are two separate parts with a gasket in-between. This also should be replaced if damaged.

When refilling the oil tank, do not exceed the recommended level marked on the filler cap dipstick, as the air space above the oil is essential for correct breathing. If the space is reduced, oil is liable to be blown out of the breather tube.

To ensure an accurate oil level check therefore, the machine must be on its centre stand, **not** on the prop stand. Before starting the engine $\frac{1}{2}$ pint of clean engine oil should be poured into the sump, this can be done by removing the oval tappet cover on the right-hand side of the engine.

Scavenge non-return valve

Whilst changing the oil it is a good point to check the scavenge pipe non-return valve for correct operation. Using a piece of wire, push the ball up off its seating and allow it to drop of its own weight. If the ball will not drop it indicates a build-up of sludge which can usually be cleared by immersing the pipe in petrol for a short period.

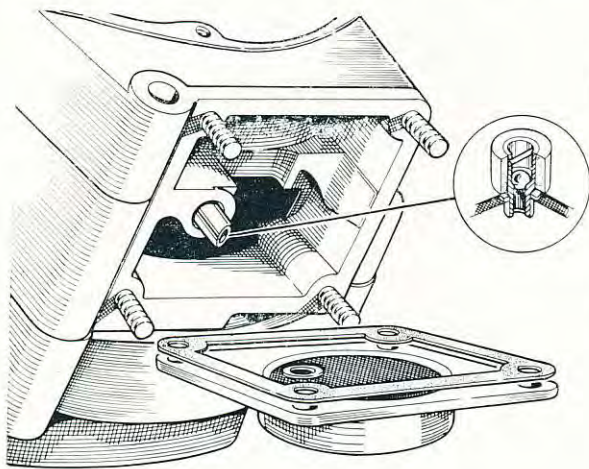


FIG. A4.

If there has been a tendency for the crankcase to fill with oil after standing overnight, so causing the engine to emit clouds of smoke when started, it is quite possible that the feed line non-return valve is not seating properly thus allowing oil to run back from the tank. This is the valve in the inner timing cover described on page A6.

Crankcase oil pipe union

The oil pipe union is secured to the crankcase with one nut. If the small rubber sealing rings in the oil pipe union are damaged, they must be replaced.

Note:—The oil pipes are correctly fitted when crossed over, *i.e.*, the outer pipe from the tank is attached to the inner connection on the crankcase.

OIL PRESSURE AND NON-RETURN VALVES

A constant oil pressure is maintained by the release valve situated on the front right-hand side of the crankcase (see Fig. A7).

To prevent the oil pressure becoming excessive, the valve opens and releases the excess oil direct into the crankcase from where it is returned to the tank.

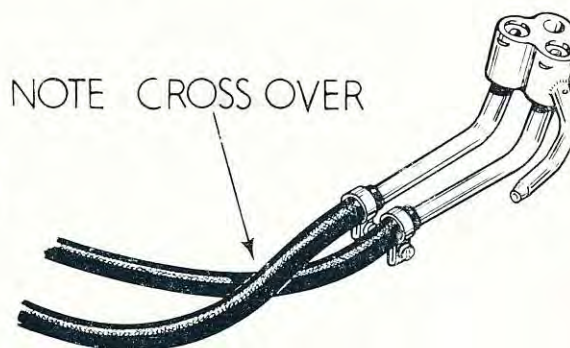


FIG. A5. Crankcase oil pipe union.

The valve is pre-set at the works and there is no point in altering the setting. However, after prolonged use, the spring does tend to weaken and corrode and must then be replaced. If there is corrosion it is wise to replace the ball also, after first cleaning the valve body.

To remove the valve, simply unscrew the large hexagon plug. Ensure that the fibre washer is fit for further use.

On 1970 models an improved oil pressure release valve has been fitted in place of the ball and spring type. It consists of a hexagon body with a gauze covering the end which screws into the crankcase. Into this is fitted a piston with a spring behind it. This in turn is secured by a

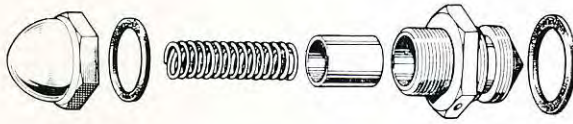


FIG. A6. Oil pressure release valve (1970).

domed hexagon cap which screws onto the end. Maintenance and removal is as for the earlier type (see Fig. A6).

Low oil pressure

Low oil pressure is dangerous since insufficient oil is likely to be delivered to the engine components. The possible causes of low pressure being:—

- (1) Insufficient oil in the tank. Check the level and the 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.

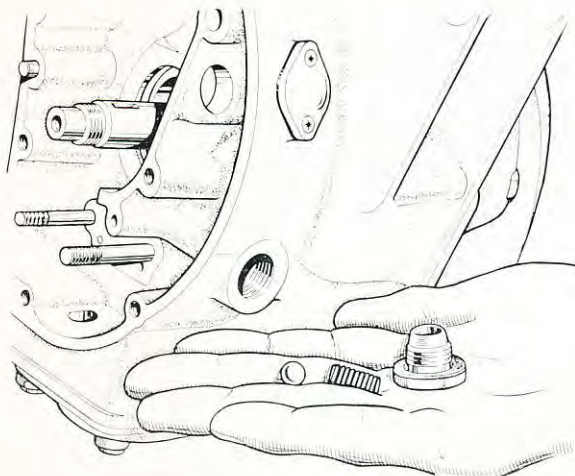


FIG. A7.

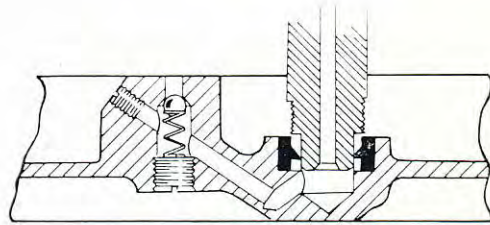


FIG. A8. Non-return valve.

- (3) Badly worn oil pump or big-end bearing in need of attention.
- (4) Oil pipes incorrectly connected, when the pump would be inducing air through the return pipe.

Syphoning

This, one of the more common troubles, happens when one of the non-return ball valves is sticking off its seating. It can also be caused by a badly worn pump or one which is loose on its mounting.

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

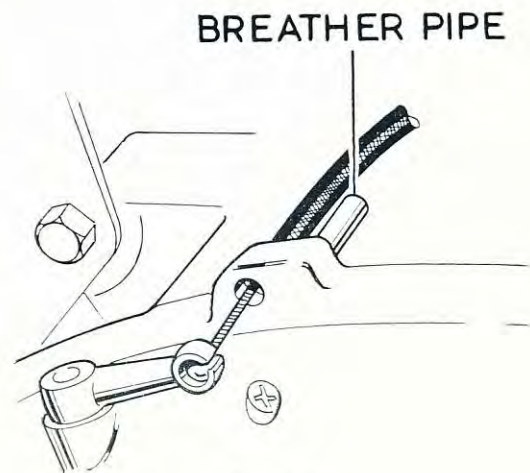


FIG. A9.

The feed line non-return valve consists of a ball and spring and is located in the inner timing cover (see Fig. A7). After unscrewing the retaining plug, the valve spring and ball can be removed for examination.

Should there be any doubt about the condition of the valve components renew them, since they are quite inexpensive.

The non-return valve in the scavenge pipe is described on page A6.

Crankcase breather

The short crankcase breather pipe emerges from the timing case near to the clutch cable abutment.

It is most important that this pipe is unobstructed and a regular examination should be made to ensure this.

DISMANTLING AND REASSEMBLING THE OIL PUMP

Having removed the oil pump from the engine (see page B23), take out the four screws from the base of pump, releasing the base plate and top cover from the pump body.

The driving spindle and driving worm gear are secured to the top cover with one nut and spring washer. Before removing the worm gear, make careful note of the way in which it is fitted to assist in rebuilding. Note also the position of thrust washers below top gears (B44 models only).

Wash all the parts thoroughly in petrol 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. Slight marks can be ignored, but any metal embedded in the gear teeth must be removed.

The most likely point of wear will be found on the driving gear teeth; if these are worn to the extent that the sharp edges have gone then they must be renewed.

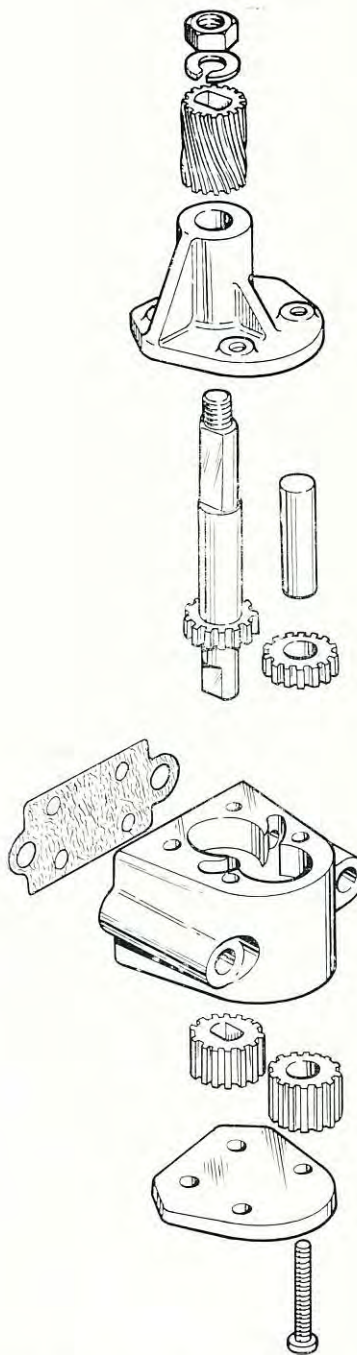


FIG. A10. *Oil pump exploded.*

Rebuilding the pump

Absolute cleanliness is essential when rebuilding the oil pump.

Insert the driving spindle (with fixed gear) into pump top cover, fit the worm drive and secure in position with nut and spring washer.

Fit the driven spindle and gear into the cover and replace thrust washers. The oil pump used on B25 models does not have thrust washers. Place the assembly on top of the pump body and insert the lower gears. Apply clean oil to the gears and refit the base plate. Check that the spindle and gears rotate easily before tightening the four fixing screws.

Finally, check the joint faces for parallelity; if the housing face is not level, it will be distorted when bolted to the crankcase and may prevent the pump from working.

For 1970 two small location dowels have been fitted between the spindle housing and the

pump body. Care should be taken not to damage or lose these dowels.

CONTACT BREAKER

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.

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

The contact breaker cam is lubricated from an oil-soaked felt wick which should have a few drops of engine oil (S.A.E. 20 or 30) applied every 5,000 miles (8,000 km.)—see Fig. A11.

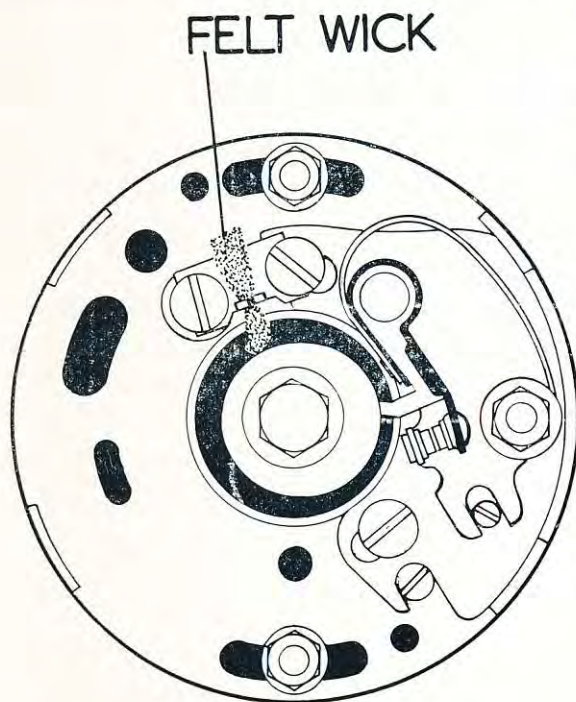


FIG. A11. Contact breaker.

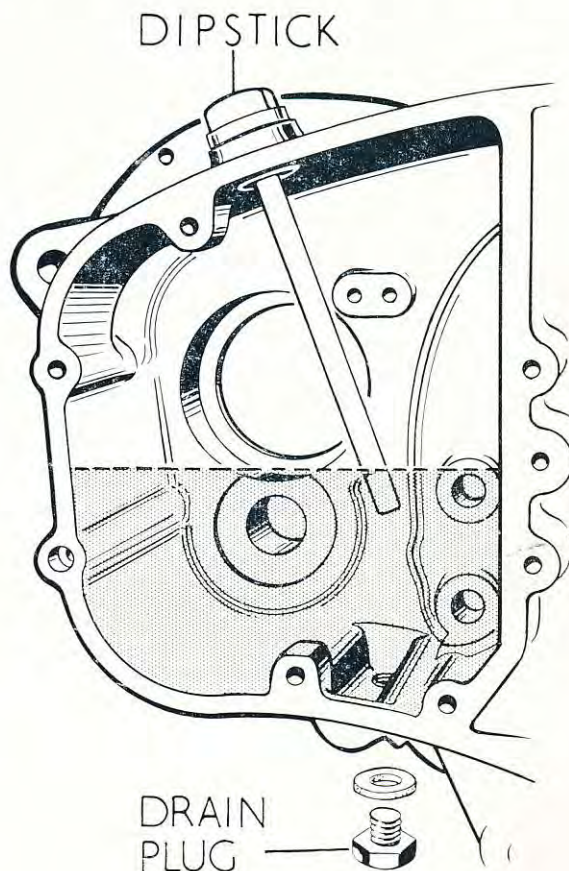


FIG. A12. Gearbox oil level system.

To lubricate the auto-advance unit it is necessary to remove the contact breaker plate. First mark across the plate and the housing so that it can be replaced in exactly the same position. Take out the fixing screws and withdraw the contact breaker plate.

The bob-weight pivot points of the auto-advance unit should be lightly oiled, again at 5,000 mile (8,000 km.) intervals.

An improved method of dry lubrication is employed for the cam spindle on all 1969 models and this spindle **must not** be lubricated by the owner.

If lubricant is introduced into the cam spindle bearing, it combines with the dry lubricant until it virtually seizes the bearing.

After lubricating, replace the plate to the marks, but if the timing has been upset, follow the instructions on pages B39 to B41.

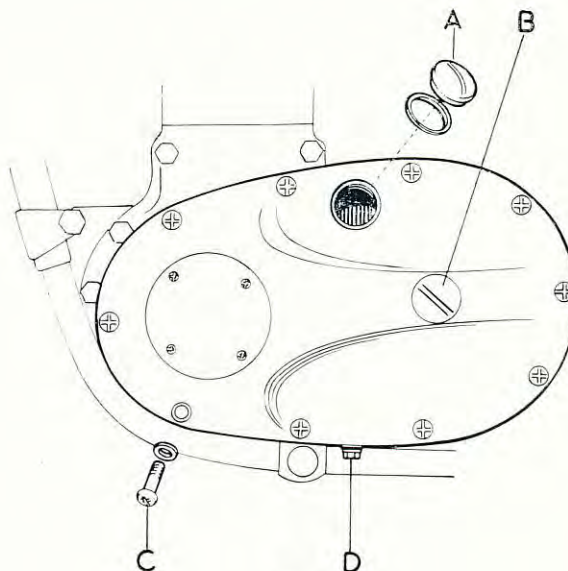


FIG. A.13.

PRIMARY DRIVE

Like the gearbox, the primary chaincase, having its own oilbath, is independent of the engine but the level of oil must be checked periodically and the oil drained and replaced as indicated in the routine maintenance sheet, page A2.

The oilbath in the primary chaincase does not lubricate the chain only, the clutch being contained in the same case is dependent on this oil supply for its efficient functioning.

A drip feed is also provided for the rear chain through an oil well and nozzle at the back of the chaincase.

Underneath the chaincase is the drain plug (D) Fig. A13 and this is fitted with a fibre washer. The level plug (C) is situated at the front lower edge of the case, this is fitted with an aluminium washer and has its head painted red.

On 1970 models the level plug has been moved and is now situated directly above the drain plug. The short screw has a fibre washer fitted and this should be replaced if damaged.

GEARBOX LUBRICATION

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

The layshaft gears run in the oil bath and oil being carried by or thrown off these gears lubricates the mainshaft gears, bearings and bushes.

To drain the gearbox, take out the filler plug and dipstick on top of the gearbox then unscrew and take out the large plug underneath, draining the oil into a suitable receptacle (see Fig. A12).

After draining, replace the drain plug, making sure that the rubber "O" ring is in good condition.

Now fill the gearbox with fresh oil and check level of oil with the dipstick.

Recommended grades of oil are quoted on page A3, capacities on page GD11 and checking frequency on page A2.

To drain the oil, take out the chain inspection cap (A) at the top of the case and the drain screw (D).

Cap (B) is only removed to enable clutch adjustments to be carried out.

After draining, replace the drain screw, take out level screw (C) and pour oil through the inspection cap hole until it commences to run out of the level screw hole. Replace level screw and inspection cap. The machine should be upright and on level ground when this operation is carried out to ensure correct level of oil.

Oil containing molybdenum disulphide or graphite must not be used in the primary chaincase. Castor-based oil must not be used either.

When replenishing, use only the grades recommended on page A3.

REAR CHAIN

Oil thrown off the primary chain is collected in a small well at the back of the primary case from which a drip feed is supplied to the rear chain.

This supply is dependent on the maintenance of the correct oil level in the primary chaincase.

This may not, however, be adequate in some circumstances and it is advisable to supplement the drip feed by occasionally applying oil to the chain links with an oil-can.

The best method of lubrication is to remove the chain every 2,000 miles, wash thoroughly in paraffin and allow to drain, then immerse it in melted tallow to which powdered graphite has been added.

Hang the chain over the grease tin to allow the surplus grease to drain off. If the tin is covered after use it can be used many times, but always use care when melting the tallow.

When replacing the chain, make sure that the spring clip of the connecting link has its closed end pointing in the direction of travel of the chain (*i.e.*, forwards on the top run).

STEERING HEAD

The steering head bearings are packed with grease on assembly and only require repacking at the intervals quoted on page A2. Removal and replacement of the steering is dealt with on pages E3 and E4 in the fork section.

Wipe out all the old grease from the bearing cups and clean the ball bearings, by rolling them in a clean rag.

After cleaning, carefully examine the bearings, cups and cones for pitting, corrosion or cracks, and renew if necessary.

The fresh grease will hold the ball bearings in position during reassembly. Check that the grease is as quoted on page A3.

There are several methods for determining the correct number of ball bearings to use, but the most effective method is to fill the cup completely with ball bearings and then extract one. The correct number of ball bearings for each cup is twenty.

FRONT FORK

The oil contained in the fork legs not only lubricates the bearing bushes, but also acts as the damping medium. Because of the latter function, it is essential that the amount of oil in each fork leg is exactly the same.

Oil leakage midway up the forks usually indicates that an oil seal has failed and requires replacement; this is dealt with on page E6 covering the dismantling and reassembly of the forks.

Correct period for changing the oil as quoted on page A2 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 twelve months.

To drain the oil, unscrew the fork cap nuts and the small drain plugs in the lower ends of the fork sliding members. Allow the oil to drain out then, whilst standing astride the machine, apply the front brake and slowly depress the forks a few times to drain any oil remaining in the system.

Replace the drain plugs, take out the cap nuts and pour one-third pint of oil into each fork leg (see page A3 for recommended grades of oil).

WHEEL BEARINGS

The wheel bearings are packed with grease on assembly and only require repacking at the intervals given on page A2.

The bearings should be removed as quoted on pages F3, F5 and F6. After removal, the bearings must be washed thoroughly in paraffin and, if possible, an air line should be used to blow out any remaining grit or paraffin.

Pack with correct grade of grease as quoted on page A3 after assembling the first bearing.

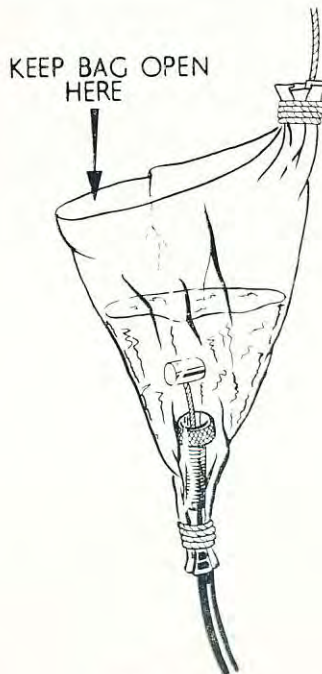


FIG. A14.

The rear brake drum bearing, having a double oil seal, does not require lubrication.

Do not over-lubricate and avoid handling the brake shoes with greasy hands.

CONTROL CABLES

Exposed sections of inner cables should be lubricated periodically (see page A2). This can be done either by greasing or applying the oil-can.

The most satisfactory way, however, is to induce a flow of oil between the inner cable and casing by using a simple oil reservoir as shown in Fig. A14, and leaving the cable for several hours.

During their manufacture, the inner cables are greased with a molybdenum-based grease which forms a semi-permanent lubricant and should therefore give long service before needing attention.

SPEEDOMETER AND TACHOMETER CABLES

It is necessary to lubricate the speedometer and tachometer cables to prevent premature failure of the inner wire. Care is also necessary to avoid over-zealous greasing which may result in the lubricant entering the instrument head. For lubricating, it is only necessary to unscrew the cable ferrule and withdraw the inner wire. The grease should be applied sparingly to the wire and the top six inches must not be greased.

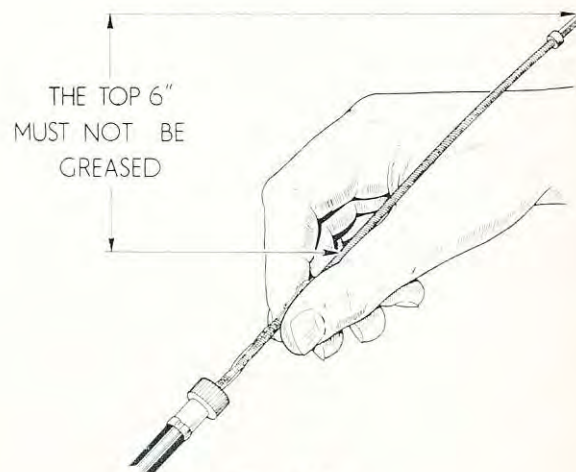


FIG. A15.

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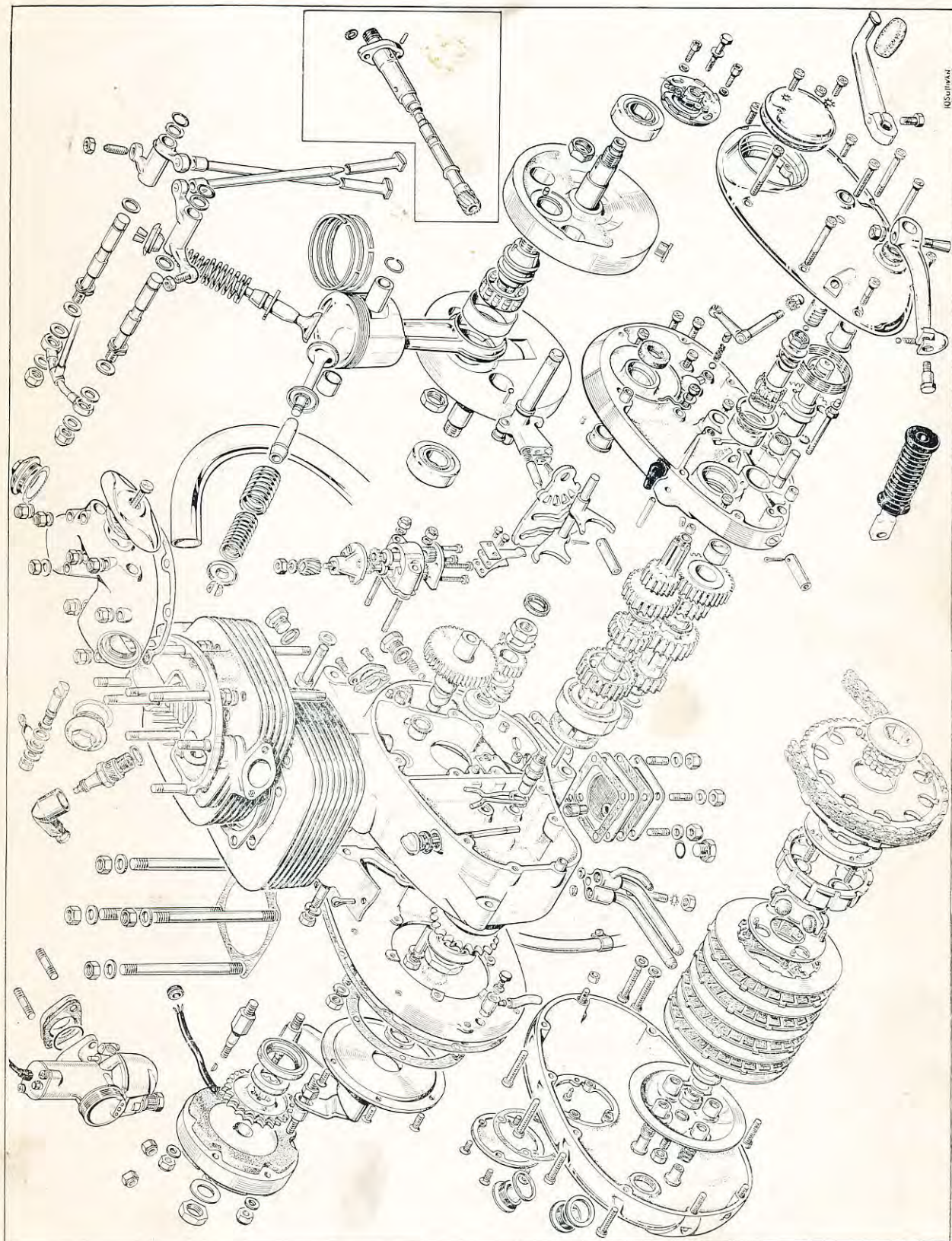


FIG. B1A. B44 engine exploded.

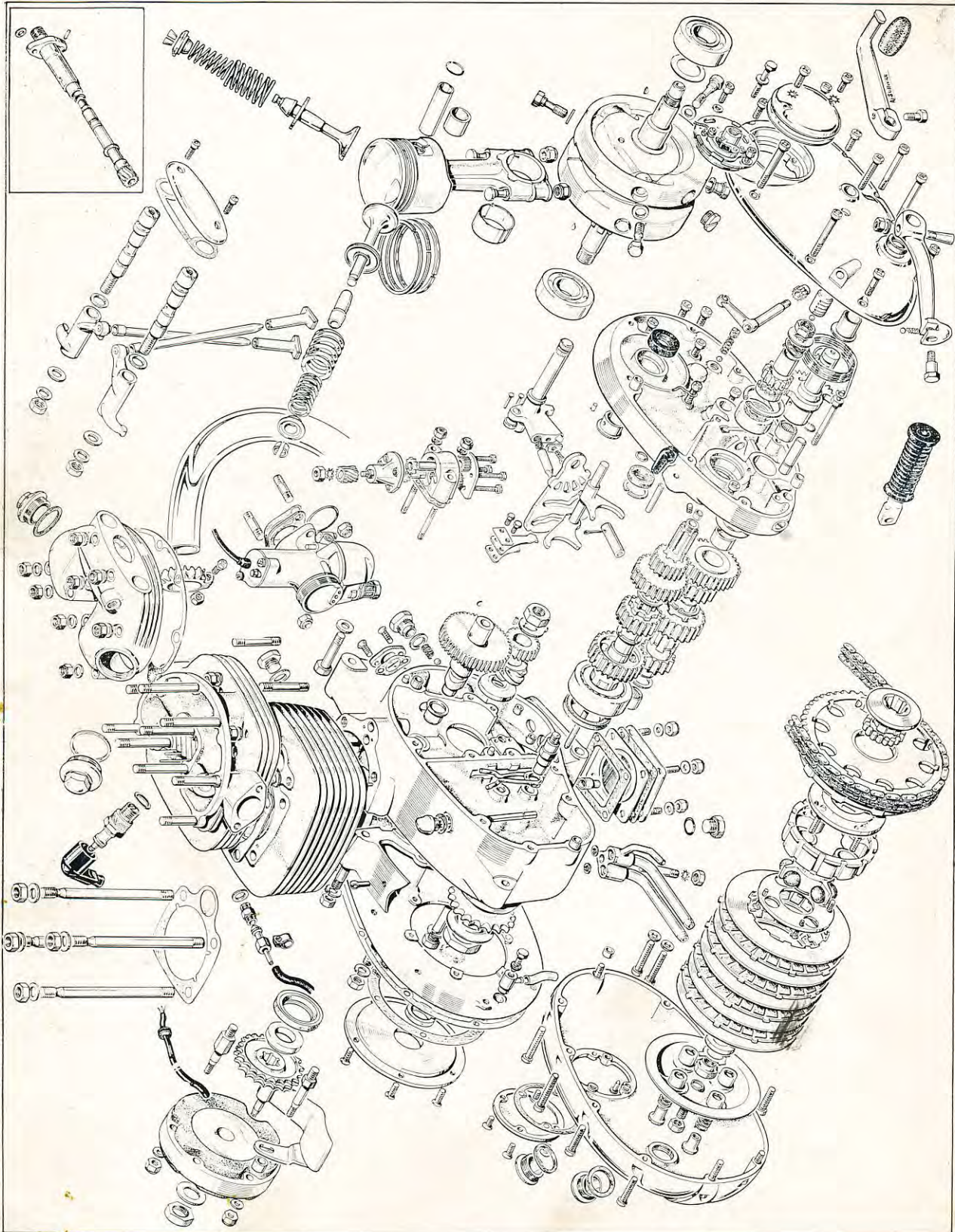


FIG. B1B. B25 engine exploded.

DESCRIPTION

B44 models

The B44 o.h.v. four-stroke engine is of the unit construction type, having a single cylinder barrel incorporating an austenitic iron liner.

A special "Lo-Ex" aluminium piston having two tapered compression rings and a scraper ring is used on a H-section connecting rod, employing a roller bearing big-end assembly.

Two balanced flywheels (with crankshafts) and the crankpin are held together by two large nuts, the unit revolving on two crankcase bearings.

The aluminium alloy cylinder head has cast-in heavy duty cast-iron valve seats and removable valve guides. Housed within the top of the cylinder head are two valve rocker spindles, carrying the inlet rocker at the rear and the exhaust rocker at the front.

The one-piece, high performance camshaft operates in two bushes, one of phosphor bronze and the other of sintered bronze.

Contained within the primary drive case on the left-hand of the crankcase are the clutch assembly, primary chain and the alternator. The alternator unit consists of an encapsulated six-coil stator, mounted on three studs and a rotor, secured to the drive-side shaft.

A vertically mounted oil pump of the double gear type is driven off a wormwheel on the gear-side crankshaft and supplies oil to the big-end assembly, piston, cylinder walls and the timing gears.

The gearbox, at the rear of the right-hand half of the crankcase, and the primary chaincase are independent of the engine lubrication system and each contain their own oil-bath.

Power from the engine is transmitted through the engine sprocket and duplex primary chain to the clutch assembly which has a built-in cush

drive. Here the drive is taken up by the bonded friction plates and is transmitted through the four-speed constant-mesh gearbox to the final drive sprocket.

B25 models

Although being of smaller capacity, the B25 engine bears very similar constructional detail to that of the B44 model. The most noticeable differences are in the valve rocker gear and the crankshaft assembly. Each of the valve rocker spindles have an eccentric cam which provides a means of adjusting the valve clearances.

Four special bolts hold each of the two flywheels to the one-piece forged crankshaft. Incorporated in the right-hand flywheel is a centrifugal oil sludge trap, fitted with a screwed plug. The bolt-on connecting rod big-end assembly consists of two bearing shell halves, available in three undersizes for use with reground crankshafts.

DECARBONISING

Decarbonising or "top overhaul" as it is sometimes called, means the removal of carbon deposits from the combustion chamber, piston crown, valve heads and inlet and exhaust ports, and to restore a smooth finish to these surfaces. Obviously, whilst the upper portion of the engine is dismantled for this purpose, opportunity will be taken to examine the valves, valve seats, springs, guides, etc., for general "wear and tear", hence the term "top overhaul."

Carbon, produced by combustion taking place in the engine when running, is not harmful providing it is not allowed to become too heavy and therefore likely to cause pre-ignition or other symptoms which may impair the engine performance.

The usual symptoms indicating the need for decarbonising, are an increased tendency for the engine to "pink" (metallic knocking sound when under load), a general decrease in power and a

tendency for the engine to run hotter than usual. An increase in petrol consumption may also be apparent.

Preparing to decarbonise

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

Spanners for 7/16" across flats to 9/16" across flats.

Set of scrapers.

Set of feeler gauges.

Supply of fine-grade emery cloth.

Jointing compound or cement.

Valve grinding tool No. 61-5035 and coarse/fine-grade grinding paste.

Valve spring compressor No. 61-3340.

Clean engine oil.

Pieces of hard wood to support piston.

Top overhaul gasket set:—

No. 00-3171 (B44);

No. 00-3168 (B25).

Gudgeon pin circlips (2):—

No. 66-0954 (B44);

No. 40-0979 (B25).

Valve springs (set):—

Nos. 65-2494 (outer) and

65-2495 (inner)—B44;

Nos. 40-1009 (outer) and

40-1007 (inner)—B25.

Paraffin and clean rag for cleaning.

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

To facilitate removal of the cylinder head for decarbonising, first take off the petrol tank, as detailed on page B14.

With the tank removed, the engine stay bracket can be disconnected, together with the exhaust valve lifter assembly after the inner cable has first been extracted through the slot in the end of the operating lever.

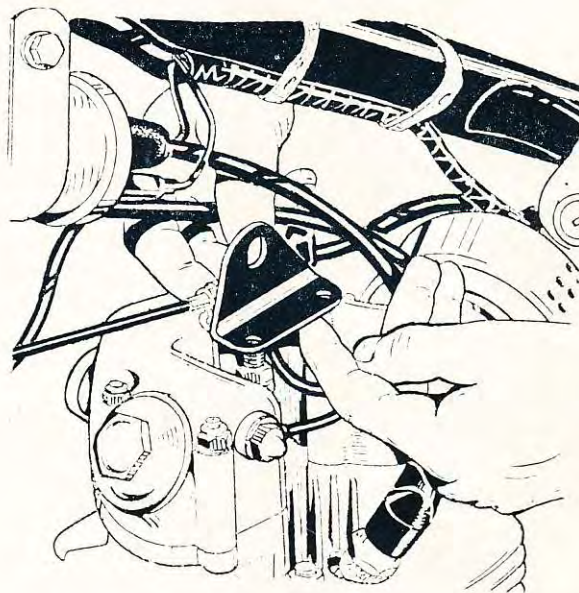


FIG. B2. Removing exhaust valve lifter assembly.

The exhaust pipe is a push-fit into the cylinder head and can be withdrawn after loosening the finned collar and releasing its bracket from the front engine mounting bolt. The silencer clip of course, must be slackened off but it will not be necessary to detach the silencer.

Remove the carburettor from the cylinder head and tie it back out of the way.

The oil feed pipe to the rocker spindles should now be disconnected and the sparking plug taken out.

Because the clearance between the cylinder head and the frame top tube is very limited, it will also be necessary to take off the horn and the coil to provide greater access. Note carefully, the terminal location of each cable.

Removing the cylinder head

Set the piston at top dead centre on the compression stroke (both valves closed) and take off the six nuts holding the cylinder head to the barrel.

Leave the rocker box assembly in position on the cylinder head, and raise the latter until it clears its fixing studs. It will then be necessary to rotate the cylinder head assembly about the push rods so as to clear the frame top tube. The rocker box can now be removed from the cylinder head, thus exposing the valves and springs.

B44 models

The clearance between the cylinder head and frame top tube on these models is not sufficient to allow the head to be lifted off, making it necessary to take the engine out of the frame. An alternative method is to extract the five central rocker box studs to allow the rocker box to be removed, so providing the necessary clearance for cylinder head removal. Continual extraction of these studs however, will eventually impair the threads in the head and it is preferable to remove the complete engine.

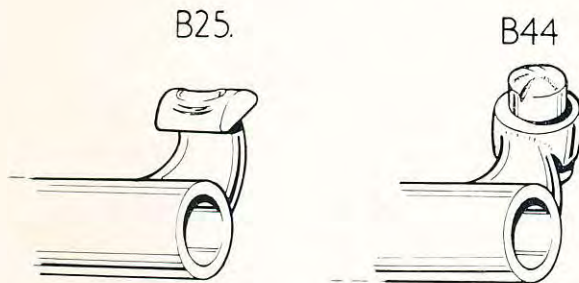


FIG. B3. *Worn valve rockers.*

Valve rockers

Figure B3 shows rocker arms which have been subjected to a great deal of wear, making the correct valve clearance difficult to determine. During their manufacture the pads (B25) and the pins (B44) are case-hardened and no attempt should be made to grind them smooth. If wear of this nature is apparent therefore, replacement parts should be fitted.

If the rockers and spindles are dismantled take care to renew any damaged washers. On B44 rocker spindles, see that the rubber sealing rings are in good condition.

Refer to Fig. B4A when reassembling.

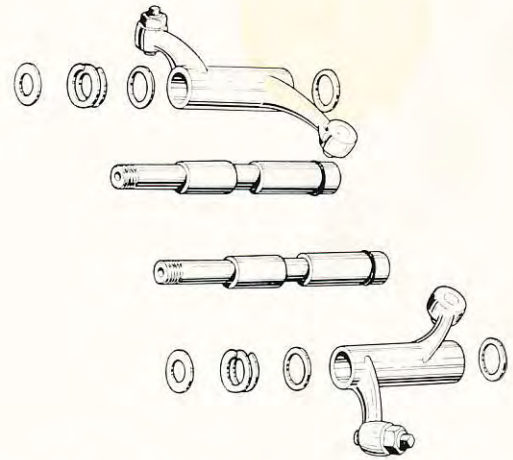


FIG. B4A. *Valve rocker assembly (B44).*

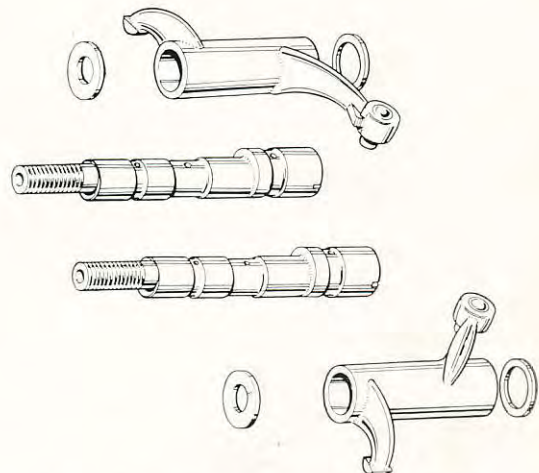


FIG. B4B. *Valve rocker assembly (B25).*

Removing the valve springs

Using service tool No. 61-3340 or similar valve spring compressor, compress each spring until the split collets can be removed. The valve springs and top collars can now be lifted from the valve stems, swilled in paraffin, then placed on a numbered board to indicate their position 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 pages GD3 and GD7.

If the springs have settled appreciably, or there are signs of cracking, they should be replaced.

Push rods

Examine the push rod end cups to see if they are chipped, worn or loose, and check that the rods are not bent by rolling them on a flat surface (*i.e.*, a piece of plate glass). If any of these faults are evident the rod(s) should be renewed.

Valve guides

Check the valves in the guides; there should be no excessive side-play or evidence of carbon build-up on that portion of the stem which operates in the guide. Carbon deposits can be removed by careful scraping and very light use of fine-grade emery cloth. If there are signs of scoring on the valve stems, indicating seizure, both valve and guide should be renewed.

An old valve guide can be driven out with service tool No. 61-3382 but, the aluminium head should first be heated by immersing in hot water. The new guide can be driven in with the same punch whilst the head is still warm. Note that the exhaust guide is counterbored at the end which protrudes into the port.

Whenever new guides have been fitted, each valve seat must be refaced with a piloted valve seat cutter, to ensure that the seat is concentric with the guide bore.

Valves

Valve heads can be refaced on a valve refacer but if pitting is deep or the valve head is burnt, then a new valve must be fitted and ground-in.

The valve seats in the cylinder head are unlikely to require any attention, but if they are marked, they should be refaced with valve seat cutter tool No. 61-3300 used with pilot No. 61-3293 and holder No. 61-3290. The seat angle is forty-five degrees.

Sometimes when the engine has been decarbonised many times, valves become "pocketed". This is when the valve head and seat are below the surface of the combustion chamber, so im-

pairing the efficiency of the valve and affecting the gas flow. The "pocket" should be removed with a special thirty-degree angle cutter before recutting the seat or grinding-in the valve (see Fig. B5).

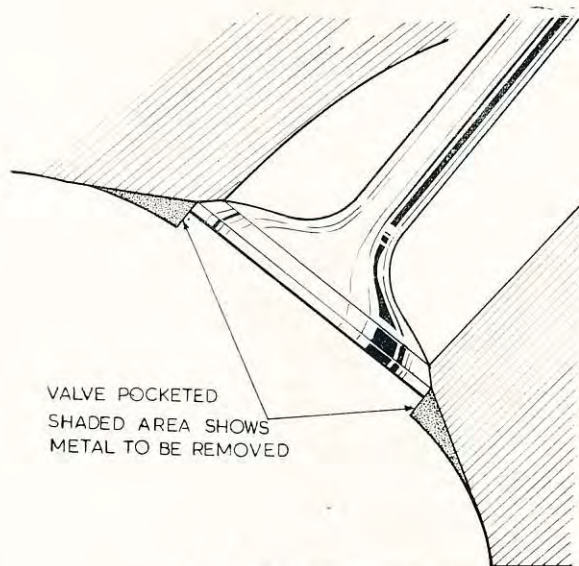


FIG. B5. *Pocketed valve.*

Valve grinding

If the valves have been renewed or refaced they must be lightly ground-in to their seats to ensure a good gas-seal.

This operation is carried out only after all carbon deposits have been removed from the combustion chamber.

Removal of carbon from the head, inlet and exhaust ports can be carried out with scrapers or rotary files, but whichever method is used great care must be taken to avoid scoring the valve seats.

A final "polish" can be achieved with the use of fine emery cloth wetted by paraffin.

Do not attempt to decarbonise the cylinder head by immersing it in caustic soda solution; the solution has a harmful effect on aluminium.

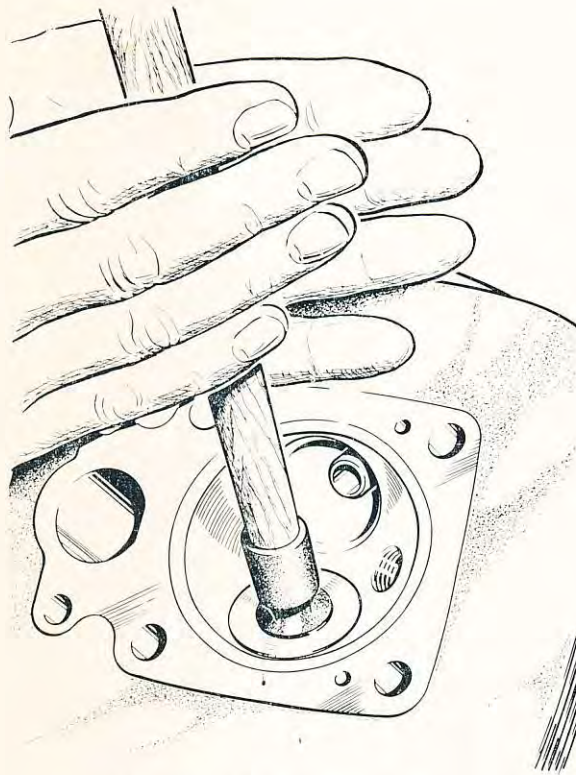


FIG. B6. *Grinding-in valve.*

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

Now, using service tool No. 61-5035, rotate the valve backwards and forwards, maintaining steady pressure. Every few strokes, raise the valve and turn it to a new position. A light spring inserted under the valve head greatly assists in raising the valve to enable it to be repositioned.

Grinding should be continued until the mating surfaces of both the valve and seat show a uniform matt finish all round.

Note:—Prolonged grinding-in of the valve does not produce the same results as recutting and must be avoided at all costs.

Reassembling the cylinder head

Before reassembling the valves and springs, all traces of grinding paste must be removed from both the valves and their seats.

Smear each valve stem with clean engine oil and replace the valves in the head.

Fit the spring cup, valve springs (with close coils at the bottom), and top collar over each valve stem, then compress the springs with service tool No. 61-3340 to allow the split collets to be inserted in the top collar. A little grease on the valve stem will assist in keeping the collets in position as the valve springs are released.

Make sure that the collets are correctly seated in the recess on the valve stem. 1970 models have slightly modified collets and top cups. These are only interchangeable as an assembly.

Cylinder barrel

Unless the condition of the engine indicates that the piston, piston rings or cylinder bore require attention, the cylinder barrel should not be disturbed.

If the bore is worn it can sometimes be detected by placing the fingers on top of the piston and attempting to push the piston backwards and forwards in the direction of flywheel rotation. Symptoms indicating faulty piston rings might include heavy oil consumption and poor compression, but only if the valves are known to be in good order. If the valves require attention they are much more likely to be the cause of such symptoms.

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

The cylinder bore can be measured for wear with a suitable dial gauge, after moving the piston to the bottom of the bore.

If the barrel is not being removed, bring the piston to the top of the bore and, after plugging the push rod opening with clean rag, proceed to remove the carbon from the piston crown. A stick of tinsmiths solder, flattened at one end, provides an ideal scraper tool and will not damage the alloy piston.

Always leave a ring of carbon around the edge of the piston crown and around the top of the cylinder bore. This will help to provide an additional seal.

After cleaning the piston crown, rotate the engine to lower the piston and wipe away any loose carbon from the cylinder wall.

The cylinder barrel and head joint faces must also be cleaned, care being taken not to damage the faces by scoring with the scraper.

Such score marks would result in gas leakage, loss of compression or even burning of the cylinder head face.

Removing cylinder barrel

To remove the cylinder barrel, rotate the engine until the piston is at the bottom of its travel, then lift the barrel upwards until the piston emerges from the base of the bore. Steady the piston as it comes free from the cylinder so that it is not damaged by violent contact with the crankcase mouth. As soon as the cylinder has been withdrawn, cover the crankcase with a clean rag to prevent the entry of foreign matter.

Examine the cylinder carefully for wear and if a deep ridge has formed at the top of the bore then the barrel will require attention.

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

The cylinder barrel on both the B44 and B25 is fitted with an austenitic iron liner, enabling a rebore to be carried out for use with oversize pistons. The recommended oversizes for the B44 are .010" and .020". For the B25 the oversizes are 1/2 mm. and 1 mm.

Removing the piston

It is not necessary to remove the piston unless it requires replacement or further dismantling of the engine is to be carried out.



FIG. B7. *Removing circlip.*

To remove the piston from its connecting rod, it will first be necessary to prise out one of the gudgeon pin circlips using a suitable pointed instrument in the notch provided.

Before the gudgeon pin can be withdrawn the piston must be thoroughly warmed by wrapping it in a rag that has been soaked in hot water and wrung out. Alternatively an electric iron can be applied to the piston crown until enough heat is obtained.

When the piston is warm, tap out the gudgeon pin with a suitable drift, supporting the piston to avoid any side strain on the connecting rod.

If the gudgeon pin comes out easily before the piston is warm then the pin or bush is worn and will need replacement.

After freeing the piston, mark the inside of the piston skirt so that it can be replaced the correct way round.

Piston rings

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 lie at least $\frac{3}{16}$ " apart.

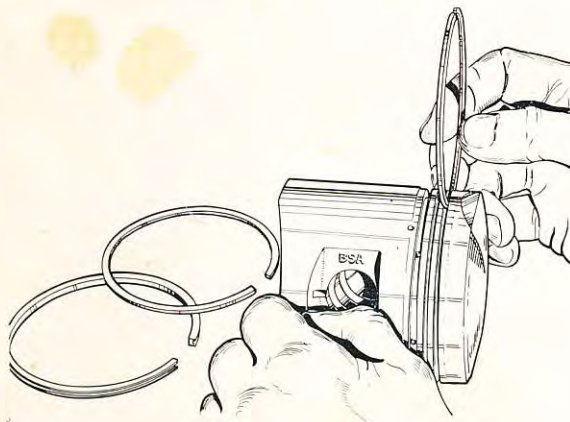


FIG. B8. *Checking ring grooves.*

Each ring should be free in its groove but with minimum side clearance. If the rings tend to stick in the grooves, remove them and clean out all the carbon from the groove and the inside face of the ring. Care is necessary to permit only a minimum amount of movement when removing the rings as they are very brittle and can be broken easily.

A piece of a broken piston ring, ground as a chisel, will provide a useful tool for removing carbon deposits from the ring grooves.

To check the piston ring gaps, place each ring in the least worn part of the cylinder bore 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 $\cdot009$ "— $\cdot014$ " and although an increase

of a few thousandths of an inch is permissible, any large increase to, say $\cdot030$ " 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 $\cdot007$ " the ends of the ring must be carefully filed to the correct limit.

Both compression rings on the B44 models are tapered on the outside face and their upper surface is marked "top" to ensure correct fitting. B25 models have a top compression ring of plain section and the second compression ring is tapered this is also marked "top."

If these tapered rings are fitted upside down, oil consumption will become excessive.

Small-end bush

Small-end bush wear is normally very slight, but when excessive it can cause an unpleasant high-pitched tapping sound.

The gudgeon pin should be a good sliding fit in the bush but if there is considerable up and down movement, then the bush should be replaced (B44 only).

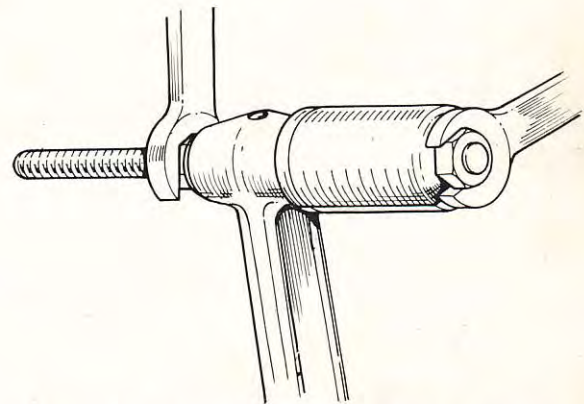


FIG. B9. *Using service tool No. 61-3653 (B44).*

The B25 models do not have a small-end bush fitted, and if the hole in the connecting rod is worn badly then a new connecting rod will have to be fitted.

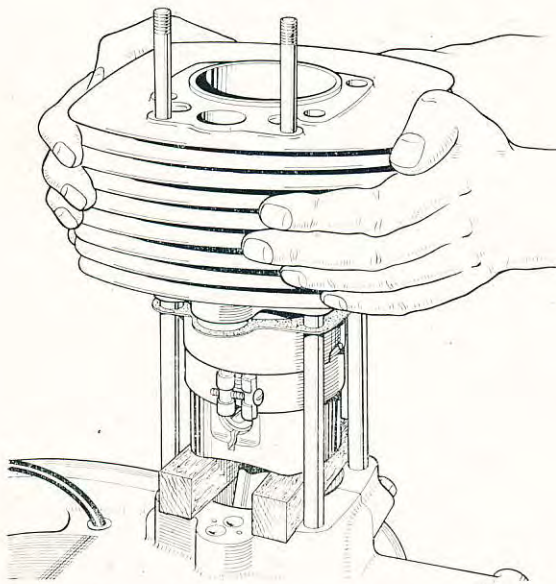


FIG. B10. Replacing cylinder barrel.

On the B44 the bush can be changed in one operation by pushing the old bush out and, at the same time, pressing the new one in with service tool No. 61-3653. The new bush must be correctly aligned with the oil hole and reamed to .7503"-.7506" after pressing into the connecting rod.

Reassembly after decarbonising

Scrupulous cleanliness must be observed when reassembling, and each component should be smeared with fresh oil before replacing.

Warm the piston before inserting the gudgeon pin and ensure that the piston is the correct way round before fitting. Always use new gudgeon pin circlips and see they are pressed well down into their grooves.

If the circlips should come adrift or if one is omitted, the cylinder barrel will be damaged and may require replacement.

Use a new cylinder base washer and support the piston with two pieces of hardwood placed across the crankcase, under the piston skirt.

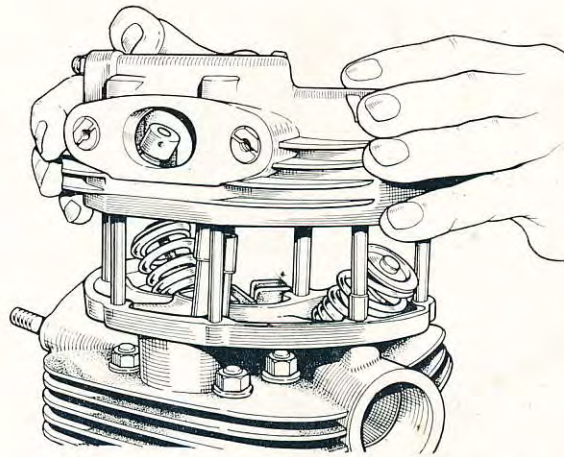


FIG. B11. Refitting rocker box (B25).

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

Using the piston ring slipper service tool No. 61-3707 (B44), or No. 61-3682 (B25), compress the rings so that they are just free to move and replace the barrel.

The slipper will be displaced as the piston enters the bore.

Take off the slipper and remove the hardwood supports, allowing the barrel to drop on to the crankcase.

Insert the two push rods down the barrel aperture, on to their respective tappets, the outer one operating the inlet push rod (see Fig. B12).

Place the cylinder head gasket in position and refit the head, complete with rocker box.

Note (B44 only):—To overcome any possible gas leakage at the cylinder head joint face, a gasket having a raised lip can be fitted in preference to the plain gasket. When fitting the new type gasket however, it is essential that the raised lip is uppermost.

The push rod inspection cover should be removed so that the upper ends of the rods can be fitted to their appropriate rocker arms. Note that the top of the exhaust push rod is painted red for identification purposes.

In order to avoid any undue strain on the head or rocker box from valve spring pressure, the piston should be set at top dead centre on the compression stroke. Alternatively, the valve rocker adjusters should be completely slackened off.

Now, using a suitable torque wrench, tighten the six cylinder head fixing nuts firmly and evenly to the figures quoted on page J1. Check that

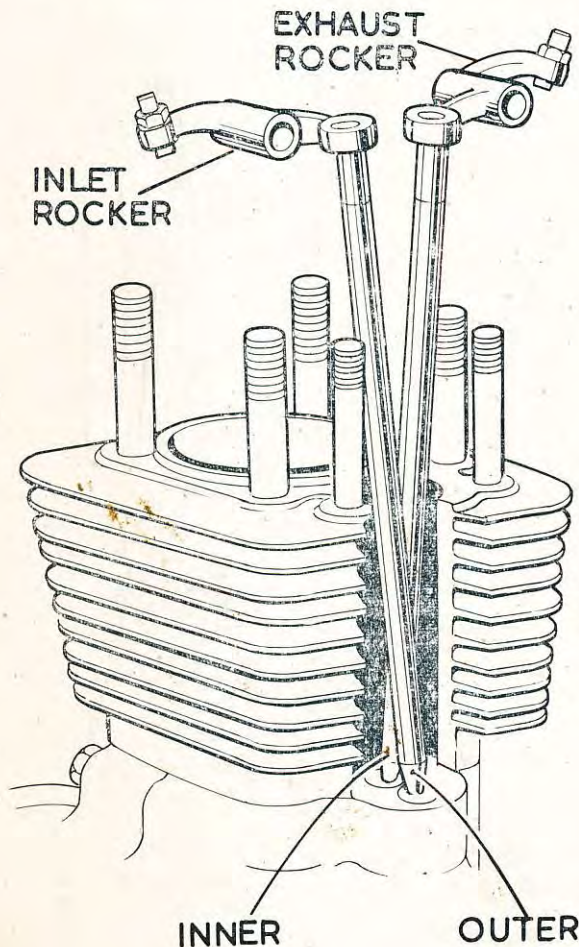


FIG. B12.

the push rods are correctly located in their proper positions and tighten the rocker box fixing nuts. On B44 models only, the inspection cover can now be refitted with its sealing washer.

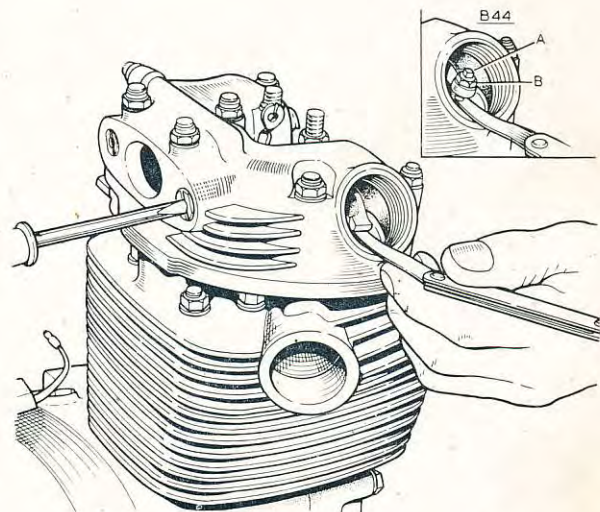
Check the valve clearances as described below, and replace the sparking plug.

Proceed by fitting the carburetter, together with its sealing washers and tighten the fixing nuts to a torque wrench setting quoted on page J1.

Reconnect the rocker oil feed pipe(s) using new copper sealing washers where necessary.

Replace the exhaust pipe and secure in position with the front engine mounting bolt. Do not omit to tighten the silencer clip and the finned collar. Refit the engine stay bracket and reconnect the exhaust valve lifter assembly. Replace the horn and ignition coil, before finally fitting the petrol tank.

If, as in the case of the B44 model, the engine was removed for decarbonising, see page B16 for details of replacement.

FIG. B13. *Checking valve clearances.*

Checking valve clearances

The clearances between the top of each valve stem and the rocker adjusting pin, must be set when the engine is quite cold.

Remove the rocker caps and take out the sparking plug, to enable the engine to be rotated easily by hand.

Set the piston at top dead centre on the compression stroke (both valves closed) and using a feeler gauge, check that the fully open gaps for the inlet and exhaust valves are as follows:—

·008" (inlet) and ·010" (exhaust)

B44 models

If the clearance requires adjusting slacken the locknut (*A*) and adjust the pin (*B*) until the correct gauge will just slide between the valve stem and pin (see inset, Fig. B13).

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.

B25 models

These engine have an eccentric cam on each rocker spindle, the valve clearances being adjusted in the following manner.

Remove the cover plate, loosen the rocker spindle nut and turn the spindle inwards to obtain the correct valve clearance. It is most important that the spindle flats are in the vertical position before commencing and that they remain in the shaded sections, indicated in Fig. B14, throughout adjustment.

During adjustment it may be found that one of the rocker spindles has reached the end of its thread and can no longer be turned forward, in which case the spindle must be turned **back** through 360 degrees before commencing adjustment.

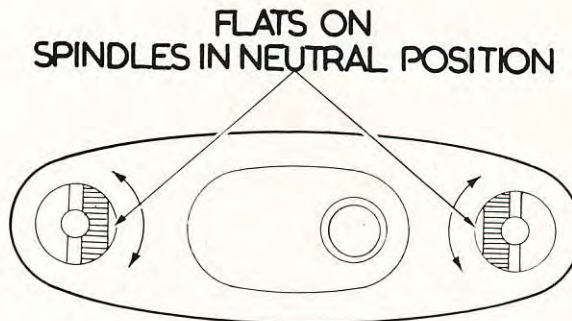


FIG. B14. *Valve rocker adjustment.*

When the necessary adjustments have been made, secure the spindles with their nuts and recheck the clearances.

Finally, replace the cover plate and gasket.

REMOVING THE ENGINE UNIT

During the process of removing the engine unit, 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 replaced.

Examine the wiring for places where the insulation may have rubbed through and protect with a few turns of good insulating tape. The owner should bear in mind that a bare wire can cause an electrical short-circuit which may set the machine on fire.

Procedure for removal of the engine unit is as follows.

- (1) First, remove the petrol tank. It will not be necessary to drain this, but only to turn off the taps and disconnect the pipes. The tank is mounted on rubber pads and is secured by a nut on a single bolt, which passes through a rubber sleeve in the centre of the tank to its anchorage on the frame top tube.

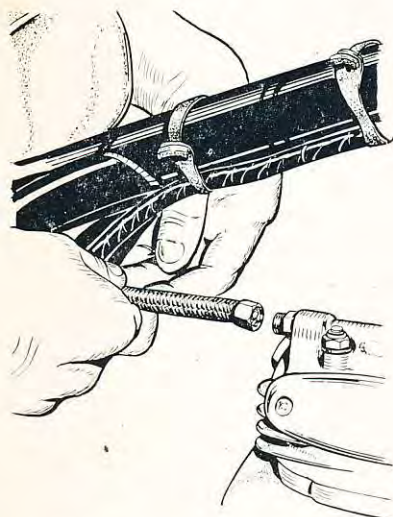


FIG. B15. *Rocker oil feed pipe (B25).*

- (2) Release the exhaust pipe from the front engine mounting, loosen the silencer clip and slacken the bolt in the finned collar. The exhaust pipe is a push-fit into the cylinder head port and can now be withdrawn from the front.

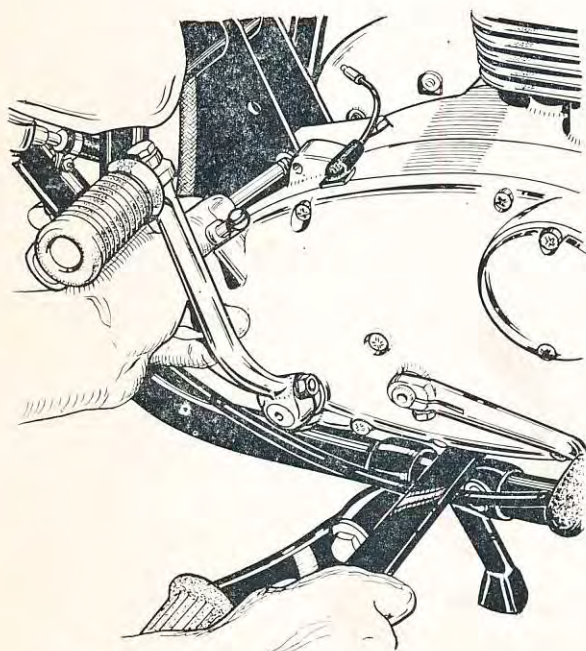


FIG. B16. *Withdrawing final stud.*

- (3) Drain the oil tank and system as detailed on page A5, then uncouple the rocker oil feed pipe and the supply and scavenge pipes union beneath the crankcase.
- (4) Disconnect the generator and the contact breaker leads from their snap connectors behind the engine. Also disconnect the high-tension lead and take out the sparking plug.

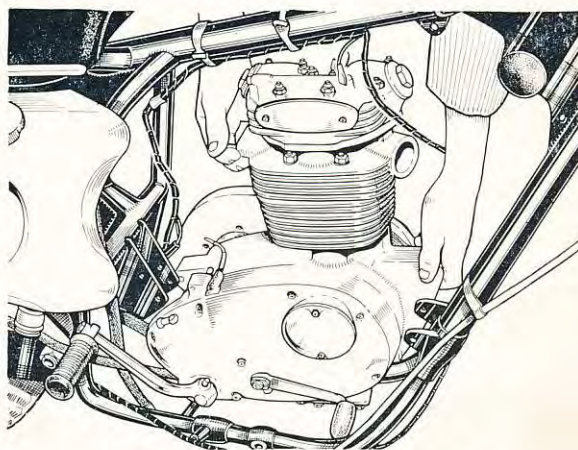


FIG. B17. *Lifting out engine unit.*

- (5) On removal of the flange fixing nuts, the carburettor can be withdrawn from its studs and tied up out of the way.
- (6) Detach the engine stay bracket complete with the exhaust valve lifter assembly, and to gain more access, take off the horn and ignition coil.
- (7) Remove the chainguard (see page D5), uncouple the rear chain at its spring link and detach it from the gearbox sprocket. Finally, disconnect the clutch cable from the operating lever on top of the timing cover.

The engine/gearbox unit is mounted in the frame at three points. At the rear the attachment is by two triangular plates welded to the frame tube, the engine being held by one stud with two nuts. A second fixing point is located below the crankcase, comprising one long bolt through the crankcase and frame lugs.

The third attachment point is at the frame front down tube. To enable the rear fixing stud to be released from the frame brackets, it will be necessary to raise the engine slightly as shown in Fig. B16. Take care when withdrawing the stud as the engine may shift its position suddenly.

Disengage the engine from the frame brackets and lift out from the left-hand side.

Replacement of the engine unit is a reversal of the above procedure for removal but, to save a great deal of time and effort, the rear fixing stud should be replaced first. Note that a spacer is fitted on the right-hand side of the front fixing bolt. A final check must be made to ensure that all nuts and bolts are tightened securely and that the handlebar controls are suitably readjusted.

TRANSMISSION

Description

Power from the engine is transmitted through the engine sprocket and primary drive chain to the clutch chainwheel, then via the clutch driving and driven plates to the cush drive or shock absorber unit and gearbox mainshaft.

The drive is then transmitted through the four-speed gearbox to the final drive sprocket and finally, to the rear wheel.

The clutch cush drive, as its name implies, smooths out the drive as the engine power impulses fluctuate.

The clutch, when operated correctly, enables the rider to stop and start his machine smoothly without stalling the engine, and assists in providing a silent and effortless gearchange.

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

The dismantling and reassembly of the primary drive can if necessary, be carried out with the engine unit in the frame, but will be treated in the following notes, as though the unit were on a work bench.

Removing primary drive cover

The primary chaincase cover is held in place by ten Phillips-head screws, one of which is the oil level screw fitted with an aluminium washer.

Note that the rear chain oiler is held to the back of the primary drive case by a single bolt with fibre washer.

Drain the oil as described on page A10 and take out the fixing screws. The screws are of three different lengths and careful note should be taken of their respective positions to facilitate refitting. If the joint has not already been broken, tap the cover gently with a hide mallet to release, but have a suitable receptacle underneath to catch any remaining oil.

Clutch dismantling

Remove the locking wires and the four spring retaining nuts (*P*) Fig. B22, and withdraw the springs with their cups. The pressure plate and the remaining clutch plates can then be taken out. If these are the only items requiring attention, the clutch need not be dismantled further.

Before unscrewing the clutch centre nut, it will be necessary to lock the chainwheel and centre together with service tool No. 61-3774, and to insert a bar through the connecting rod small-end bush. If a service tool is not available, engage top gear and lock the gearbox sprocket with a length of chain in a vice. Flatten the tab washer under the clutch centre nut and unscrew the nut, which has a normal right-hand thread.

Take off the nut, tab washer and distance piece. The clutch push rod may now be withdrawn but do not attempt to remove the chainwheel at this stage.

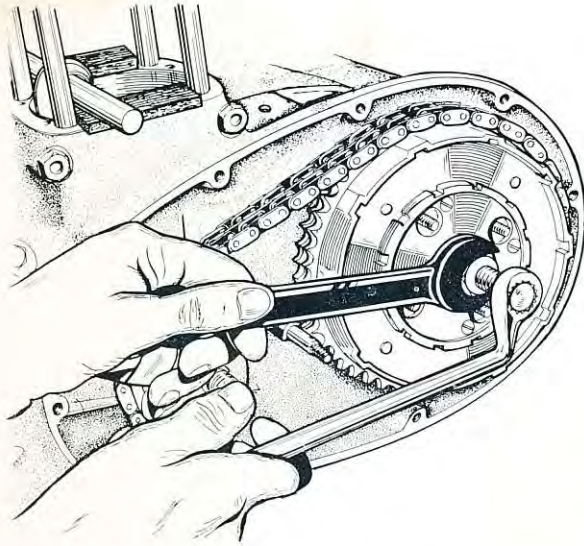


FIG. B18. *Removing clutch.*

Generator removal

The generator comprises the rotor, fitted to the engine shaft, and the stator which is mounted on three studs around the rotor, both being detailed in the electrical section.

Before the clutch chainwheel, chain or engine sprocket can be removed, the generator must be taken off.

To remove the stator, take off the three nuts and pull the generator lead through the rubber grommet in the front of the chaincase. Take care not to damage the stator casing, when pulling the stator off its studs. Note that the stator unit is fitted with the lead on the inside.

The primary chain tensioner can now be taken off but note that the small spacer is fitted on the rear stud.

Bend back the tab of the lockwasher under the engine shaft nut and unscrew the nut (right-hand thread). Pull off the rotor and take out the small Woodruff key from the shaft to avoid losing it.

With extractor No. 61-3583, the clutch sleeve can now be freed from the tapered mainshaft, enabling the clutch chainwheel, chain and engine sprocket to be withdrawn together.

Inspecting the clutch

The four driving plates have segments of special friction material which are securely bonded in the metal. These segments should all be complete, unbroken and not displaced. Even if there is no apparent wear or damage to the plates or segments, the overall thickness of each segment should be measured and if the extent of wear is more than $\cdot 030$ " ($\cdot 75$ mm.), the plates should be replaced. Standard thickness is $\cdot 167$ " ($4\cdot 242$ mm.).

The tags on the outer edge of the plates should be a reasonable fit in the chainwheel slots and should not be "hammered" up. If there are burrs on the tags or the segments are damaged, the plates should be renewed.

The plain driven plates should be free from score marks and perfectly flat. To check the latter, lay the plate on a piece of plate glass; if it can be rocked from side to side, it is buckled and should be replaced.

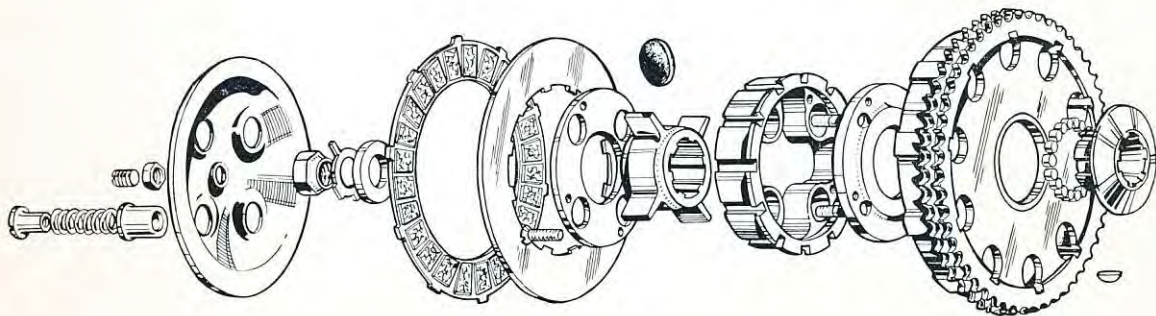


FIG. B19. *Clutch exploded.*

Cush drive

To inspect the cush drive rubbers which are within the clutch centre, take out the four countersunk-head screws adjacent to the clutch spring housings and prise off the retaining plate.

The rubbers should be quite firm and sound, and should not be disturbed unless wear or damage is suspected.

When refitting the clutch rubbers it may be found necessary to use a lubricant, in which case a liquid soap is recommended.

Do not use oil or grease.

Clutch chainwheel

Examine the slots for wear; if they are corrugated or the teeth are hooked and thin, the chainwheel should be replaced.

Check the chainwheel roller bearing for up and down movement. Slight play is permissible but if excessive, the bearings should be renewed.

Gearbox or final drive sprocket

Access to the gearbox sprocket can only be obtained when the clutch assembly has been removed.

Take out the six screws holding the circular plate at the back of the primary case, break the joint and remove the plate with its oil seal.

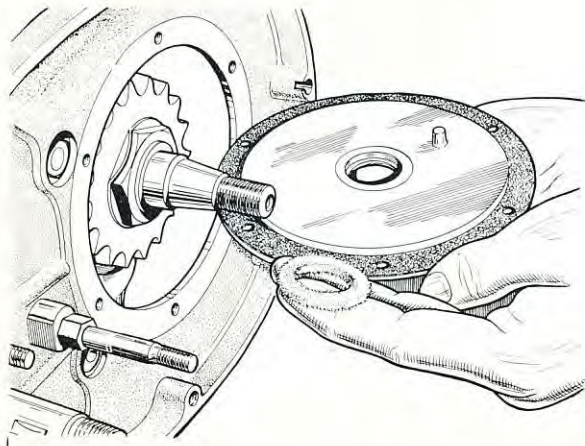


FIG. B20. *Primary case back plate.*

Look for signs of oil leakage down the back of the cover. If leakage is evident, change the oil seal, taking care to see that it is fitted the correct way round with the lip of the seal to the inside of the primary case.

A felt washer is fitted between the circular plate and the sprocket fixing nut, preventing the entry of grit which may damage the small oil seal. If the washer no longer appears serviceable, replace it.

If it is necessary to change or renew the gearbox sprocket, first place a length of chain round the sprocket and lock in a vice or with a suitable bolt, then flatten the tab washer and unscrew the large nut. The sprocket can now be pulled off the mainshaft splines.

If the oil seal is suspected of being faulty or leakage has occurred it should be renewed. Check that the sprocket boss is not worn or damaged as this would quickly damage a new seal.

If the sprocket boss is smooth and not scored it can be replaced, but lightly oil the boss to avoid damaging the seal as the sprocket is pressed home.

Reassemble in the reverse order but do not omit to turn the tab washer over the nut after tightening.

Clutch operation

As already indicated the clutch being part of the transmission system, carries power to the rear wheel, but by separating the driving and driven plates this connection is broken.

The disengagement is achieved by operating the clutch lever, the force imposed being transmitted via the clutch cable to the clutch lever in the timing case. The lever, working on the rack-and-pinion principle, drives the push rod through the hollow gearbox mainshaft, forcing the pressure plate out; so compressing the clutch springs and freeing the plates.

To ensure smooth clutch operation, it is essential that the spring pressures are equal and that the pressure plate runs "true."

See page B20 for details of clutch adjustments.

Reassembling the primary drive

Place the felt grit protection washer in position against the sprocket securing nut and replace the circular cover, using a new paper gasket jointed on one side only.

If the clutch sleeve has been removed from the chainwheel, smear the sleeve with grease and place the twenty-five rollers in position. Now, slide the chainwheel over the rollers and fit the clutch centre over the splines of the sleeve.

Pass the stator lead through the front of the primary chaincase and clip in position behind the cylinder base. This connection may be found difficult if left to a later stage.

The engine shaft distance piece should not have been disturbed, but if it was removed for any reason, it must now be refitted with the chamfered side outwards.

See that the Woodruff keys are fitted to both mainshafts and that they are a good fit in the keyways.

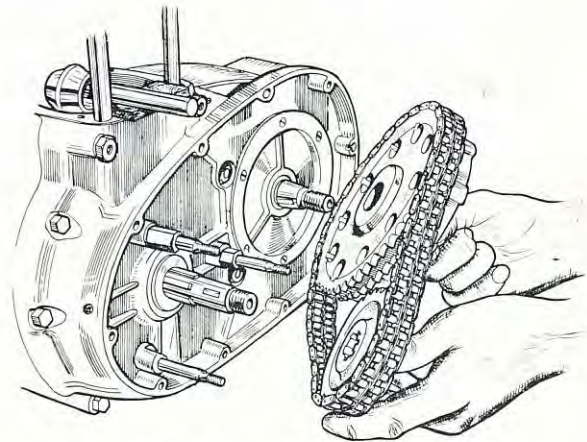


FIG. B21. *Fitting primary drive.*

Place the primary chain around both the engine and clutch sprockets pulling the chain taut.

Pick up the engine sprocket, chain and chainwheel with both hands and slide the sprockets on to their respective shafts. It will be necessary to turn the clutch chainwheel to locate over the keyed shaft. Place the thick washer with the recess outwards in position against the clutch sleeve, then the tab washer and fixing nut. After tightening the nut to torque wrench figures quoted on page J1, lock in position with the tab washer.

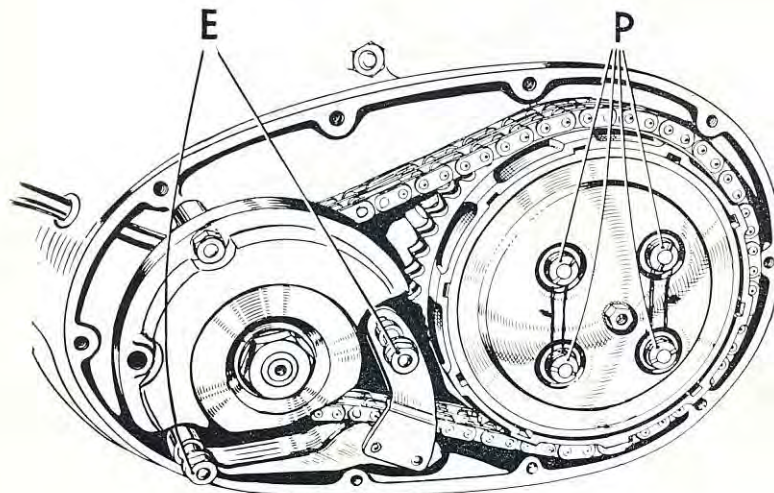


FIG. B22.

Replace the clutch plates, starting with one plain then one segmented plate and so on alternately, there being five plain plates and four segmented plates. Insert the clutch push rod into the hollow mainshaft.

Place the pressure plate in position and fit the four spring cups with springs, which should be of equal length. If in any doubt about the condition of the springs, replace them since they are quite inexpensive.

Screw on the four spring nuts (*P*) Fig. B22, with the special screwdriver No. 61-3700 until the first coil of each spring is just proud of its cup.

If the springs are compressed excessively, the handlebar lever will be stiff to operate. On the other hand, if the spring pressure is insufficient the clutch will tend to slip. Check the accuracy of the spring setting by declutching and depressing the kickstart lever, when it will be seen if the pressure plate is running "true" or not. If necessary, adjust each nut accordingly to correct any "run-out."

When the spring setting has been determined the clutch movement can be adjusted by means of the central screw and locknut on the pressure plate.

Replace the rotor on to the keyed engine shaft with its "Lucas" marked face outwards and fit the tab washer and nut.

Turn the tab over the nut after tightening securely to torque wrench figures quoted on page J1.

Replace the primary chain tensioner on to the lower stator studs (*E*), Fig. B22, and fit the small spacer on to the rear stud.

Fit the stator on to its studs with the cable on the inside, at the front, and secure with the self-locking nuts. It is important that the air gap between the rotor and the stator pole pieces is equal all round. The gap can be checked with a

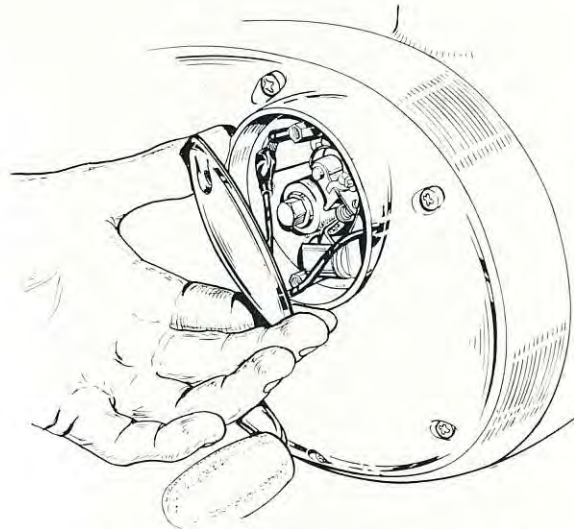


FIG. B23. *Contact breaker cover.*

.010" feeler gauge and any variation should be corrected. Adjust the primary chain tensioner to give approximately $\frac{1}{4}$ " free play on the top run of the chain between the sprockets. Finally, tighten the stator fixing nuts.

Having completed the assembly of the primary drive, the primary cover can now be replaced. Apply jointing cement to both faces of the chain-case and, using a new gasket, replace the cover. Ensure that the fixing screws are fitted in their correct positions and that the rear chain oiler is replaced.

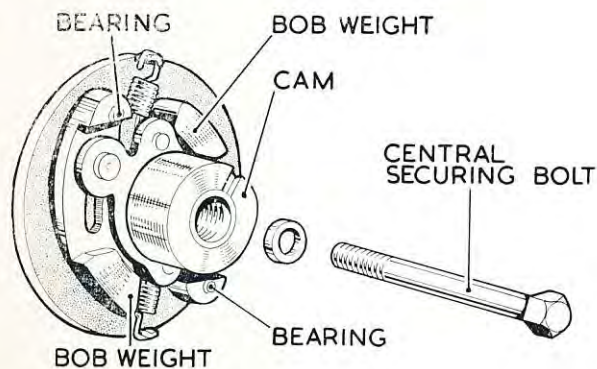
See that the oil level screw is correctly located in the lower edge of the case and is fitted with an aluminium washer.

CONTACT BREAKER

Description

The contact breaker assembly is contained within a circular compartment in the inner timing cover, its cover being secured by two screws.

The assembly comprises the contact breaker plate, on which are mounted the contacts. An oil seal is fitted in the back of the housing and

FIG. B24. *Automatic-advance unit.*

prevents oil from reaching the assembly. The automatic advance/retard unit, mounted behind the plate, consists of two spring-loaded bob-weights coupled to the contact breaker cam and is secured in the tapered hole of the camshaft by one central bolt and washer.

The bob-weights, when the engine is stationary, are held closed by the springs, retaining the contact breaker cam in the fully retarded position. This is necessary to make starting easier and considerably reduces "kick-back" on the kick-start lever.

As the engine revolutions increase, centrifugal force carries the bob-weights outwards progressively turning the cam into the direction of rotation, thus advancing the ignition.

The elongated holes in the contact plate enable the plate to be moved backwards and forwards around the cam so providing a means of adjustment for ignition timing.

Removing the contact breaker

Before removing the contact plate scribe a mark across the plate and housing so that it can be replaced in exactly the same position, otherwise the ignition will have to be retimed.

Disconnect the condenser cable at its snap connector (if not already done), unscrew the two pillar bolts and take off the plate complete with contacts and cable.

To remove the auto-advance unit and cam, first take out the central fixing bolt then free the unit from its taper with service tool No. 61-3761.

Avoid removing the auto-advance unit unnecessarily as the timing will have to be reset. During reassembly refit loosely and retime the ignition as detailed on page B39.

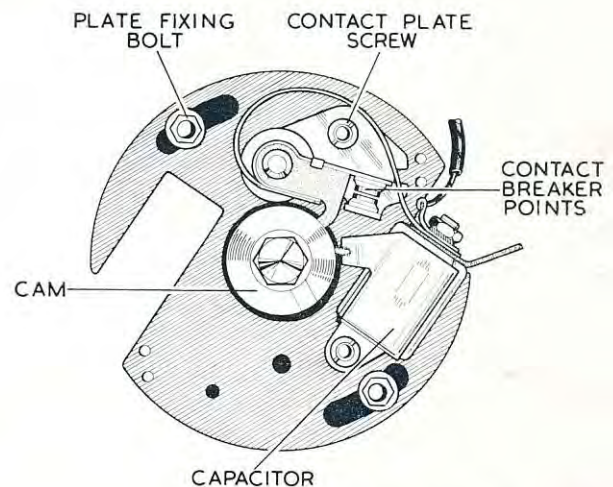
Contact breaker points

To change or inspect the contact points unscrew and remove the screw inside the C-shaped spring and take off the nut securing the spring and lead. The movable contact can now be lifted off, followed by the fibre washer and fixed contact.

The contacts must be free from grease or oil. If they are blackened or burnt, clean with a fine carborundum stone or very fine emery cloth. Wipe away any traces of dirt or metal dust with a clean rag moistened with petrol.

When replacing, do not omit to fit the fibre washer between the contacts.

It will now be necessary to reset the contact points gap. Revolve the engine until the fibre

FIG. B25. *Contact breaker unit.*

heel is on the peak of the cam, loosen the fixed contact screw and move the contact by turning the eccentric screw (C) to give the correct gap of .015" (.381 mm.). Tighten the contact screw and recheck the setting.

It is advisable to check the ignition timing after carrying out any adjustment to the contact breaker points as a variation in the contact points gap tends to alter the timing. Widening the points gap advances the ignition; closing the gap retards the ignition. Although this variation is very slight, it must be remembered that accurate timing is important in the operation of the ignition system.

See pages B39 to B41 for full details of ignition timing.

TIMING COVERS

To obtain access to the timing gears or the gearbox components it will be necessary to remove the covers on what is known as the timing or gear-side of the engine. It will be assumed that the primary drive has been dismantled as described on previous pages.

To remove the outer cover, first take off the gearchange and kickstart pedals, then take out the ten cover retaining screws, noting their respective locations. The cover, complete with contact breaker plate and clutch operating mechanism, can now be withdrawn, exposing the auto-advance unit and kickstart mechanism. Note that the contact breaker lead is held by a spring clip under one of the inner timing cover screws.

If the clutch operating lever is to be removed, care must be taken to avoid losing the operating rack and ball which are loosely located on the inside of the outer cover.

It is necessary to remove the kickstart quadrant and spring before the inner cover can be removed.

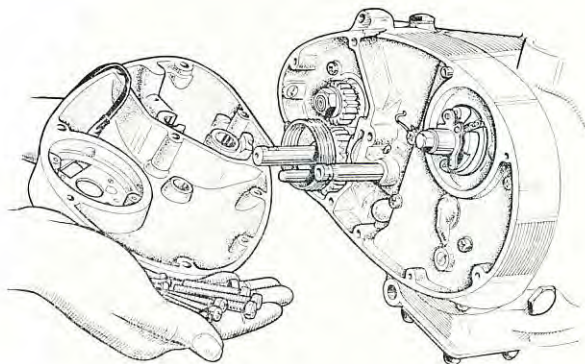


FIG. B26. Removing outer timing cover.

To release, free the spring from the kickstart spindle and withdraw the quadrant complete with layshaft needle bearing. When fitting a new spring, first locate the hooked end of the spring in the quadrant slot then "wind-up" the spring in a clockwise direction and slip the eye of the spring on to its stud. The quadrant bush is a push-fit into the outer timing cover.

Remove the contact breaker auto-advance unit as described on page B21.

Take out the seven fixing screws and note that the contact breaker cable clip fits under the uppermost central fixing screw. Also unscrew

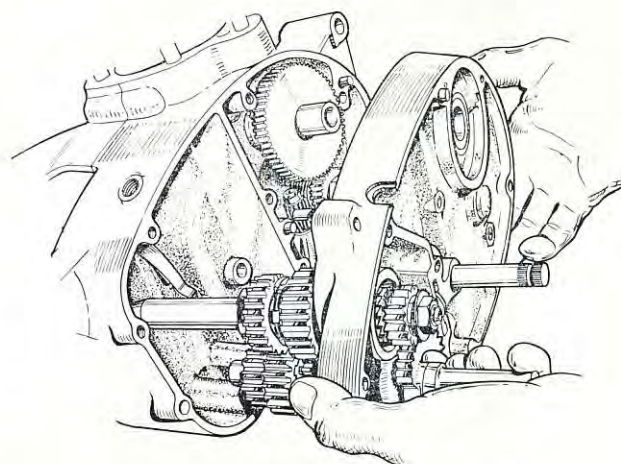


FIG. B27. Removing inner timing cover.

the kickstart spring anchor bolt. The inner cover joint can be broken by tapping gently around the edges with a mallet.

The cover, complete with kickstart ratchet, gear cluster and gearchange assembly can now be eased away, leaving only the oil pump and timing gears exposed.

Take care not to lose the loose-fitting thrust washer on the end of the layshaft.

Note that the camshaft bush in the cover is located by a small peg to ensure correct alignment of the oil holes during reassembly. Check that the oil seals in the covers are not damaged and are fit for further use.

OIL PUMP, TIMING GEARS AND TAPPETS

Oil pump removal

During engine dismantling, the oil pump need not be removed unless it is known to be faulty.

Use a suitable bar through the connecting rod to lock the flywheel, flatten the tab washer under the crankshaft nut and unscrew the nut which has a normal right-hand thread.

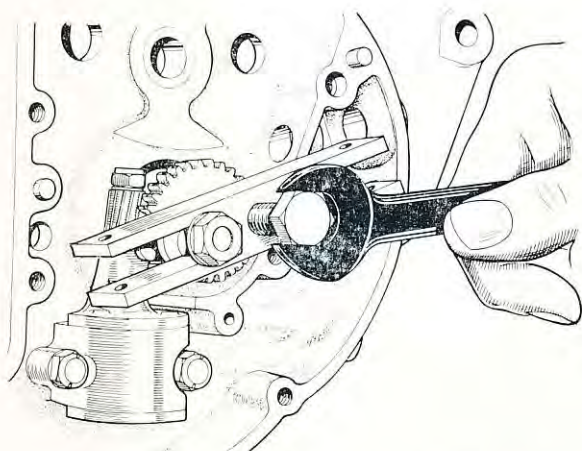


FIG. B28. Using tool No. 61-3773.

Pull off the crankshaft pinion, using extractor No. 61-3773 with appropriate legs. The oil pump wormdrive need not be disturbed unless further engine dismantling is to be carried out, in which case the extractor should be used with the special legs.

Unscrew the two self-locking nuts from the main body of the pump and pull the pump off its studs.

It is not advisable to dismantle the oil pump unless it is suspected that there is possible damage caused by neglected periodical oil changes.

Full details of dismantling and rebuilding the oil pump are given on page A8.

Replacing the oil pump

Ensure that the joint faces are clean, apply a smear of grease to a new gasket and place the gasket in position on the crankcase face. Locate the pump over the studs, replace the fixing nuts and tighten evenly to a torque wrench setting quoted on page J1 to avoid distortion.

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.

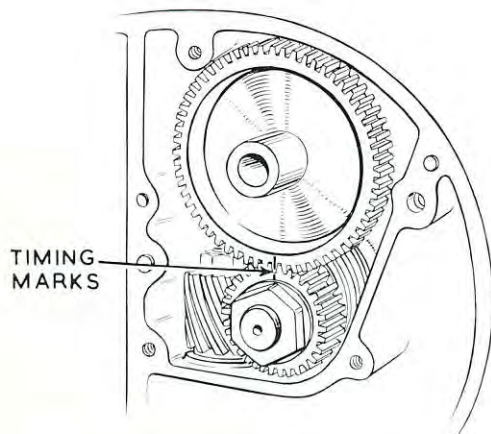
These marks are to assist in correct reassembly, so ensuring precise valve timing. It is good practice to familiarise oneself with them before removing the gears (see Fig. B29).

The removal of the crankshaft pinion and oil pump wormdrive is described in the section dealing with oil pump removal.

Pull the camshaft, with pinion, from its location in the crankcase and allow the tappets to fall clear. The pinion is a press-fit on to the keyed end of the camshaft.

Tappets

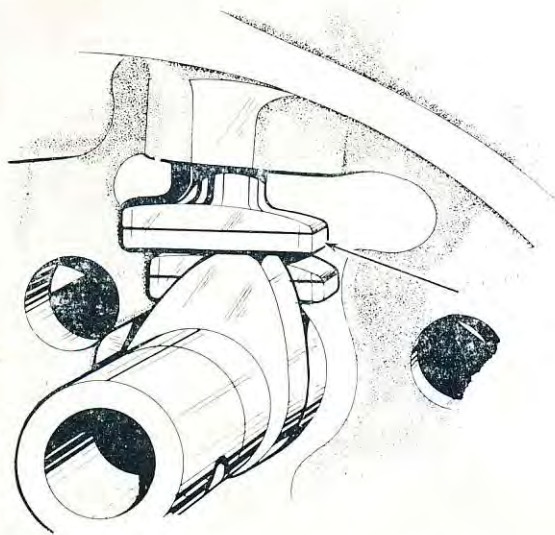
Examine both ends of each tappet for signs of excessive wear or chipping and make sure that they are quite free to move in their locations in

FIG. B29. *Timing marks.*

the crankcase. If there are signs of "scuffing" on the feet, they should be replaced. The camshaft must also be examined as this may be damaged too.

Note that one end of each tappet foot has been made slightly thinner than the other. When re-fitting, it is most important that this end faces towards the front, as indicated in Fig. B30.

Reassembly of the timing gear is the reversal of the above procedure for dismantling, but care

FIG. B30. *Correct fitting of tappets.*

must be taken to match the timing marks on the pinions.

GEARBOX DISMANTLING

Gearchange mechanism

First remove the timing covers, as detailed on page B22.

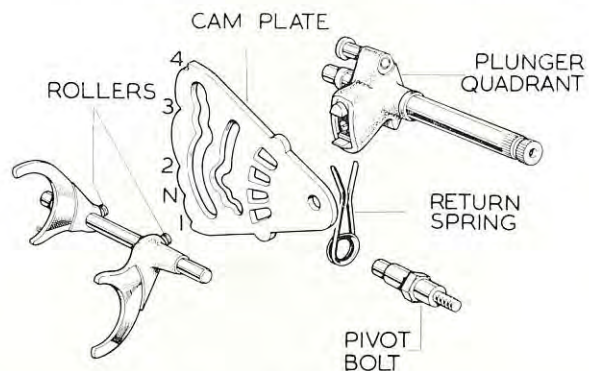
Press in the cam plate plungers with a suitable flat-bladed instrument and withdraw the gear-change quadrant complete with spring.

The spring-loaded plungers are retained by a small plate, secured with one screw.

The gearchange return spring pivot bolt need not be disturbed.

Take out the large split pin from the outside of the cover and withdraw the cam plate pivot pin. This job will be simplified if a suitable bolt is screwed into the pin enabling the pin to be extracted with pliers (see Fig. B32).

The cam plate can now be withdrawn from its slot, complete with selector forks and spindle, the layshaft with fixed top gear, second gear and sliding gear (third) and the mainshaft sliding gear (second). The large layshaft low gear with its bronze bush can now be removed. Note that the top face of the cam plate is stamped with a letter "T" or the numbers 69 indicating that the cam

FIG. B31. *Gearchange mechanism.*

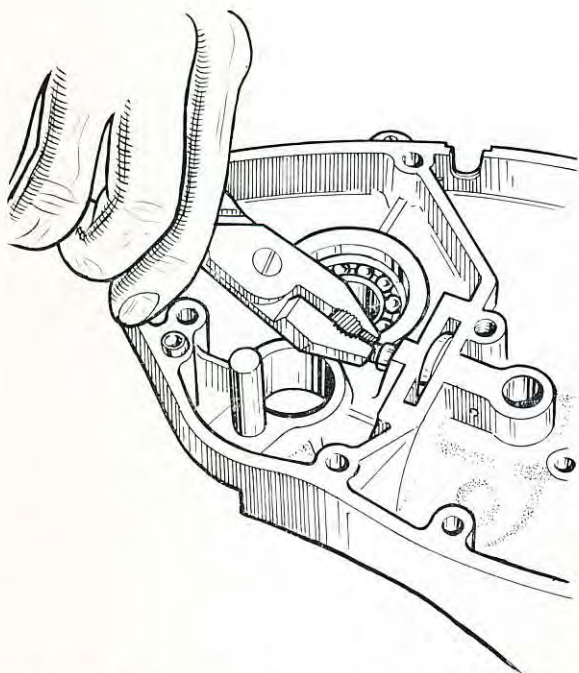


FIG. B32. *Removing the cam plate pivot pin.*

plate is of the latest design (see Fig. B34) to ensure correct reassembly. By fitting the cam plate upside down, the gearchange positions will be reversed.

Check the cam plate for wear in the cam tracks and the plunger "windows."

Also check that the quadrant plungers are not chipped or worn and are quite free in their housings.

The cam plate locating spring plates are secured to the gear-side crankcase half with two small bolts. If they are damaged or no longer retain their springiness, then they must be replaced.

Any damage or wear to these parts will make a good gearchange impossible.

Gear cluster

Proceed as detailed above, when it will be seen that only the mainshaft with its third and low gear, remains on the inner timing cover.

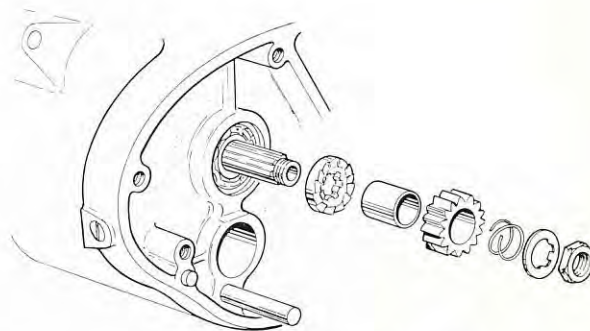


FIG. B33. *Kickstart ratchet.*

To remove first grip the shaft in a vice using soft metal clamps, unscrew the kickstart ratchet nut then take off the special washer, spring, ratchet pinion, sleeve and driving pinion. The gearbox mainshaft can now be withdrawn from the cover bearing, together with its low gear and third gear.

The smaller gear is a press-fit on to the shaft, so retaining the larger gear which has a spacer between it and the end of the splines.

If it is necessary to change either of these gears, the shaft must be pressed out of both gears at the same time, an operation which requires a good press properly mounted on a workbench.

The layshaft second gear is held against the fixed gear (high) by one circlip.

When examining the gears, look for cracked, chipped or scuffed teeth, the latter will show (if present) on the thrust faces of the teeth and in severe cases, might even have broken through the case hardening.

Gearbox bearings

When examining gearbox bearings and bushes for wear, do not overlook the bronze bushes in the layshaft low gear and the mainshaft high gear. The mainshaft high gear is still in the crankcase at this stage.

The layshaft has needle roller bearings at each end, one in the crankcase and one in the kickstart quadrant boss.

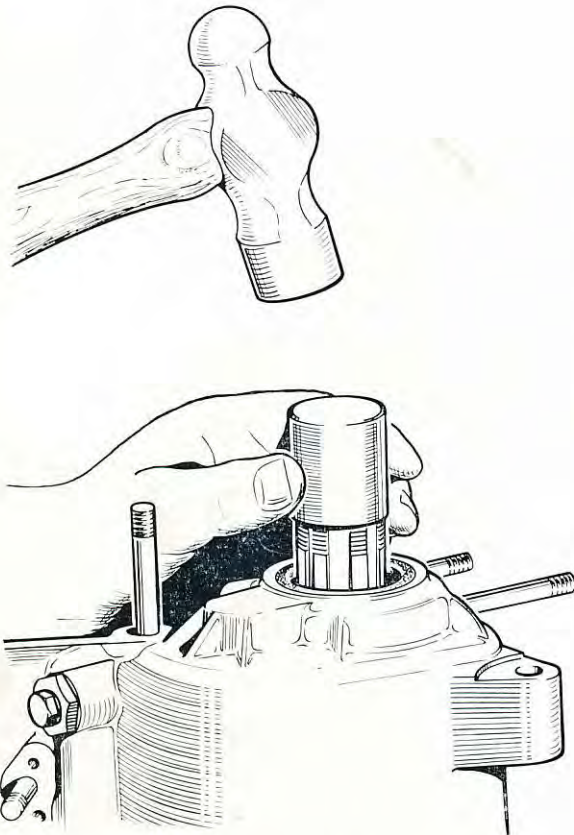


FIG. B34. *Removing sleeve gear.*

The mainshaft has two ball journal bearings, one at each end. To gain access to the left-hand bearing, first remove the gearbox sprocket (as detailed on page B18), then drive the high gear sleeve pinion through into the gearbox with a drift which passes over the bronze bush which protrudes through the end of the sleeve pinion (see Fig. B34).

After prising out the oil seal, the bearing can be pressed out from the outside of the crankcase half.

Note:—Before attempting to remove any bearing or bush from an aluminium case, the case should first be heated. The bearing can then be pressed out and the replacement fitted whilst the case is still hot.

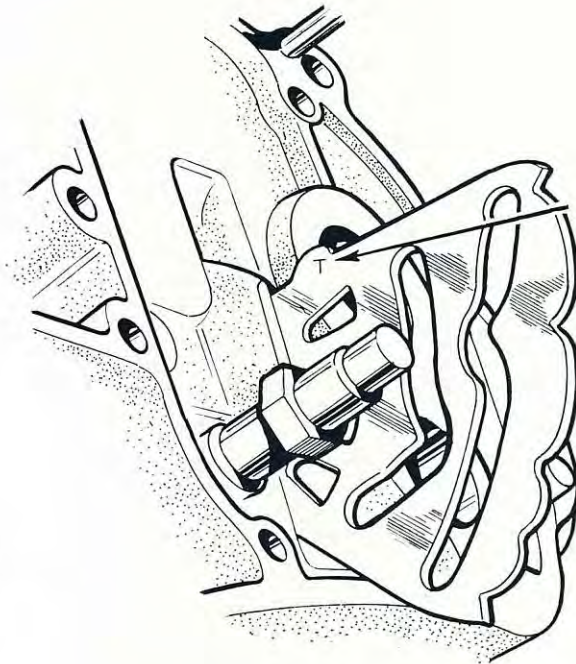


FIG. B35.

The right-hand mainshaft bearing can be pressed out from the inside of the inner cover after first removing the circlip.

GEARBOX REASSEMBLY

It will be assumed that all bearings, bushes and oil seals have been replaced as necessary.

If it has been removed, replace the cam plate, correct way round, in the cover slot (see Fig. B35 for guidance), insert the pivot pin and secure with the split pin.

Insert the mainshaft fitted with its low gear and third gear, into the cover bearing, replace the kickstart ratchet assembly and secure with the fixing nut. It will be necessary to hold the mainshaft in a vice, using soft metal clamps, to tighten the nut fully. This nut should be tightened to the torque wrench figure quoted on page J1.

50/55 lb./ft.
692 - 761 MKGS

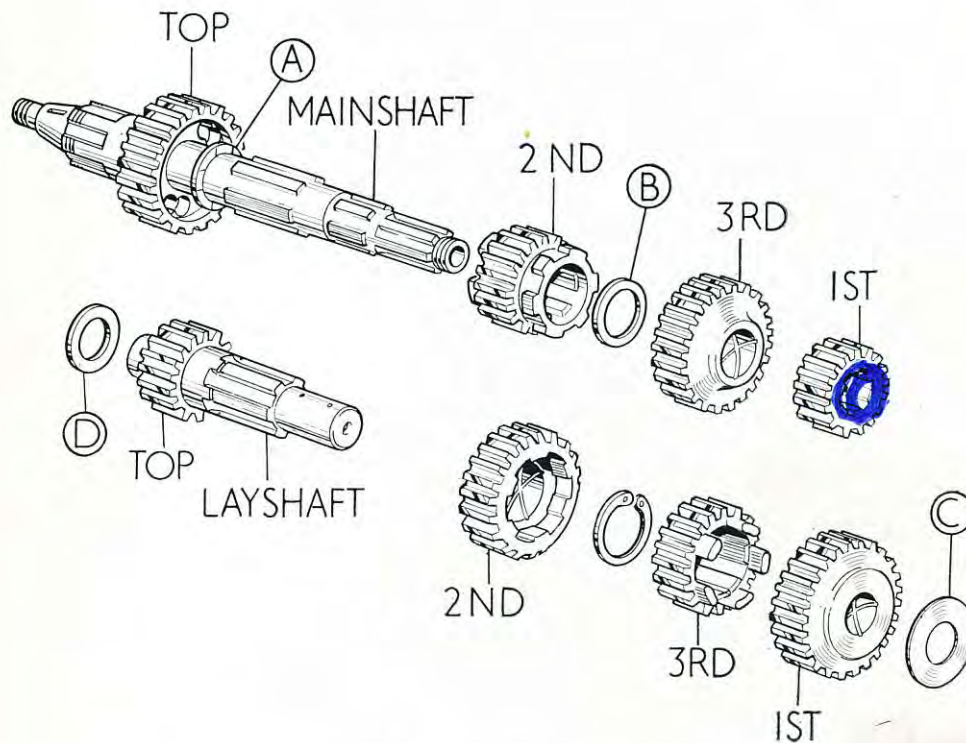


FIG. B36. Gear cluster exploded.

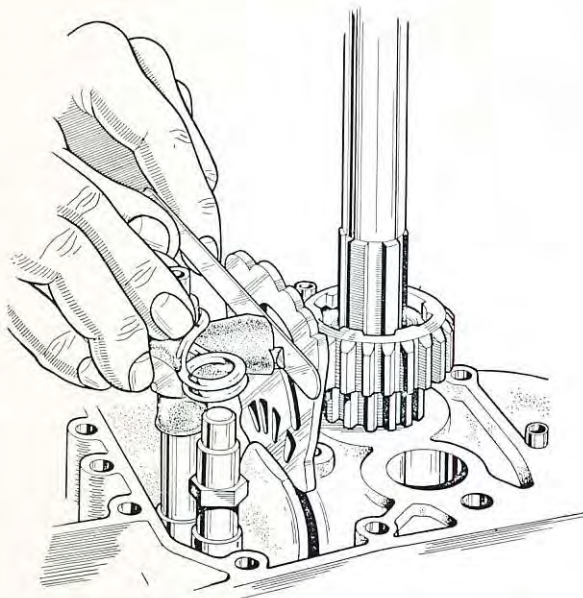


FIG. B37. Fitting the gearchange quadrant.

Holding the cover face down, place the layshaft low gear with its shim (C) Fig. B36, and sliding gear (third) in position on the cover. Fit its selector fork, the roller being located in the lower cam plate track.

Next fit the mainshaft sliding gear (second) with the appropriate spacers (see page B28). Replace its selector fork and locate the fork roller in the upper cam track. Insert the spindle through the selector fork bosses and locate in the cover.

The layshaft, with its remaining two gears (fixed high gear and second gear) can now be passed through the gears on the cover, into the kickstart boss needle roller.

Fit the gearchange return spring to the quadrant and replace the assembly in the cover, locating the spring loop over the pivot bolt. It will be necessary, whilst carrying out this operation,

to press in the plungers with a suitable flat-bladed instrument, before finally engaging the plungers with the cam plate "windows" as the quadrant is pressed home.

A thrust washer (D) Fig. B.36 is fitted to the drive-side end of the layshaft when there should be just perceptible end float. The mainshaft, being locked to the inner cover, does not need checking for end float but excessive movement between the gears and the ends of the splines must be corrected by fitting the appropriate spacers. See Fig. B36 for position of each spacer, the thickness and part numbers of which are as follows.

- (A) .093"—.094" (40-3020);
.098"—.099" (40-3126);
.103"—.104" (40-3127).
- (B) .070"—.071" (40-3119);
.075"—.076" (40-3019);
.080"—.081" (40-3120).
- (C) Standard shim (40-3258).
- (D) .078"—.080" (41-3072);
.083"—.085" (41-3074).

When all the components have been assembled on the inner timing cover, apply a light smear of "Loctite Plastic Gasket" to one face and slide the whole assembly into the crankcase making sure that the spacers on the end of the layshaft and mainshaft are in position.

Proceed by fitting all the screws into the cover. It is advisable before fitting the outer-cover to check the gear selection for correct operation.

When this has been checked to satisfaction proceed with the assembly of the outer timing cover in the reverse of the dismantling procedure not forgetting to apply a light smear of "Loctite Plastic Gasket" to the joint face.

SEQUENCE OF GEAR CHANGING

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

- (1) **Cam plate**—this is the large fan-shaped component that has "windows" for the gear-change quadrant plungers, cam tracks for the selector fork rollers and notches to locate the gear positions.
- (2) **Cam plate locating spring plates**—these are secured to the crankcase, the larger of which locates in the cam plate notches at various gear positions.
- (3) **Quadrant plungers**—these are held in the gearchange quadrant and operate in the cam plate "windows."
- (4) **Selector forks**—each selector fork has a roller which locates in the cam plate tracks. When the cam plate is turned about its pivot pin, these selector forks are moved backwards or forwards.
- (5) **Sliding gears**—both the layshaft and the mainshaft have one sliding gear each. They are operated by the selector forks and are carried along the splined shafts.

The gears must always be in the neutral position for starting the engine, this is the position shown in Fig. B38.

The spring plate is holding the cam plate by the second notch. At the other end of the cam plate the selector quadrant plungers are compressed ready to operate either way the pedal is moved.

When the pedal is moved down, to engage first gear, the plungers will enter the cam plate and move it to first gear position, this in turn will operate the layshaft selector fork and will mesh the layshaft sliding gear with the layshaft first gear.

Reference to Fig. B39 will now show the quadrant plunger in the second window ready to move the 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 gear in the opposite direction to mesh with the second gear.

Reference to Fig. B40 will show both quadrant plungers in the cam plate windows ready to move the gears from second to first or neutral or back again.

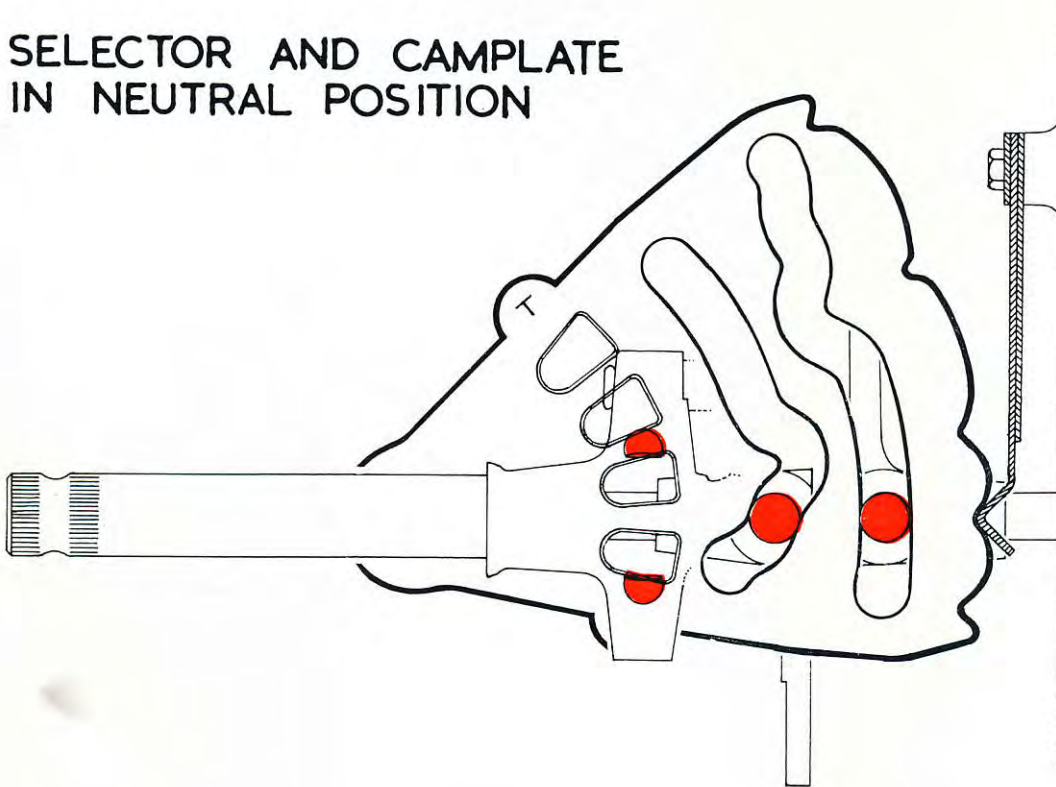
When the cam plate is moved to third gear position as will be seen by reference to Fig. B41, the action moves both selector forks, drawing the layshaft sliding gear to a neutral position and moving the mainshaft sliding gear into mesh with

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. B42) operates the mainshaft selector fork only, again sliding the gear the opposite way 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 spring plate at the large end 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.

Note:—The cam plate can be reversed if required, to give an opposite gearchange action as sometimes preferred for competition use.

SELECTOR AND CAMPLATE
IN NEUTRAL POSITION



NEUTRAL POSITION

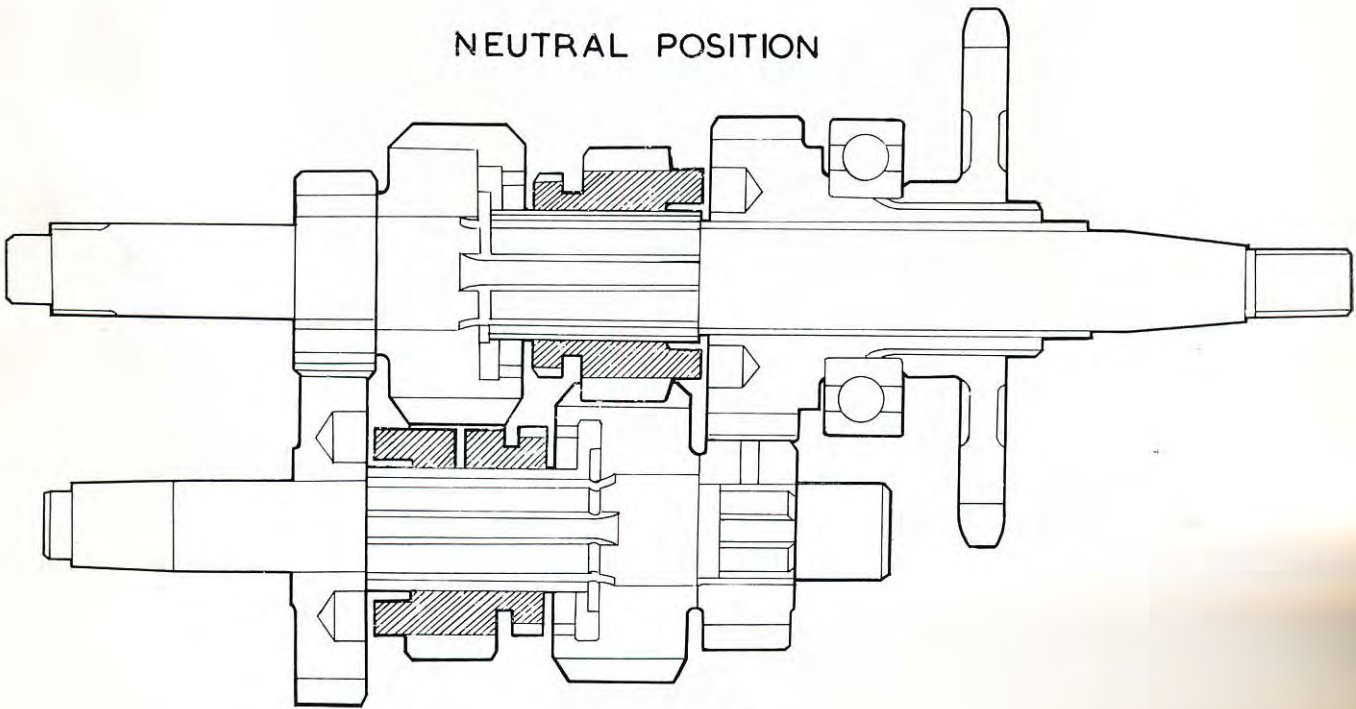


FIG. B38.

SELECTOR AND CAMPLATE
IN FIRST GEAR POSITION

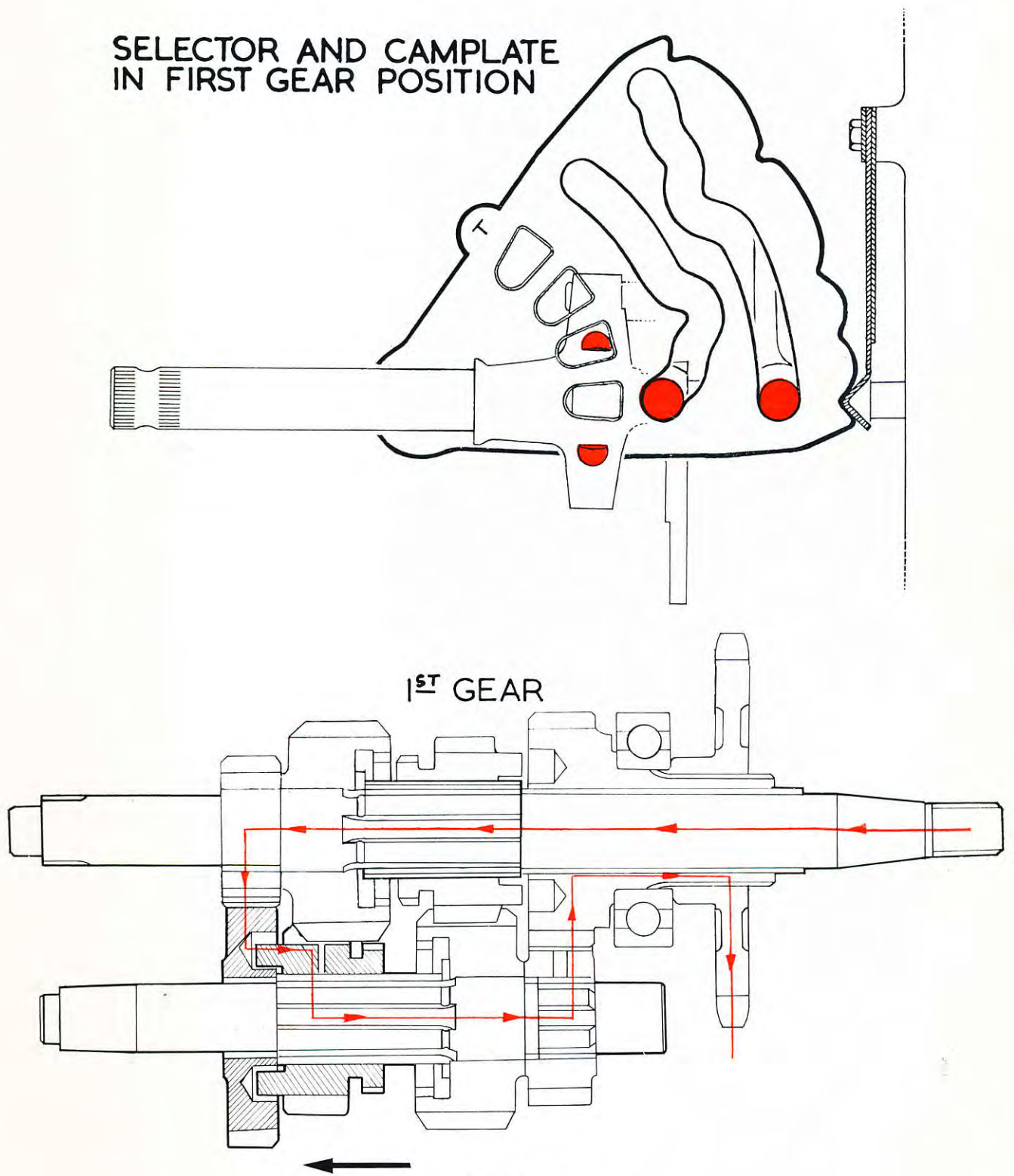


FIG. B39.

SELECTOR AND CAMPLATE
IN SECOND GEAR POSITION

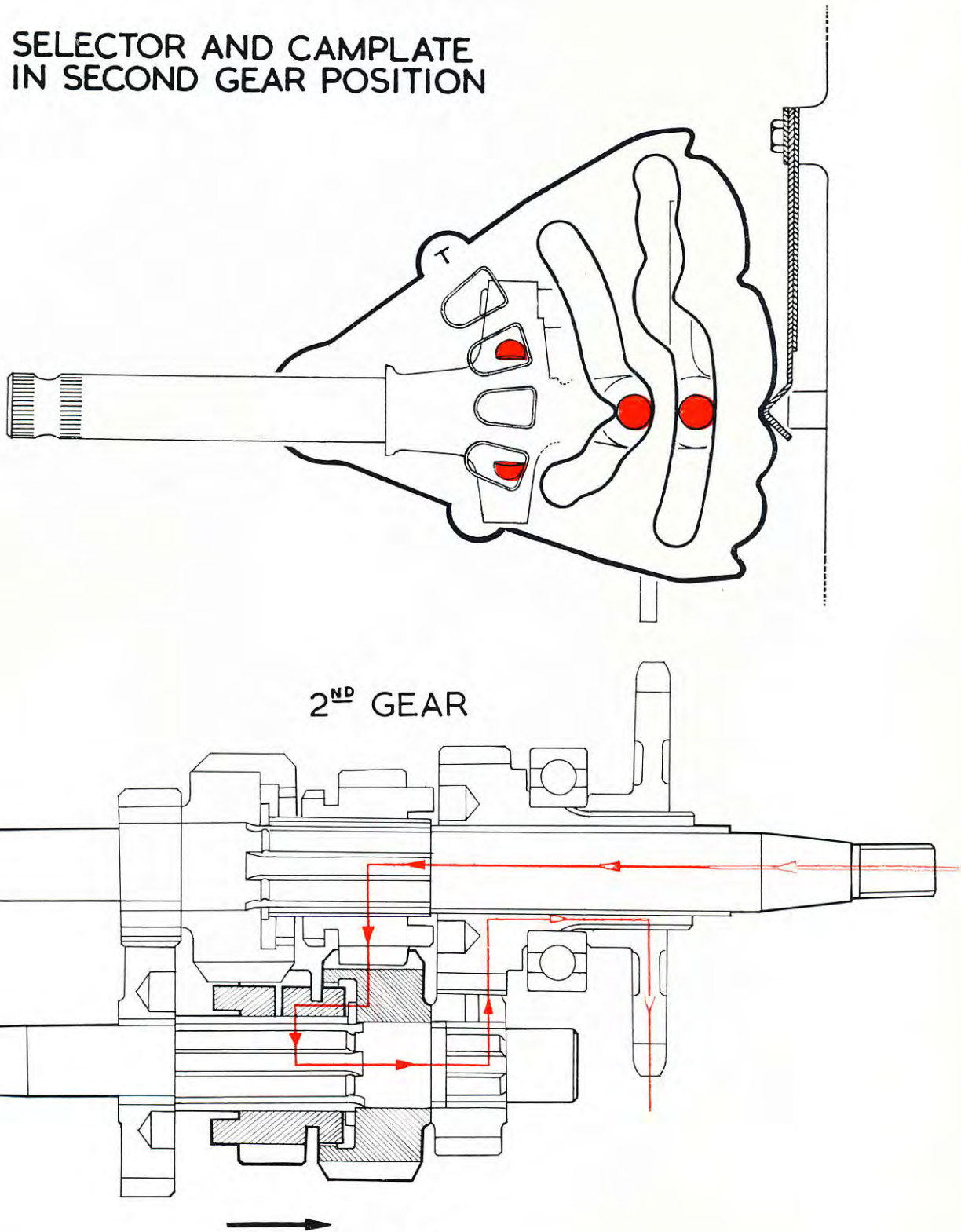


FIG. B40.

SELECTOR AND CAMPLATE
IN THIRD GEAR POSITION

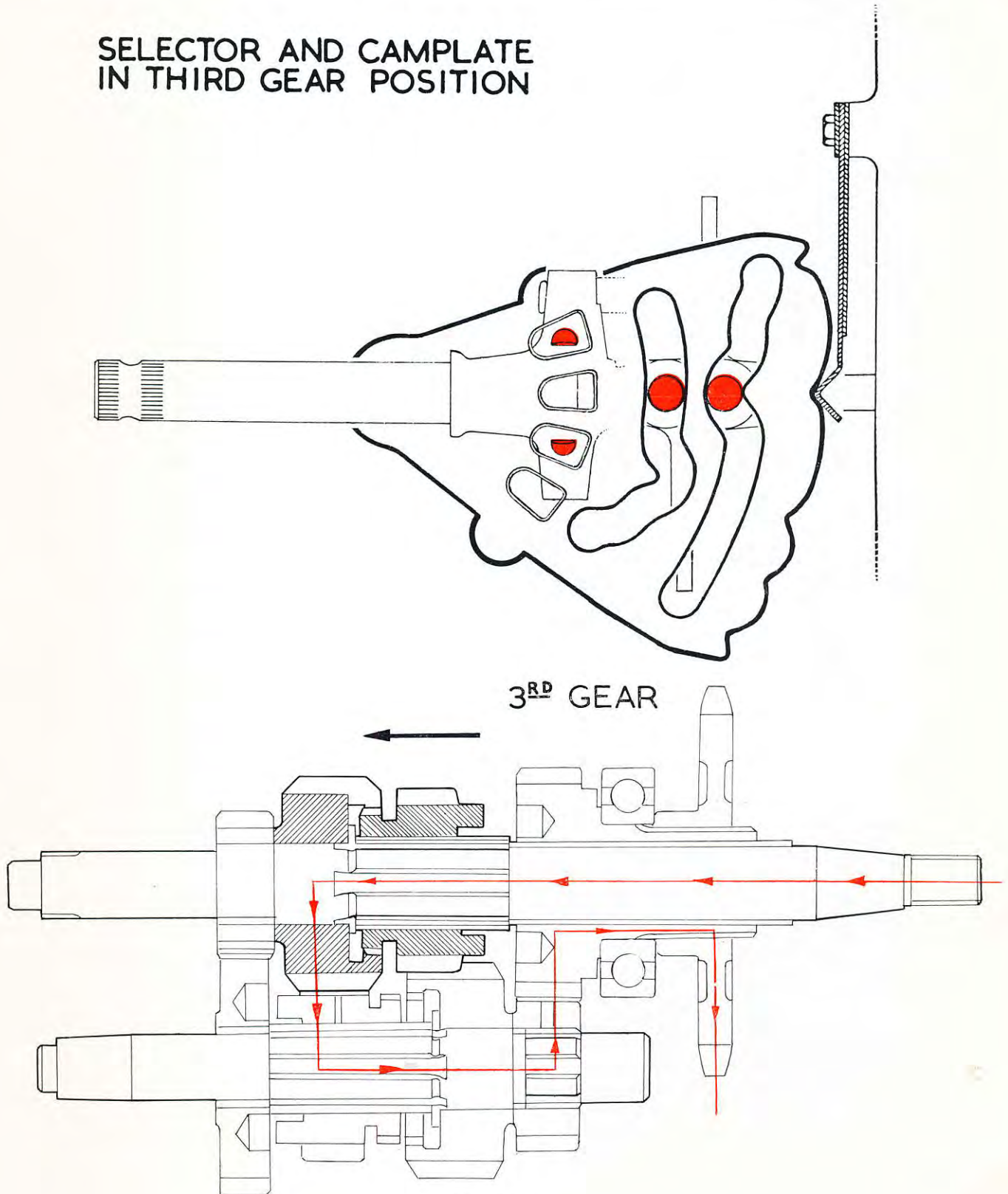


FIG. B41.

SELECTOR AND CAMPLATE
IN FOURTH GEAR POSITION

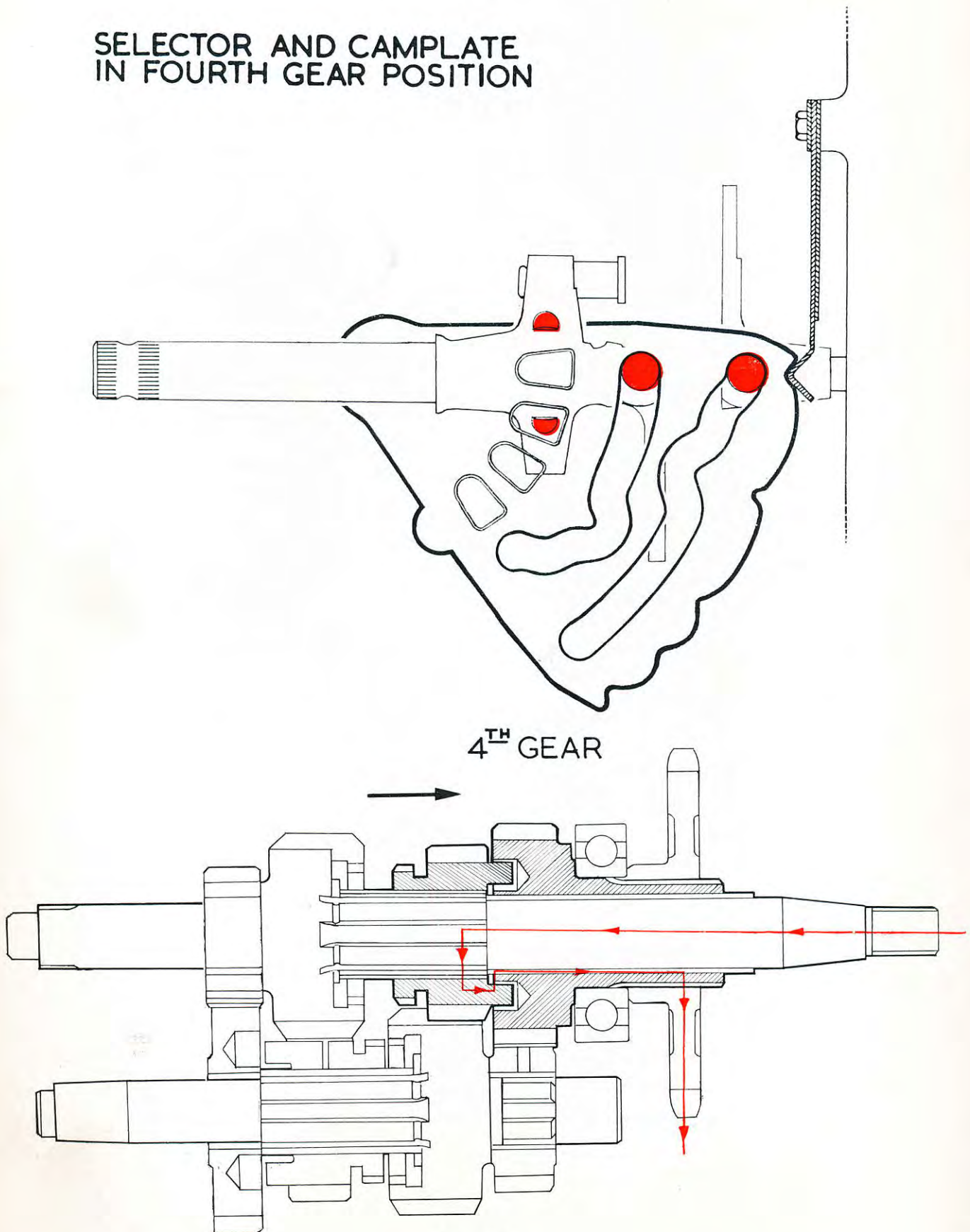


FIG. B42.
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SPLITTING THE CRANKCASE HALVES

Before attempting to part the crankcase halves, first remove the primary drive assembly, timing covers and timing gear as described on previous pages.

Working on the primary side of the crankcase, first remove the three bolts at the lower front of the case then take off the four stud nuts; two from the centre of the case and two from the cylinder base.

The sump filter and the oil pipe union may be left on the crankcase unless they require cleaning or replacement.

Remove any Woodruff keys which may still be in the shafts, noting their particular locations, and break the crankcase joint by tapping gently with a hide-mallet.

Do not attempt to prise the crankcase halves apart by using a tool between the joint. This will only damage the joint faces, resulting in oil leaks. The best method to use is to tap the gear-side shaft with a hide-mallet, so enabling the drive-side half of the case to be drawn away complete

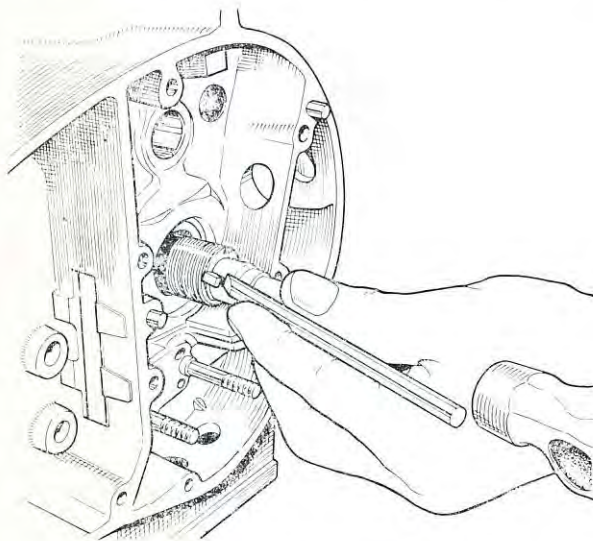


FIG. B43. *Removing a Woodruff key.*

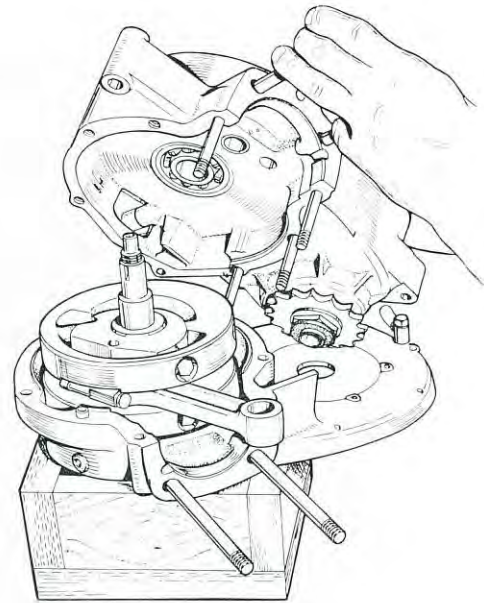


FIG. B44. *Splitting the crankcase (B25).*

with flywheel assembly. The flywheel assembly can now be carefully tapped out of the drive-side case. Take care not to lose the gear-side shaft spacing shim.

Do not omit to replace the oil seal for the drive-side bearing.

BIG-END AND FLYWHEEL ASSEMBLY

B44 models

Opportunity should be taken whilst the flywheel assembly is out of the crankcase, to clean the oil sludge trap, located in the right-hand flywheel. Remove the screwed plug and thoroughly clean out the drilling with paraffin. If possible, use a high-pressure air line to blow through the oil-ways.

Should the big-end and flywheel assembly require replacement, it is advisable to obtain a works reconditioned unit through your dealer. If, however, it has been decided to renew the big-end assembly, first unscrew the large crankpin nuts from each side with socket No. 61-3770.

When parting the flywheels, take care not to lose the small crankpin locating peg in the gear-side flywheel.

After cleaning the big-end assembly, a thorough examination should be made of the crankpin, big-end bush and rollers for wear or damage. Even though the components may not appear to be badly worn, it is recommended that they are checked in accordance with the dimensions quoted on page GD4 and replaced as necessary.

When reassembling, replace the small crankpin locating peg in the gear-side flywheel and locate the crankpin over the flywheel hole so that the peg will locate with the groove in the tapered face of the crankpin. This ensures that the oil hole in the crankpin will line-up with the oil-way in the flywheel. It is most important that these holes are not obstructed. Press the crankpin firmly in position, then fit the drive-side flywheel. Replace the crankpin nuts and tighten to a torque wrench setting quoted on page J1, to bring the flywheels together on the crankpin.

The flywheel assembly will now have to be "trued."

Place the bearings on to the shafts and mount the assembly in vee-blocks. True-up the flywheels as indicated in Fig. B45, using a dial indicator for checking.

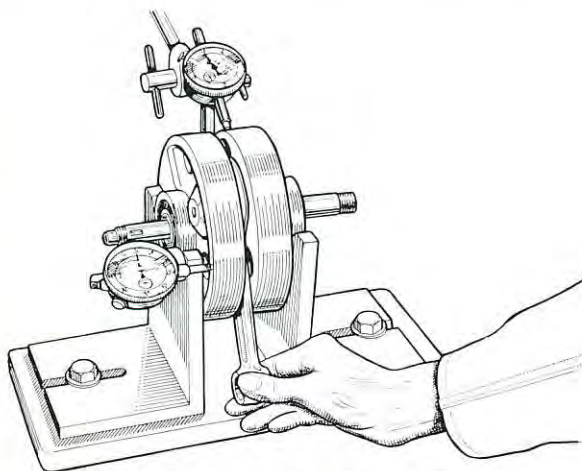


FIG. B45. *Checking the flywheels.*

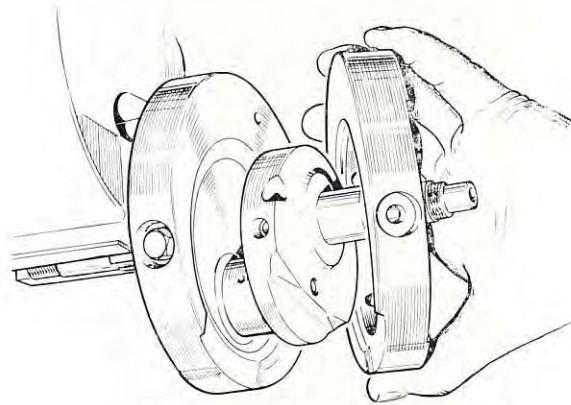


FIG. B46. *Removing a flywheel.*

Each wheel should be "trued" to within $\cdot005$ ", the drive-side shaft to within $\cdot002$ " and the gear-side shaft to within $\cdot0005$ ".

B25 models

Removal of the connecting rod from the crankshaft is quite straightforward but, to assist in correct reassembly, it is recommended that the rod and its cap are marked. Using a suitable tube spanner, unscrew the cap retaining nuts a turn at a time to avoid distortion, then withdraw the cap and connecting rod. When extracting the bearing shells, note that they are each located by means of a small tag.

Worn bearings will have developed a distinct "knock", the engine sounding generally very rough. If the shells appear to have worn considerably or are badly scored, then it will be necessary to regrind the crankshaft journal for use with undersize shells, as indicated in the chart on page B37.

Note:—Replacement bearing shells are pre-finished to give the correct diametrical clearance on a suitably reground journal. On no account should the shells be scraped or the connecting rod and cap joint faces be filed.

To facilitate machining of the crankshaft, the flywheels must first be detached. Four special bolts, of two different sizes, secure each flywheel to the crankshaft webs. Loosen and remove the four short bolts first to avoid distortion.

| | Bearing Shell Marking | Suitable Crankshaft Journal Size | |
|----------------|-----------------------|----------------------------------|----------------------------|
| | Standard | 1.4375" 1.4380" | 36.5125 mm. 36.5252 mm. |
| First regrind | — .010" | 1.4275" 1.4280" | 36.2585 mm. 36.2712 mm. |
| Second regrind | — .020" | 1.4175" 1.4180" | 36.0045 mm. 36.0172 mm. |
| Third regrind | — .030" | 1.4075" 1.4080" | 35.7505 mm. 35.7632 mm. |

Note that the right-hand flywheel contains a centrifugal oil sludge trap and is blanked off on the outer diameter of the flywheel by a large slotted screwed plug. When removing or replacing the flywheels, the crankshaft should be held in a vice (fitted with soft vice clamps) by the left-hand mainshaft.

When rebuilding the crankshaft assembly the eight special bolts should have their threads smeared with a small amount of "Loctite" grade AV screw lock. Tighten the bolts evenly to the torque wrench figure quoted on page J1.

It is most important that the radii at the inner faces of the journal remain at .070"—.080".

On completion of machining, the appropriate undersize figure must be clearly marked on the outer face of each crankshaft web.

Flywheel balancing

If a new or reground crankshaft or flywheels have been fitted, the assembly should then be re-balanced. Flywheel balancing is a skilled operation and should not be undertaken by anyone other than an expert mechanic having access to the necessary equipment. The equipment required is a drilling machine with depth stop and knife-edge rollers similar to those shown in Fig. B47. The rollers must be set perfectly horizontal. To ensure accurate balancing, a weight equivalent

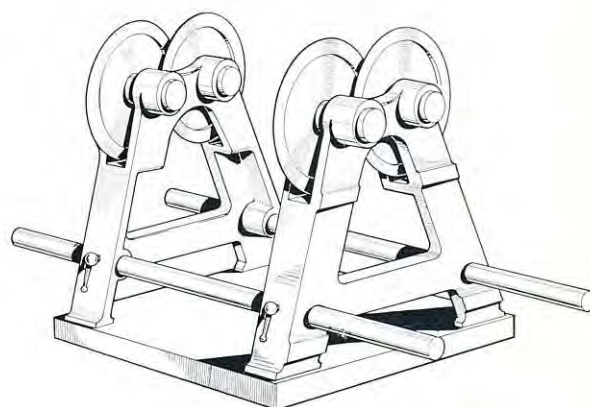


FIG. B47. Knife-edge rollers.

to 58 per cent of the reciprocating weight (part No. 61-3809) must be attached to the crankshaft journal.

Place the crankshaft centrally on to the rollers and revolve a few times. Allow the assembly to come to rest then mark the lowest point on the flywheels with chalk. This will indicate the heaviest part of the assembly.

The next step is to find the amount of out-of-balance so, plasticine is applied to the rim of each flywheel diametrically opposite the heaviest point (marked with chalk), until the assembly remains stationary when placed in any position on the rollers.

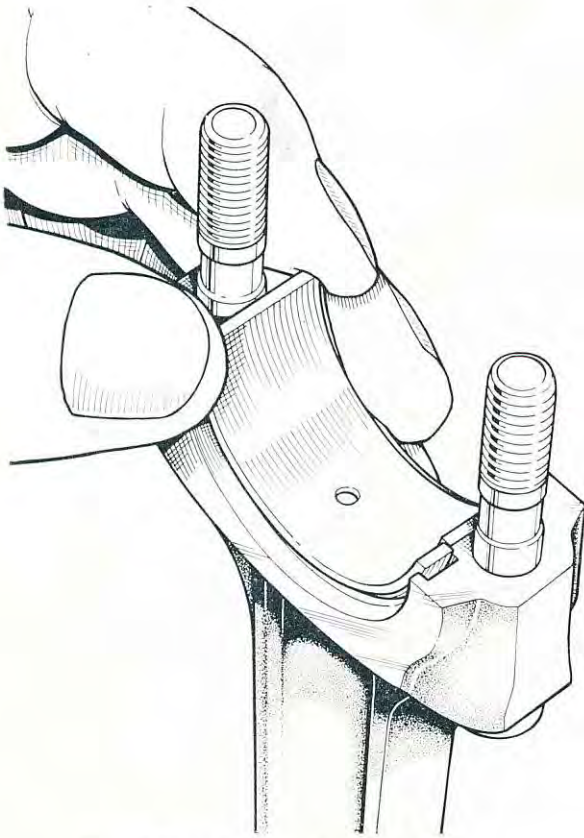


FIG. B48. *Fitting a bearing shell.*

The wheels must now be drilled at the heaviest point to remove metal equivalent in weight to that of the plasticine.

Drilling should be confined to the thicker portion of each flywheel, opposite the balance weight, and must be carried out equally on the periphery of **both** wheels. The holes must not be deeper than $\frac{3}{8}$ " or be more than $\frac{3}{8}$ " in diameter. Obviously, it is wiser to start with a smaller diameter hole which can be opened out if necessary, than to start with a large hole and find that too much metal has been removed.

Finally, thoroughly wash the assembly in paraffin and check that the oil-ways are free from blockage.

Refitting the connecting rod

The need for cleanliness cannot be over-emphasized and, as the various parts are assembled, all bearing surfaces should be coated with clean engine oil.

Place the new bearing shells in both the connecting rod and cap, making sure they are seated correctly. Fit the rod to the crankshaft journal and replace the end cap. After checking that the marks on the rod and cap correspond and that the rod is the right way round, insert the bolts and tighten the new self-locking nuts to a torque setting quoted on page J1.

Using a pressure oil-can, force clean oil through the drilling, at the right-hand end of the crankshaft until it is seen to issue from around the big-end bearing, thus indicating that the oil-ways are not blocked and are full of oil.

REASSEMBLING THE CRANKCASE

Assuming that the bearings, bushes and oil seals have been checked and, where necessary, replaced, the crankcase can now be reassembled.

On B25 engines, the crankshaft end-float should be between $\cdot002$ " and $\cdot005$ ". This is controlled by shims fitted between the crank web and the inner face of the right-hand bearing. The shims are available in thicknesses of $\cdot003$ " (40-0064), $\cdot005$ " (40-0065), $\cdot010$ " (40-0066), and $\cdot015$ " (40-0069). If, however, the original crankshaft is being refitted, it will only be necessary to see that the shims are replaced.

Place the flywheel or crankshaft (B25) assembly into the drive-side case. This operation will be simplified if the case is supported on a large block of wood, deep enough to keep the end of the shaft clear of the work bench.

Apply a thin coating of "Loctite Plastic Gasket" to the joint faces of each crankcase half and fit the gear-side case.

Replace the three bolts at the front of the case and the four nuts (two at the base of the cylinder and two in the primary case).

Tighten bolts and nuts evenly, to avoid distorting the joint faces.

Check that the flywheel or crankshaft (B25) assembly rotates quite freely. If it does not, then the alignment may be incorrect and the cause of the trouble must be rectified.

Fit the engine shaft sprocket distance piece and the oil pump wormdrive thrust washer, each with its chamfered face outwards. The sprocket distance piece is available in three thicknesses to provide accurate alignment of the primary chain in relation to the clutch sprocket. The sizes are as follows: $\cdot 294''$ — $\cdot 297''$; $\cdot 309''$ — $\cdot 312''$; $\cdot 324''$ — $\cdot 327''$.

Reassembly from this point is described in the previous sections, but do not omit to replace the keys in the ends of the shafts before fitting the pinions or sprockets.

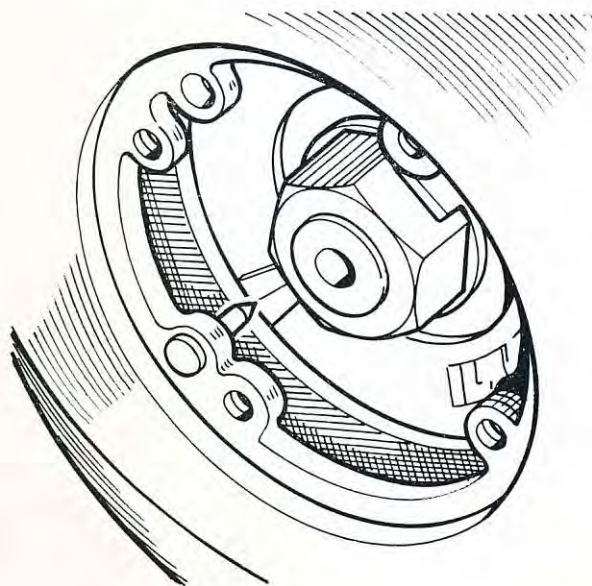


FIG. B49.

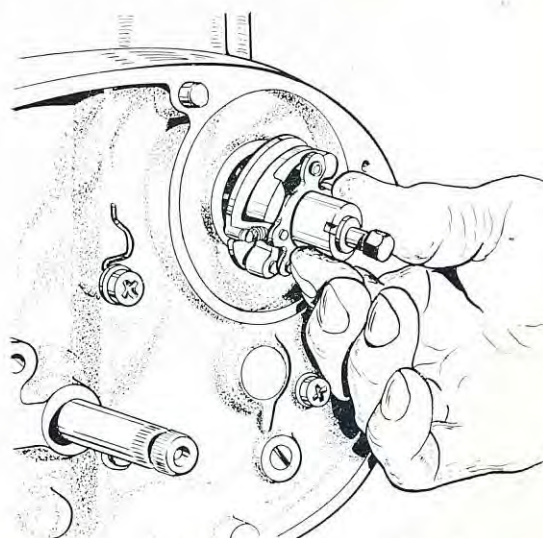


FIG. B50. *The auto-advance unit.*

IGNITION TIMING

Before carrying out any check on the ignition timing, the contact points gap should first be verified and, if necessary, readjusted as described on page B21.

Remove the sparking plug to enable the engine to be rotated without any resistance due to compression. If the engine is in the frame, it will also help if top gear is obtained, so that the engine may be turned either backwards or forwards by rotation of the rear wheel.

Piston position

Before checking the ignition timing, the piston must first be set at the recommended position before top dead centre on its compression stroke (both valves closed).

Remove the small inspection cover at the forward end of the primary drive case to expose the generator rotor. It will be seen that the timing mark is scribed on to the face of the rotor and that a pointer is mounted at the base of the inspection aperture (as shown in Fig. B49).

Rotate the engine slowly until the pointer coincides with the timing mark to obtain the correct piston setting.

At this stage the auto-advance unit should be freed from its taper and rotated until the contact points are about to open. This will give an approximate setting on which to base the final ignition timing.

Setting the contact breaker cam

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 the ideal because, whilst it will set the timing of the engine for tick-over speeds, the firing at wide throttle openings will vary due to differences in the amount of automatic-advance.

The automatic-advance functions by centrifugal force acting on spring-loaded bob-weights which will advance the ignition timing as the engine revolutions rise. Since exact timing accuracy is required at operating speeds it is better

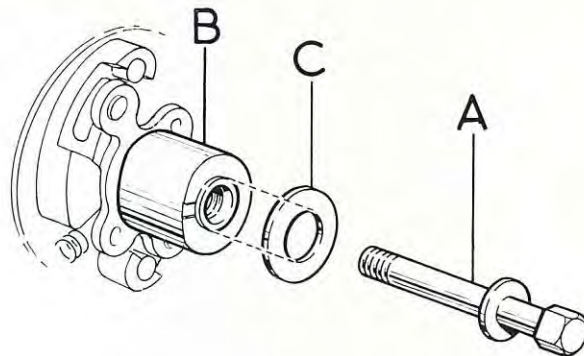


FIG. B51. *Setting the contact breaker cam.*

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.

Whilst setting the ignition timing, therefore, the contact breaker cam must be locked in the fully advanced position.

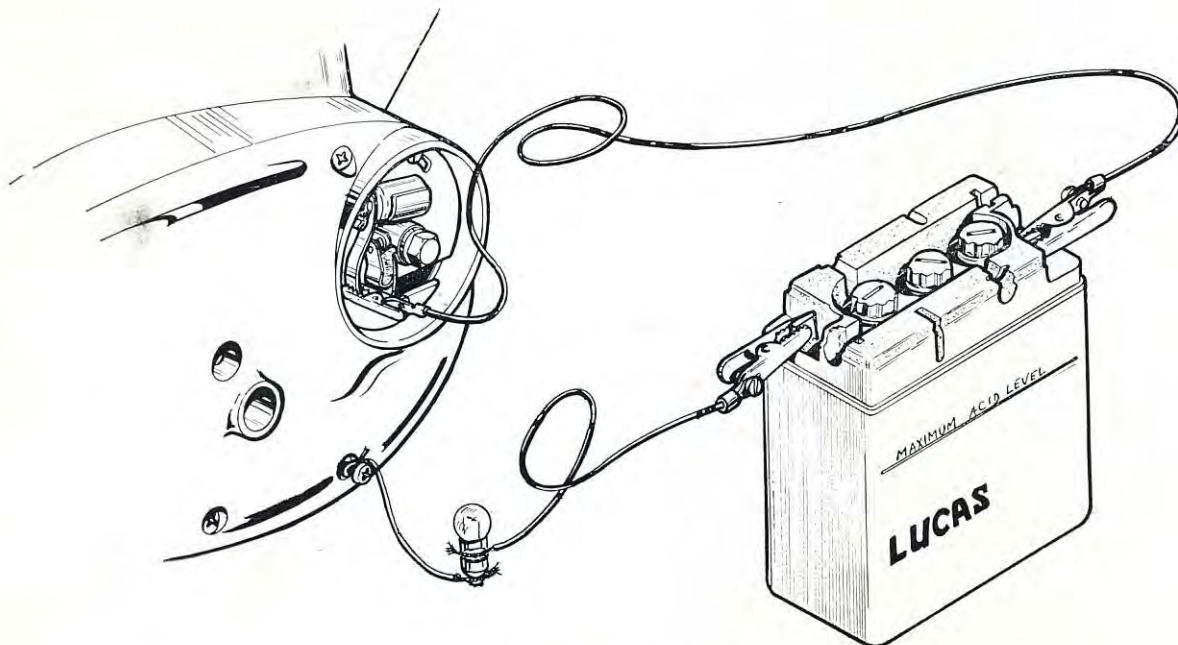


FIG. B52. *Battery and bulb in circuit.*

Carefully remove the central fixing bolt (*A*) with washer from the contact breaker cam (*B*) and temporarily fit another washer (*C*) having a hole just large enough to clear the cam inner bearing (see Fig. B51), thus allowing the washer to bear against the top face of the cam.

Replace the bolt, but before tightening, rotate the cam in an anti-clockwise direction until the bob-weights are fully expanded, hold in position and tighten the bolt. Care must be taken during this operation to avoid releasing the whole mechanism from its location.

Setting the ignition timing

Having locked the contact breaker cam in the fully advanced position and with the rotor timing mark set at the pointer, the ignition timing can now be set.

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 (see Fig. B52).

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 contact points open, the circuit will be broken and the lights will go out.

Loosen the two locking screws (*A*)—see page B21, and adjust with the eccentric screw (*B*) until the points are just opening.

Hold the plate in this position, tighten the screws and recheck the setting. There should be no change in the fully-open gap setting.

Do not forget to remove the large washer, fitted temporarily behind the contact breaker fixing bolt, otherwise the auto-advance mechanism will be inoperative.

The importance of accurate ignition timing cannot be over-emphasized. Care and patience

must be taken to ensure that the final setting is in accordance with the recommended figures.

Some dealers possess electronic equipment especially designed for setting the ignition timing of engines accurately, and if any difficulty is experienced in obtaining the correct setting as detailed above, advantage should be taken of this service.

Checking the ignition timing with a stroboscope

If the contact breaker setting has been completely lost or if the engine has been dismantled, a basic static check and preliminary setting as detailed in previous pages, must be made in order to facilitate engine starting for the strobe check.

To proceed, remove the small inspection cover at the forward end of the primary drive case to expose the generator rotor and ignition pointer.

Connect the strobelight to a suitable six-volt battery and attach the high-tension lead to the spark plug. Start the engine and direct the light on to the generator rotor. If the ignition timing is correct, the pointer and the mark on the rotor will line-up when the engine exceeds 3,000 revs per minute.

Correct any variation by adjusting the contact breaker plate as detailed in the previous section. A minute degree of adjustment can also be obtained by altering the contact points gap. By increasing the gap by .001" the timing will be advanced by one degree. By closing the gap by .001" the timing will be retarded by one degree.

REVOLUTION COUNTER

(if fitted)

Description

The rev-counter drive is situated in the timing-side crankcase half just above the pressure release valve. It consists of a spindle with drive gear doweled to it. This spindle is housed in an

aluminium body and is retained with a small dowel pin which, after passing through the body locates in a groove around the spindle. As this rev-counter drive is an optional extra the hole in the crankcase on standard engines is covered by a diamond-shaped aluminium cover, held by two screws.

Removal

To remove the rev-counter drive first disconnect the cable, taking care not to lose the fibre washer which locates between the outer cable end and the spindle housing.

Unscrew the two screws in the body and withdraw the unit.

Dismantling and reassembly

There should be no need to dismantle the unit except to replace the "O" ring or thrust washer. If it is thought necessary to renew any part, tap the dowel out of the body with a suitable punch, then withdraw the spindle.

Check that the thrust washer has not broken up or that the rubber "O" ring has not perished or split. If even slight evidence of this is noticeable these parts must be replaced.

Check also that the drive gear is not worn badly.

To rebuild the unit slide the thrust washer over the spindle followed by the "O" ring, now smear clean engine oil on to the spindle and slide it into the housing and replace the location dowel.

When refitting the unit into the crankcase using a new gasket, do not force the gear into location with the oil pump drive gear. If any difficulty is experienced use a sharp instrument to turn the spindle until it engages with the gear, then push the unit home and replace the screws.

On 1970 models it may be found beneficial to remove the oil warning light switch when removing or fitting the rev-counter drive.

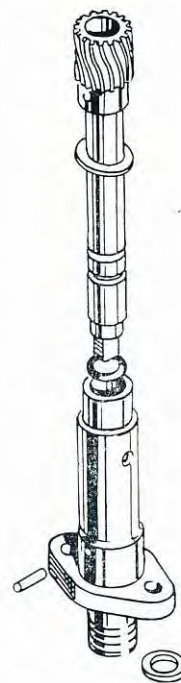


FIG. B53. *Rev-counter drive (exploded).*

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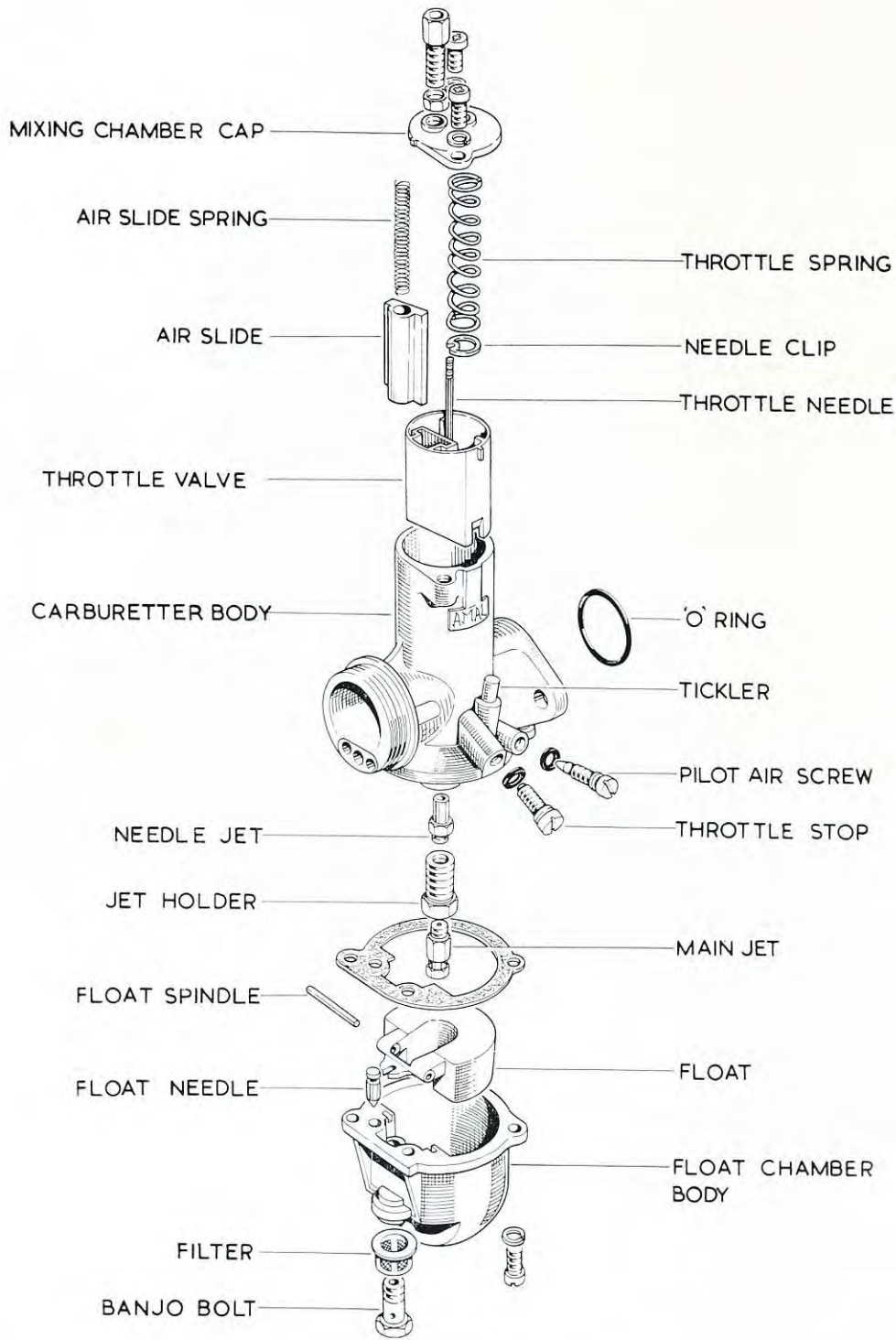


FIG. C1. Carburetter exploded.

DESCRIPTION

Both the B44 and B25 machines are fitted with an Amal carburetter, incorporating a concentric float chamber.

The carburetter, because of its jets and choke bore, proportions and atomises just the right amount of petrol and air which provides a highly inflammable mixture. The mixture is drawn into the engine and ultimately burnt within 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 supply when the engine stops.

The throttle, being operated from the handle-bar twist grip, controls the volume of mixture and therefore the power.

When the engine is ticking-over, the mixture is supplied by the pilot jet. As the throttle is opened, via the pilot by-pass, the pilot mixture is augmented by the supply from the main jet: the initial stages of which, being controlled by the taper needle in the needle jet.

The pilot supply is controlled by a small drilling situated within the concentric float chamber.

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, into the main air choke. This primary air choke has a compensating action in conjunction with bleed holes in the needle jet, which serves 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

Unscrew the air filter, release the two fixing nuts and withdraw the carburetter from its mounting studs; it will not be necessary to detach the cable from the twist grip.

Take out the two Phillips-head fixing screws and remove the carburetter top cover complete with throttle valve assembly. Compress the throttle spring and remove the needle clip to release the needle. Whilst still compressing the spring, push the cable downwards to release the nipple from its location in the valve. Take care not to lose the needle clip when taking off the spring and top cover.

Unscrew the "banjo" bolt which secures the fuel pipe "banjo" connector to the float needle seating block and withdraw the nylon filter.

The float chamber is secured to the base of the 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.

Having dismantled the carburetter, carefully clean all parts in petrol (gasolene). Hard deposits on the carburetter body are best removed with a light-grade wire brush. After washing the parts in clean petrol, 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 in General Data.

Reassembly is simply a reversal of the above instructions but remember to replace any gaskets or "O" rings that appear unserviceable. Refer to Fig. C1 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 GD4 and GD8).
- (2) Check the throttle return spring for efficiency. Check also that it has not lost its compressive strength by measuring the free length and comparing it with the figure given on page GD4 and GD8.
- (3) Examine the needle jet for wear or possible scoring and check the tapered end of the needle for similar signs.
- (4) Check the float needle for efficiency by inserting it into the float needle seating block, pouring a small amount of petrol (gasolene) 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 petrol (gasolene) 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.

Use the adjuster on the cable to obtain the correct setting and ensure that the throttle slide shuts down freely.

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 petrol 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 joints at the carburetter flange and the cylinder head (see Fig. C2) and can be detected by applying oil around the joints. Eliminate



FIG. C2.

by fitting new washers and tightening the flange nuts evenly to the torque wrench setting quoted on page J1.

Also check that the rubber sealing ring in the carburettor flange is undamaged and located correctly.

On much used or old machines look for air leaks caused by a worn throttle or a worn inlet valve guide.

Banging in exhaust

This may be caused by too weak a pilot mixture when the throttle is closed or nearly closed. It may also 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 but has fired in the hot silencer.

If the banging occurs when the throttle is fairly wide open, the trouble will be traced to ignition, not carburation.

Excessive 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 carburettor alone.

Air filters

If a carburettor is first set with an air filter and the engine is then run without, the jet setting may be affected and care must be taken to avoid overheating the engine due to too weak a mixture. Testing with the air supply will indicate if a larger main jet and higher needle position are required.

Effect of altitude on a carburettor

Increased altitude tends to produce a rich mixture; the greater the altitude, the smaller the main jet required. Carburettors ex-works are suitably set for use in altitudes of up to approximately 3,000 feet. Carburettors used constantly in altitudes of between 3,000 to 6,000 feet should have a reduction in main jet size of 5 per cent. A further reduction of 4 per cent 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.

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-strokes, four-stroking.
- Heavy lumpy running.
- Sparking plug sooty.

Indications of weakness

- Spitting back in carburetter.
- Erratic slow-running.
- Overheating.
- Engine goes better if throttle is almost closed.

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

- (1) Petrol feed — check that jets and passages are clear, that 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 flange joint or due to worn inlet valve stem and guide.
- (3) Defective or worn parts — such as a loose-fitting throttle valve, worn needle jet, loose jets.
- (4) Air cleaner choked-up.
- (5) An air cleaner having been removed.
- (6) Removal of the silencer — this requires a richer setting.

Having ensured that the fuel feed is correct and that there is no air leaks etc., check the ignition, valve operation and timing. Now test to see if the mixture is rich or weak by partially covering the carburetter inlet and noting how the engine runs. If the engine runs better, weakness is indicated, but if the engine runs worse then the mixture is too rich.

To remedy, proceed as follows:—

To cure richness

- Position 1. Fit smaller main jet.
- Position 2. Screw out pilot air adjusting screw.
- Position 3. Fit a throttle with a larger cut-away (see paragraph “E”, page C8).
- Position 4. Lower needle one or two grooves (see paragraph “D”, page C7).

To cure weakness

- Position 1. Fit larger main jet.
- Position 2. Screw pilot air adjusting screw in.
- Position 3. Fit a throttle with a smaller cutaway (see paragraph “E”, page C8).
- Position 4. Raise needle one or two grooves (see paragraph “D”, page C7).

(Positions 1, 2, 3 and 4 refer to positions of throttle openings as shown in Fig. C4, page C7).

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.

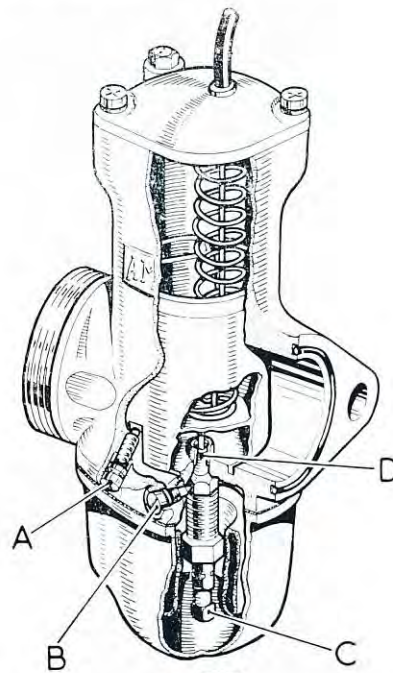
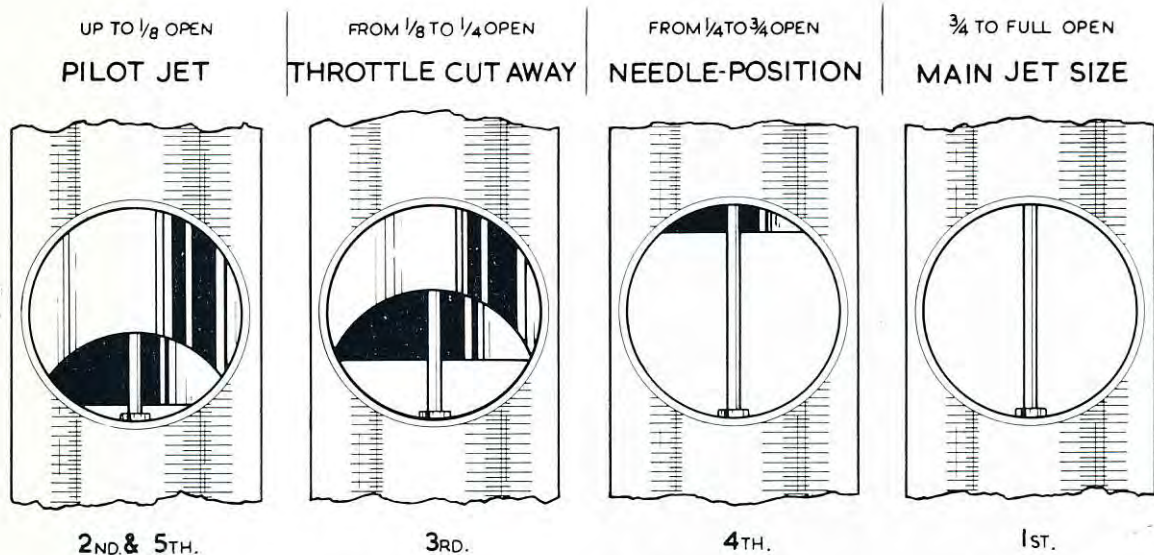


FIG. C3.



SEQUENCE OF TUNING

FIG. C4.

VARIABLE SETTINGS AND PARTS

The following paragraphs have reference letters for guidance and should be read in conjunction with the sectioned diagram (Fig. C3) indicating the variable parts.

(A). Throttle adjusting screw

Set this screw to hold the throttle open sufficiently to keep the engine running when the twist grip is shut off.

(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 drilling 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 taper — 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.*, 3½, 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 C7 and C8 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 throttle in position 1 (Fig. C4). 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 evenly and regularly with maximum power.

If testing for speed work, ensure that the main jet size is sufficient for the mixture to be rich enough to maintain a cool engine. To verify this, examine the sparking plug after 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. C4) with throttle in positions 2 and 5. With engine idling too fast with the twist grip shut off the throttle shut down on to the throttle adjusting screw, and ignition set for best slow-running: (1) Screw out throttle adjusting screw until the engine runs slower and begins to falter, then screw pilot air adjusting screw in or out, to make engine run regularly and faster. (2) Now gently lower the throttle adjusting screw until the engine runs slower and just begins to falter, adjust the pilot air adjusting screw to get best slow-running, if this second adjustment leaves the engine running too fast, go over the job a third time.

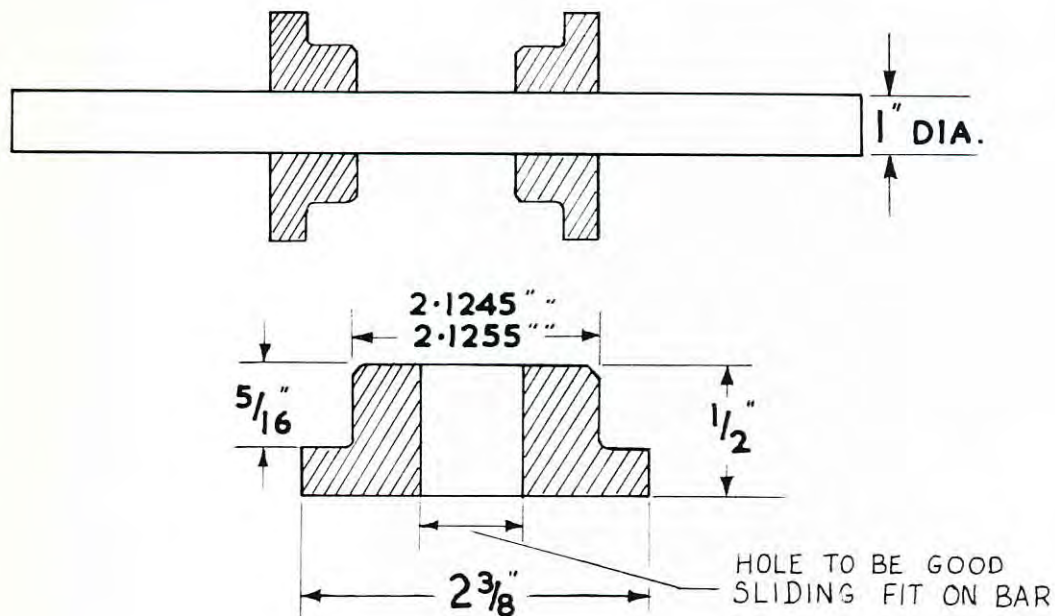
3rd — Throttle cut-away with throttle in position 3 (Fig. C4). If, as you take off from the idling position, there is an objectionable spitting from the carburetter, slightly richen the pilot mixture by screwing in the air screw. If this is not effective, screw it back again, and fit a throttle with 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 throttle in position 4 (Fig. C4). The needle controls a wide range of throttle openings and also the acceleration. Try the needle in as low a position as possible, *viz.*, with the clip in a groove as near the top as possible; if acceleration is poor and with the carburetter inlet partially covered, the results are better, raise the needle by two grooves; 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 clip in groove number one nearest the top, the needle jet probably wants replacement because of wear. If the needle itself has had several years use replace it also.

5th — Finally, go over the idling again for final touches.

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FIG. D2. *Steering head mandrel.*

FRAME ALIGNMENT

The only satisfactory way of checking the frame for correct alignment is on an engineers setting-out table. In addition to the table, which should be approximately five feet by three feet, the following equipment will also be necessary.

- One mandrel and two blocks as in Fig. D.2.
- One mandrel or bar for swinging arm pivot $13/16$ " diameter by 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.

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. Figure D3 shows the basic set-up for checking the frame, though variations can of course be used according to the facilities available.

Place the blocks into the steering head, insert the mandrel and support with the "V" blocks at one end of the 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 hole.

Now, using jacks or packing pieces, set the frame horizontal to the table so that checks taken at points (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 been subjected to a frontal impact, the main tube may remain parallel at points (A) but will be bent as shown in Fig. D4. A straight-edge made from a piece of good quality hardboard can be used for this purpose, but the checking edge must be quite straight.

When the frame is set parallel to the surface table, the mandrel through the swinging arm pivot holes should be vertical. 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 both the upper and lower tubes together at points (C) and (D) if the

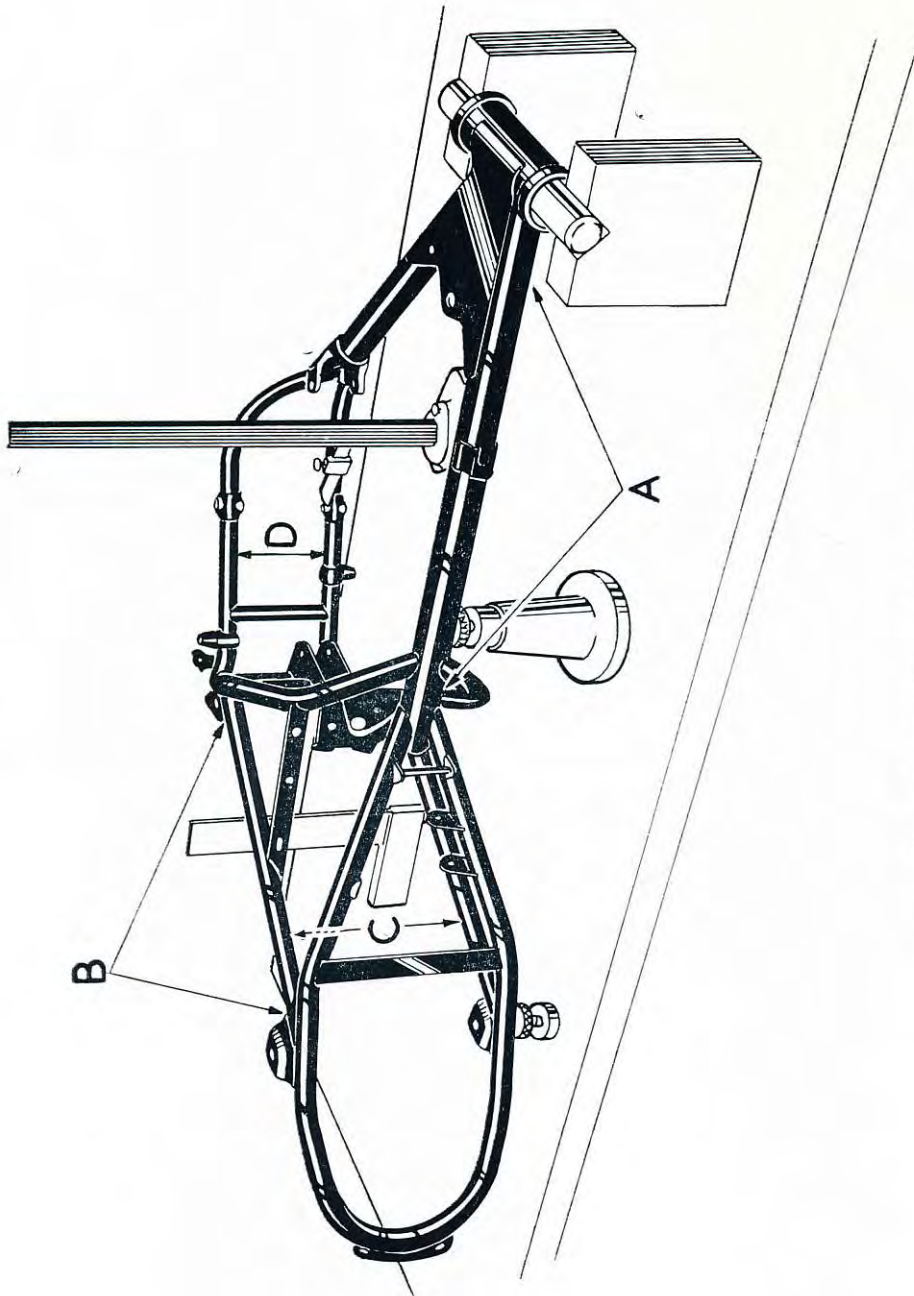


FIG. D3. Setting-up the frame.

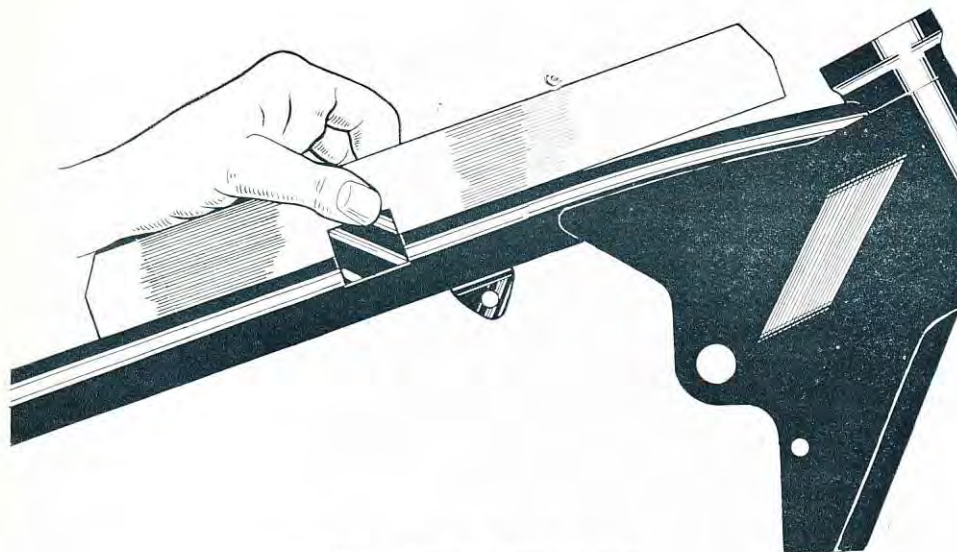


FIG. D4. *Showing bent top tube.*

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 now be taken at the engine mounting lugs and other points of the frame. Errors at any point should not exceed $\frac{1}{32}$ " (.79 mm.).

CHAINGUARD

Take out the two bolts and washers from the bracket just in front of the rear wheel nut, then release the single front fixing nut and bolt. Withdraw the chainguard from the rear.

Refitting the chainguard is simply the reversal of the removal procedure.

REAR SHOCK ABSORBERS

The rear shock absorbers, or dampers, are of the coil-spring type, hydraulically damped and are mounted on bonded-rubber bushes at each end.

The actual damping unit is a sealed assembly and the only dismantling that can be carried out is for the removal and replacement of the springs.

The top damper fixing bolts also retain the ends of the dual seat bracket and the mudguard support rail.

To remove a damper, take out the top fixing bolt with nut and washers and unscrew the lower fixing nut. Pull the damper off the stud at the bottom and withdraw from the top frame bracket.

The removal and replacement of the mounting bushes will be found much easier if a little liquid soap is applied.

The damper springs are graded at 100 lb./in. rate and have green/pink identification markings.

If the springs are to be changed, the spring must first be compressed with service tool No. 61-3503 to allow the split collets to be removed (see Fig. D5). After removing the tool, the dust shield can be lifted off, allowing the spring to be

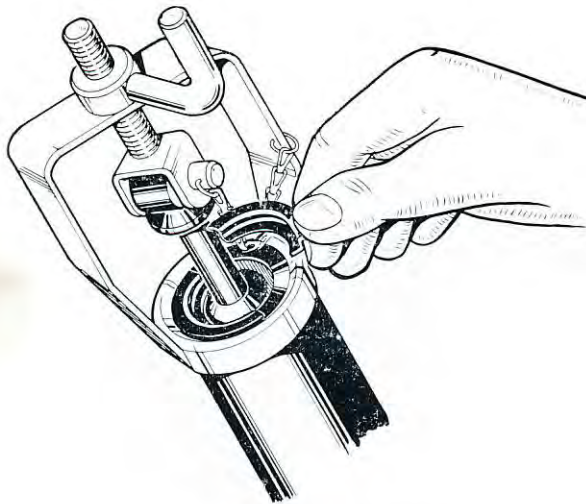
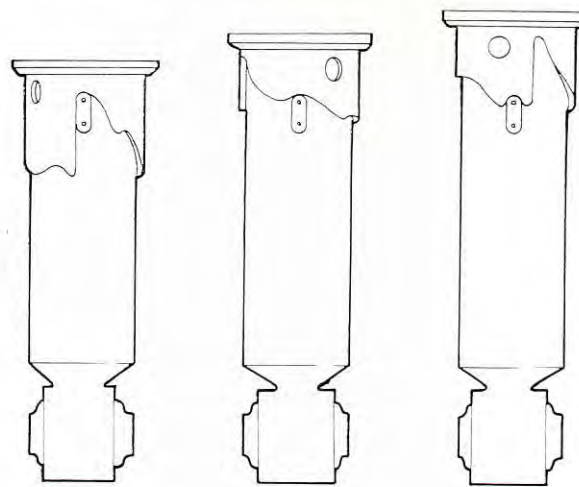


FIG. D5. Using tool No. 61-3503.



LIGHT MEDIUM HEAVY

FIG. D6. Cam ring positions.

taken out. Having renewed the spring and refitted the dust cover, the spring will have to be compressed with the service tool again to enable the split collets to be inserted.

Do not lubricate the plunger rod or bushes.

The dampers have three load positions, light, medium and heavy (see Fig. D6) and they must be set in the "light load" position before dismantling. A "C" spanner for this adjustment is provided in the toolkit.

SWINGING ARM

Removal

Take off the rear wheel, chainguard, dampers and rear brake pedal as described on pages F4, D5, D6 and D8 respectively.

The left-hand pillion footrest bracket is welded to the swinging arm spindle and also carries the brake light switch. Disconnect the cable connectors at the switch and release the nut and bolt holding the bracket to the frame plate. The brake pedal stop is held by one nut and must also be removed. Unscrew the large nut with lockwasher,

securing the swinging arm spindle at the right-hand side and drive the spindle out.

Now, using a raw-hide mallet, tap the left-hand side of the swinging arm downwards and the right-hand side upwards to release it from the frame plates.

When replacing the swinging arm, do not tighten the large spindle nut until the dampers have been refitted.

Bushes

Each of the two bushes fitted to the swinging arm fork consist of two steel sleeves, bonded together with rubber. The inner sleeve is slightly longer than half the width of the fork in the frame, the two inner sleeves are locked together on the end faces, so placing the rubber under tension when the fork moves.

Under normal circumstances, the bushes will last the life of the machine, but should they require renewal, the rubber will have to be first removed. This can be done by progressively burning out the rubber with thin rods or strips

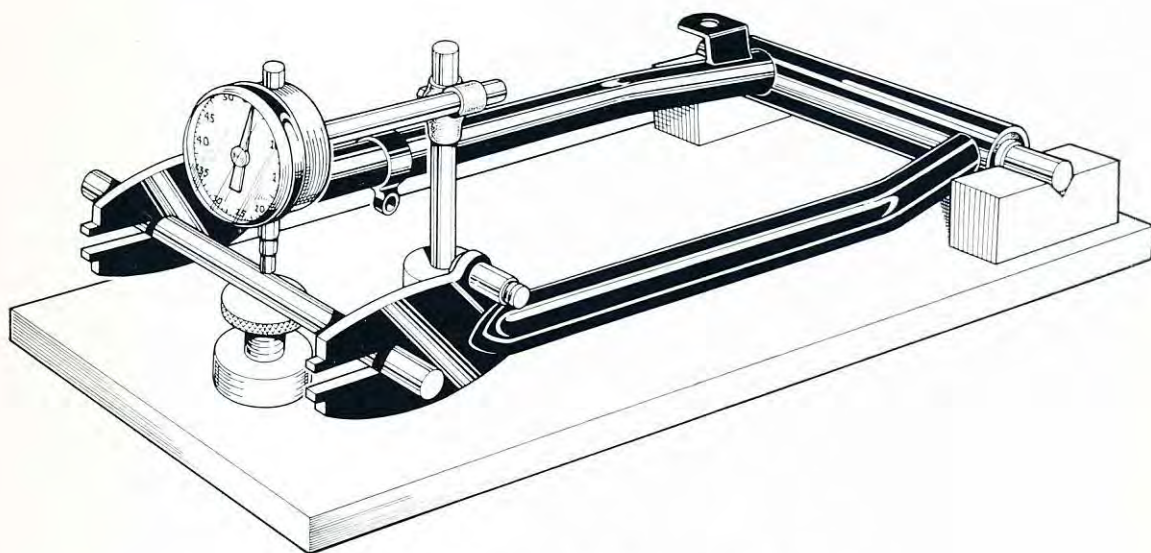


FIG. D7. *Checking the swinging arm.*

of metal which have been heated. When sufficient rubber has been burnt away, drive out the inner sleeves, after which the outer sleeves can be removed with a suitable drift.

Using the same mandrel that was used for the swinging arm pivot on the frame (see page D3), set the swinging arm in "V" blocks as shown in Fig. D7. Another mandrel 9" long by $5\frac{1}{8}$ " diameter should be inserted through the fork ends. Both mandrels should be parallel to the surface table. Should there be less than $\frac{1}{4}$ " malalignment of the swinging arm fork it is permissible to correct it by means of a suitable lever but, care must be taken to avoid causing further damage.

Alignment

Before checking the swinging arm, it must be established that the bushes are in good condition.

To check that the forks are square to the pivot, they must be set-up at 90 degrees to the position illustrated, so that the pivot is vertical. Next, find the centre of the pivot and check that the fork ends etc., are in accordance with the dimensions shown in Fig. D8.

When there is considerable malalignment in either frame or swinging arm, it is recommended that a works reconditioned unit is fitted.

Note:—There may also be a variation 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, caused by the "settling" of a spring. If this should be the case, it is advisable to renew the springs in both dampers.

DUAL SEAT

The dual seat is mounted on a bracket at the rear, which is secured at each side by the damper top fixing bolts. It will only be necessary to loosen these bolts sufficient to allow the seat to be raised at the rear. Withdraw the seat rearwards to disengage the front clip from the frame tie bar.

The clip is held to the base of the saddle by two nuts with washers and is slightly offset.

Replace in the reverse order, making sure that the clip engages correctly with the front mounting rod.

PROP STAND

The prop stand is secured to the frame lug with one bolt and lockwasher. Bend back the tabs of

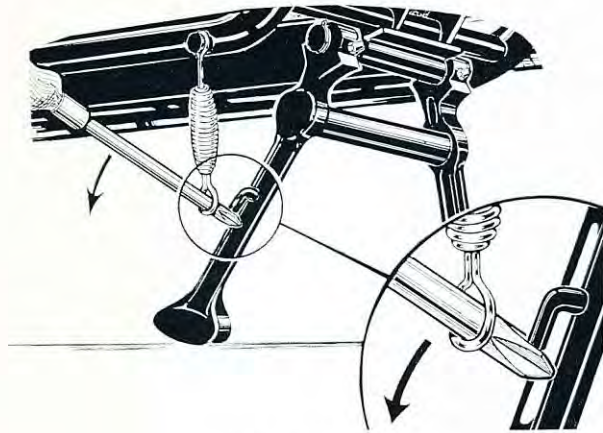


FIG. D9.

crum pin is fixed to the frame with one large nut and washer.

The pedal is fitted with two adjuster bolts. The upper bolt controls the operation of the brake light switch and the lower one is used for setting the pedal position against the brake stop.

MUDGUARDS

Removal of the front mudguard should be found quite straightforward, providing the stays are also removed.

The rear mudguard must be removed complete with its support rail, rear light and number plate. Whilst supporting the swinging arm, take out the damper top fixing bolts and lift off the dual seat. The ends of the support rail will now be free.

Disconnect the rear light cables (brown and brown/green) at their snap connectors near the battery. Reach inside the guard and release the two nuts and bolts holding the lower front of the guard to the frame cross-member.

Unscrew two nuts and bolts securing the support rail brackets to the rear of the seat rail and withdraw the guard from the rear, complete with its fittings.

Replace in the reverse manner and check that the rear light cables are not damaged at any point.

CARBURETTOR AIR CLEANER

The carburettor air cleaner should be regularly examined at intervals of 1,000 miles (1,600 km.), but if the machine is used under exceptionally severe conditions a weekly examination must be made. Running the machine with a badly choked air cleaner will cause restricted maximum speed, an increase in fuel consumption and many other carburation troubles.

The air cleaner unit is simply screwed on to the carburettor intake. Release the clip nut and bolt, holding together the ends of the perforated band and dismantle the unit.

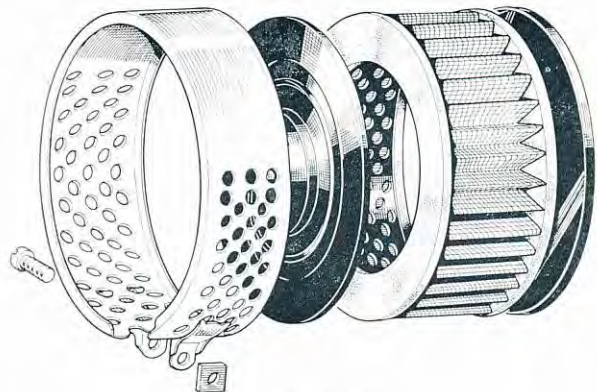


FIG. D10.

The surgical gauze element must be washed in clean petrol and thoroughly dried before being replaced. If, however, the element no longer appears serviceable, it should be renewed.

Refer to Fig. D10 for details of correct re-assembly.

OIL TANK REMOVAL

After removing the sidecover by releasing the two "Oddie" studs unscrew the tank filter plug and allow the oil to drain into a suitable receptacle,

taking care not to lose the large fibre washers fitted each side of the oil feed pipe connection. Whilst waiting for the oil to drain, loosen the damper top fixing bolts, raise the dual seat at the rear and withdraw from the frame tie-bar at the front. Undo the small fixing clip and detach the oil return pipe from the crankcase union. The rocker oil feed pipe need not be disturbed.

Two long bolts with nuts secure the tank mounting clips to the dual seat support rail. Each clip is fitted with a rubber sleeve which should be left in place, unless in need of renewal. The tank is located at its base by a bolt which passes through a rubber grommet, mounted in a frame bracket.

Having released the top mounting bolts take out the bottom bolt and carefully withdraw the unit.

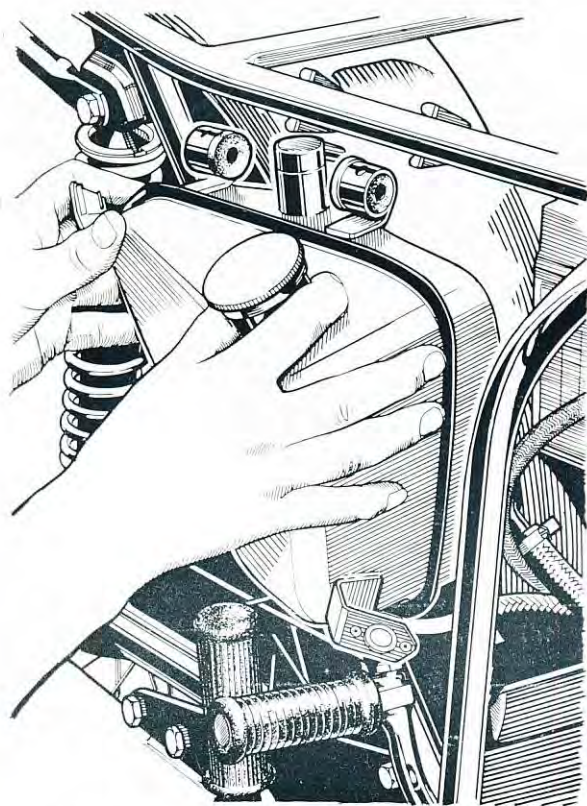


FIG. D11. *Withdrawing the oil tank.*

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.

BATTERY CARRIER AND TOOLBOX

Access is gained to the battery carrier and toolbox by removing the fibre-glass sidecover. This is retained by two "Oddie" studs which require only half a turn to release.

Disconnect the battery terminal connections, unclip the fixing strap and lift out the battery. Note that a vent pipe is connected to the battery top and is so arranged that corrosive fumes from the battery cells are directed clear of the machine.

Proceed by removing the rubber mat from the carrier base to expose the three fixing bolts. The two outer bolts are each fitted with two rubber bushes, two plain washers and a nut. A third nut retains the sidecover buffer bracket on to the end of the front bolt. The inner fixing point consists of one long bolt, three rubber bushes, a spacer tube, three plain washers and a nut.

The rubber bushes help to insulate the battery and carrier from road shocks and vibration. It is most important therefore, that a note is made of the way in which they are fitted in order to ensure correct reassembly.

To remove the toolbox, first take out the tool-roll then release the two fixing bolts and nuts. The lower bolt is fitted with a spacer between the toolbox base and the frame bracket. Gently pull away the toolbox and, noting their terminal locations, disconnect the rectifier cables, allowing the assembly to be withdrawn from the frame.

The rectifier is held to the rear of the toolbox by a single nut and should not be disturbed unnecessarily. When either unscrewing or tightening the fixing nut, the bolt head should be held firmly with a second spanner to prevent it from

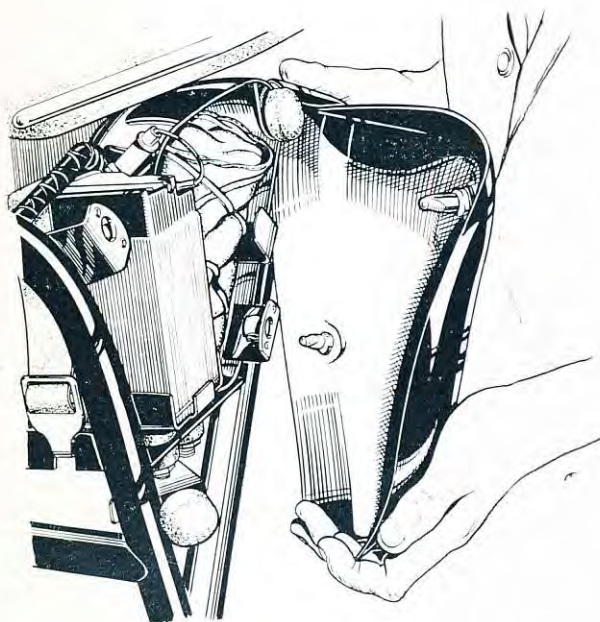


FIG. D12. *Removing sidecover.*

turning. If this precaution is not taken, the rectifier plates may twist and break the internal connections.

HEADLAMP REMOVAL

Pull out the bulb holder from the base of the speedometer head. Slacken the rim retaining screw situated at the top of the headlamp. Pull the rim away from the top and disengage from the clip at the base to release the light unit assembly. Press the main bulb adaptor inwards, rotate it to the left and lift it off. Pull out the parking bulb holder from its location in the reflector, withdraw the light unit and rim assembly and place to one side. To avoid damage, the bulbs should now be taken out of their holders.

Disengage the light switch cable then, making careful note of their respective locations, disconnect the cables at the ammeter terminals. Pull out the headlamp main beam warning light holder from its sleeve and take out the bulb.

By displacing the large rubber grommet at the base of the headlamp shell, the harness complete with bulb holders can now be withdrawn from the shell. Note on reassembly, that the harness is held securely by a spring clip inside the headlamp shell.

Finally, take out the two fixing bolts with washers from the fork leg brackets and withdraw the headlamp shell complete with ammeter.

Replace in the reverse manner, making sure that all connections are secure and that the cables are not "bared" at any point.

Remember to adjust the headlamp to give the correct beam setting as detailed on page G14.

CONTROL CABLE REPLACEMENT

Throttle cable

First turn the twist grip to open the throttle, then, whilst pulling the cable sleeve, release the grip to allow the slotted cable stop to be removed. Now remove the two 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 the grip by inserting it up through the lower half and locating the nipple in its slot. Replace the top half of the grip, but, before tightening the screws, check that the grip turns freely. Do not replace the cable stop at this stage.

Proceed by removing the petrol tank (see page B14) and detaching the cable from the frame clips.

Take out the two Phillips-head fixing screws and withdraw the carburettor top cover complete with throttle valve assembly. Compress the throttle spring, remove the needle and clip. Whilst still compressing the spring, push the cable downwards to release the nipple from its location in the valve.

First pass the replacement cable through the cable guide bracket then insert the cable through the top cap and spring. Whilst compressing the spring, insert the cable nipple through the valve needle hole and locate to one side. Fit the throttle needle, assemble the throttle valve to the carburettor body, making sure that the

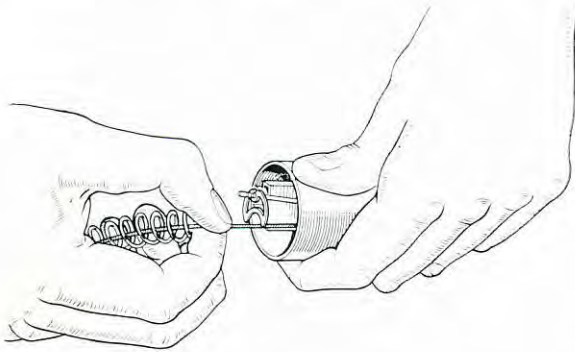


FIG. D13. Removing throttle cable.

needle enters the needle jet squarely. Locate the peg on the throttle valve with the slot in the mixing chamber and fit the top cap. Do not tighten the cap fixing screws until the throttle valve has been checked for correct operation.

Finally, attach the cable to the frame, replace the cable stop at the twist grip and adjust the cable as necessary (see page C4).

Front brake cable

To remove the front brake cable, first completely loosen the cable adjusters and unscrew the nut and bolt holding the toggle to the lever on the brake cover plate. Now, pull the cable adjuster away from the handlebar lever bracket and slip the cable nipple out of the lever.

Replacement is simply a reversal of the above procedure but do not omit to readjust the brake cable and test the efficiency of the brake thoroughly before using the machine.

Clutch cable

Unscrew and remove the handlebar lever fulcrum bolt and nut. Slacken the cable adjuster and

swing the control lever away from the bracket, allowing the cable nipple to be released.

The adjuster and cable can now be withdrawn from the bracket. It will now be possible to release the nipple at the other end of the cable from the clutch actuating lever.

Replace the cable in the reverse manner and adjust as necessary to give correct operation.

Note:—After adjustment, the control lever on the timing cover should take up a position approximately parallel with the timing cover joint face, when operated.

Exhaust valve lifter cable

Undo the handlebar control lever pivot bolt and nut. Pull the lever away from the bracket and disconnect the cable nipple.

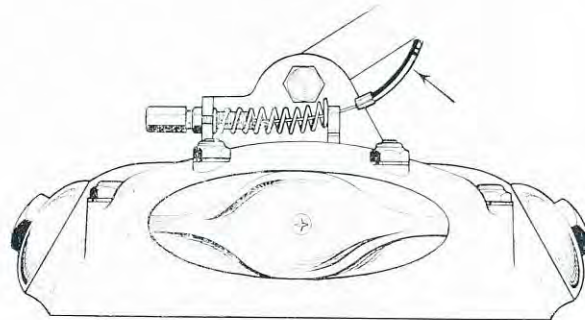


FIG. D14.

Now, working from the right-hand side of the machine, pull the cable outer cover out of its location in the valve lifter lever and raise the cable to release (see Fig. D14). Screw out the cable adjuster from the bracket and withdraw the cable complete with adjuster and spring.

After replacing the cable, use the cable adjuster and locknut on the bracket to obtain the correct setting. Ensure that there is ample slack in the cable to allow the exhaust valve to close properly whilst the lever is not operated. Incorrect setting of this control will cause difficult starting, a burnt valve and a considerable depreciation in performance.

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DESCRIPTION

The telescopic hydraulically-controlled front fork 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 overtighten, 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. E2).

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

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, 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. E1).

Having adjusted the steering, tighten the pinch bolts.

Care is necessary when testing for play to distinguish between play in the head races and play in the forks bushes. In some cases there may be both.

If possible get a friend to place the fingers of one hand lightly round the bottom head races whilst the forks are being pushed and pulled, if play is there, it will be felt quite easily by the fingers.

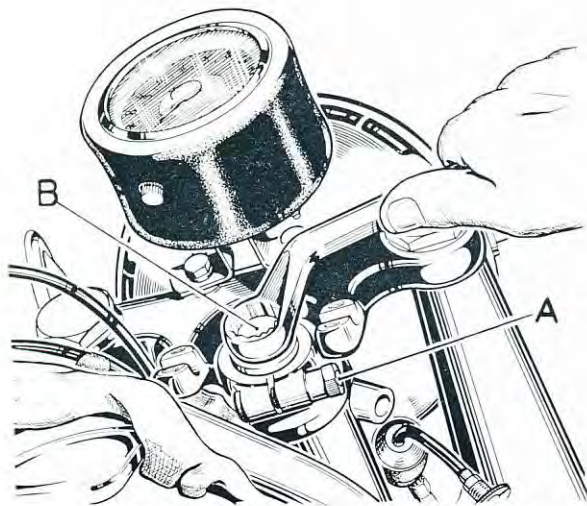


FIG. E1. *Steering head adjustment.*

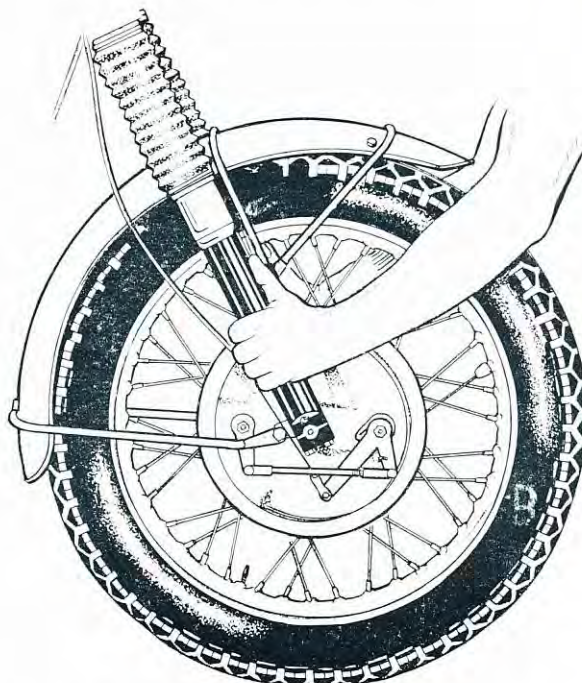


FIG. E2. *Testing the steering head for play.*

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 inside the head-lamp. The two wires should also be disconnected from the front brake light switch.

Disconnect the front brake cable from the handlebar lever.

Slacken the pinch bolt (A), and remove the adjuster nut (B) Fig. E3. Unscrew and remove top caps (C) with service tool No. 60-0779.

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.

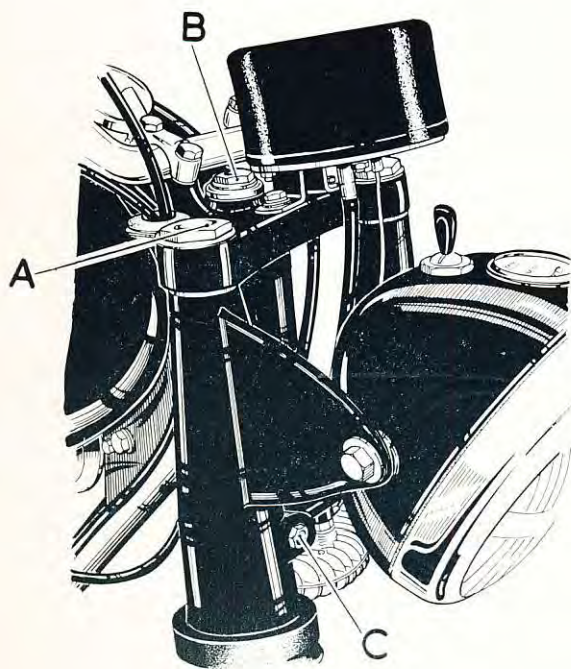


FIG. E3. Top yoke.

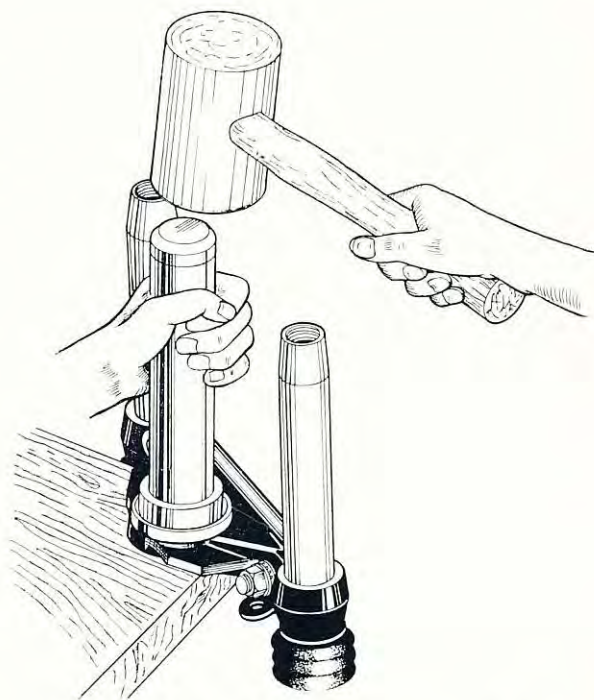


FIG. E4. Replacing bottom cone using service tool No. 61-6009.

There should be twenty $\frac{1}{4}$ " diameter, steel balls in each race. See page A11 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. E4).

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. E5).

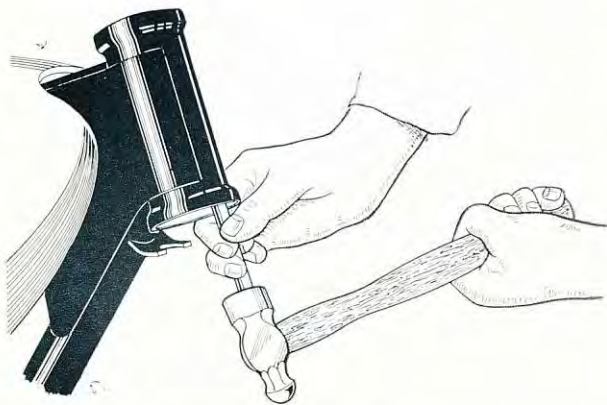


FIG. E5. *Removing top cup.*

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. E6.

REASSEMBLING THE STEERING HEAD

After replacing the cups and bottom cone, grease the cups, assemble twenty 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 E2, 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 G17.

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) |
| 60-0779 | Service tool |
| 61-6017 | Service tool |
| 61-3824 | Service tool |
| 61-3007 | Service tool |

Remove the front wheel as described on page F2, then remove the front mudguard, by taking out the bolts from the fork ends and the four nuts and bolts from the brackets in front of the fork legs.

Remove the two caps (C) Fig. E3.

Drain the oil from the forks as described on page A11.

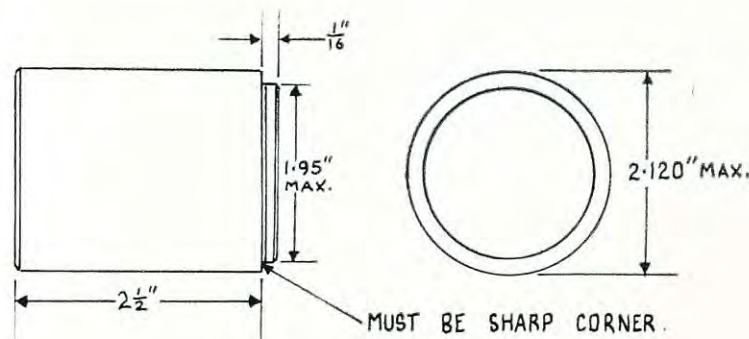


FIG. E6. *Cup drift.*

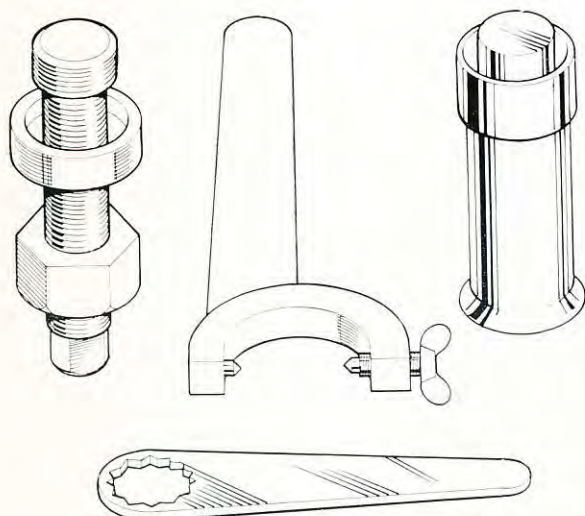


FIG. E7. Fork tools.

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 springs, apply a liberal coat of grease to the new springs and to replace.

Replacing the fork leg is described on page E7.

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,

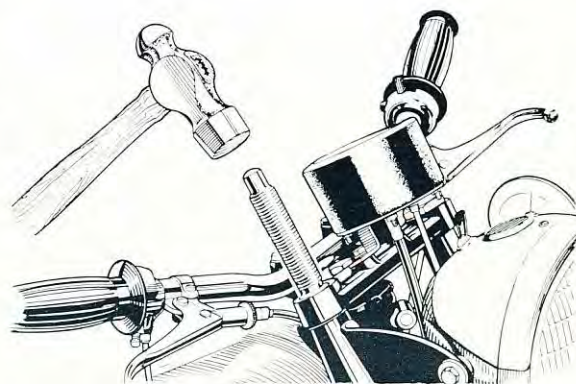


FIG. E8. Removing fork leg.

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.

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 counter-bore 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 shuttle 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 peripheral slot.

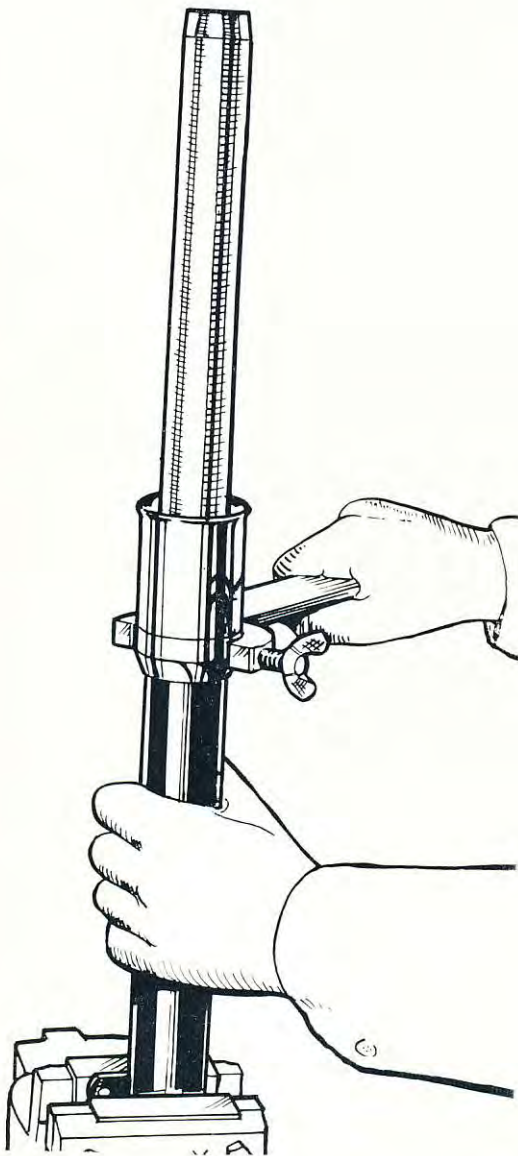


FIG. E9. *Removing sleeve nut.*

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.



FIG. E10. *Removing oil seal.*

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.

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. E11. Using service tool No. 61-3824 to reassemble the forks.

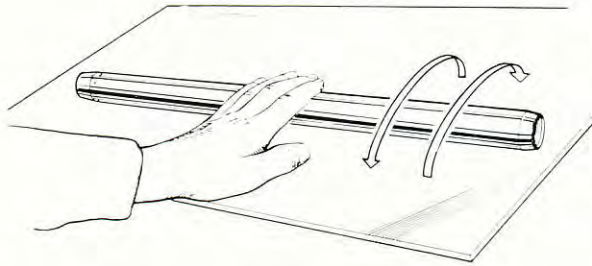
To pull the stanchion up to the top yoke, service tool No. 61-3824 is required, which should be inserted into the top yoke and the plug adaptor screwed into the stanchion top. The stanchion can then be easily drawn up to the required level and when this is achieved temporarily tighten the pinch bolt 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 $\frac{3}{8}$ U.S. pint (190 c.c.) of the recommended grade of oil (see page A3) 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 E2.

Now tighten the top yoke pinch bolt, top cap nuts and the bottom yoke pinch bolts to the torque wrench figures quoted on page J1.

Reassembly continues as the reversal of the dismantling procedure, referring to page G17 for the wiring diagram and page G14 to set the headlamp beam.

FIG. E12. *Testing for straightness.*

FORK ALIGNMENT

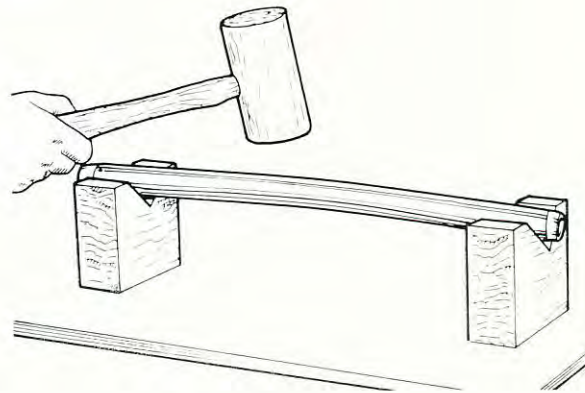
It is possible during reassembly of the forks, for them to be incorrectly aligned.

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.

The tubes can only be accurately checked for straightness with special equipment such as knife-

FIG. E13. *Straightening.*

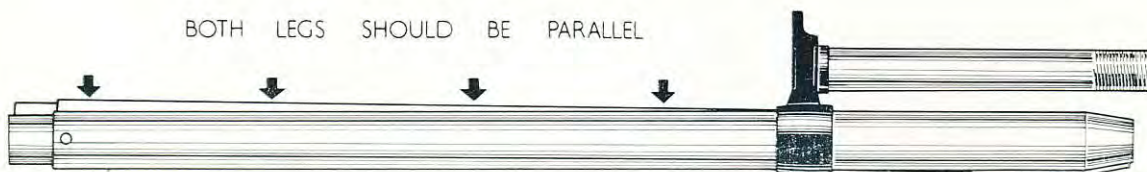
edged rollers and dial gauges and special gauges are required to check the yokes.

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 replacement 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 recheck. 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.

FIG. E14. *Bottom yoke twisted.*

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. E14, then the yoke can be set providing the error is not excessive.

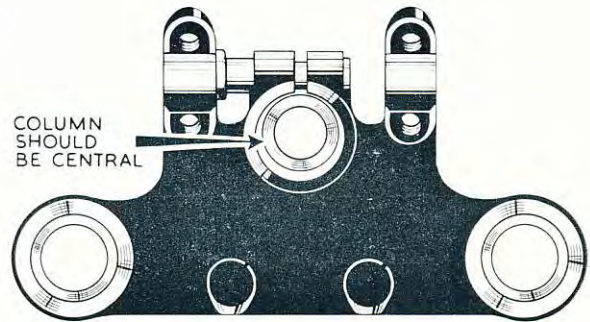


FIG. E15. Bent steering column.

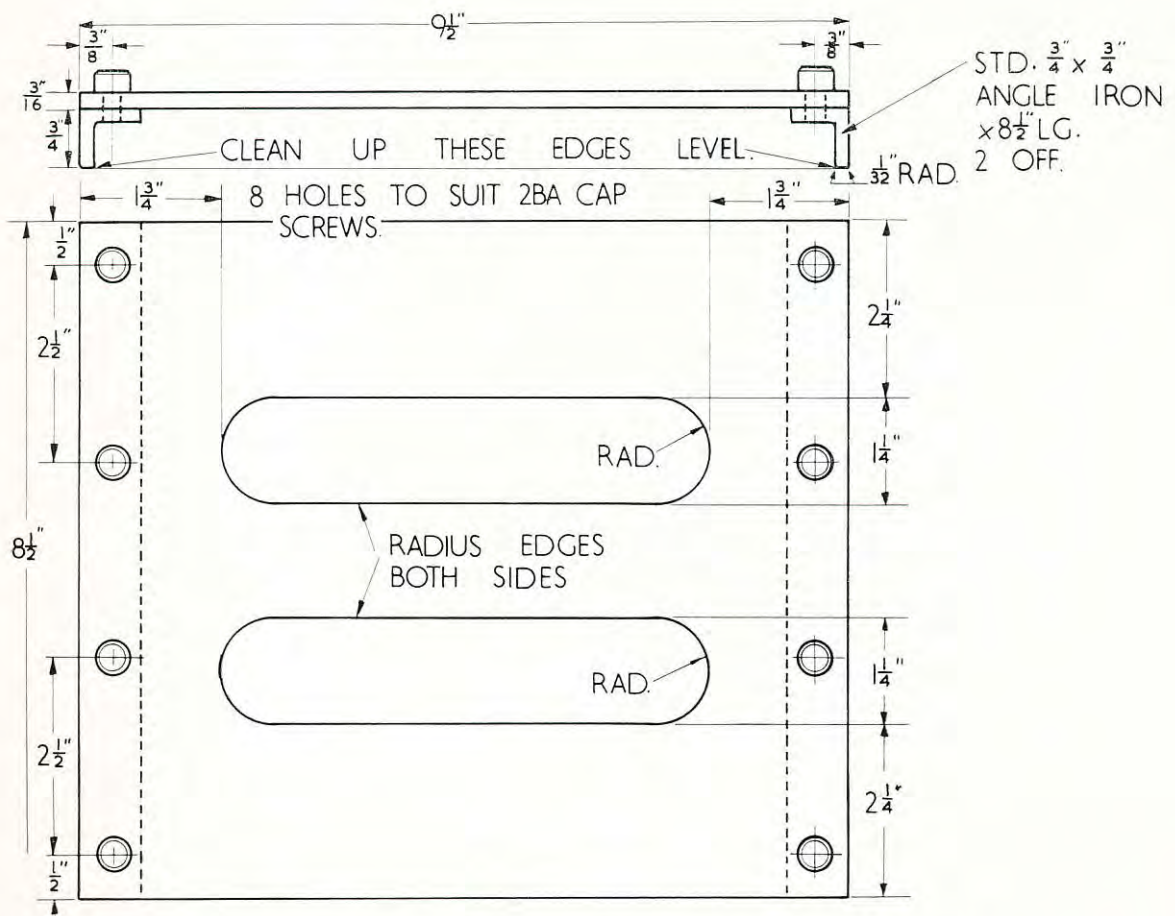


FIG. E16. Telescopic fork alignment gauge, service tool No. 61-6025.

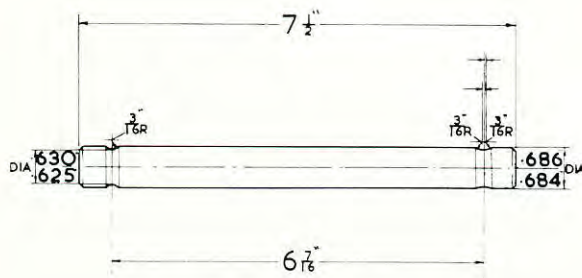


FIG. E17. *Dummy wheel spindle.*

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. E15 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.

For this operation service tool No. 61-6025 will be found necessary, the measurements of which are detailed in Fig. E16.

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, 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. E17.

Hold the alignment gauge firmly against the fork legs as shown in Fig. E18, 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.

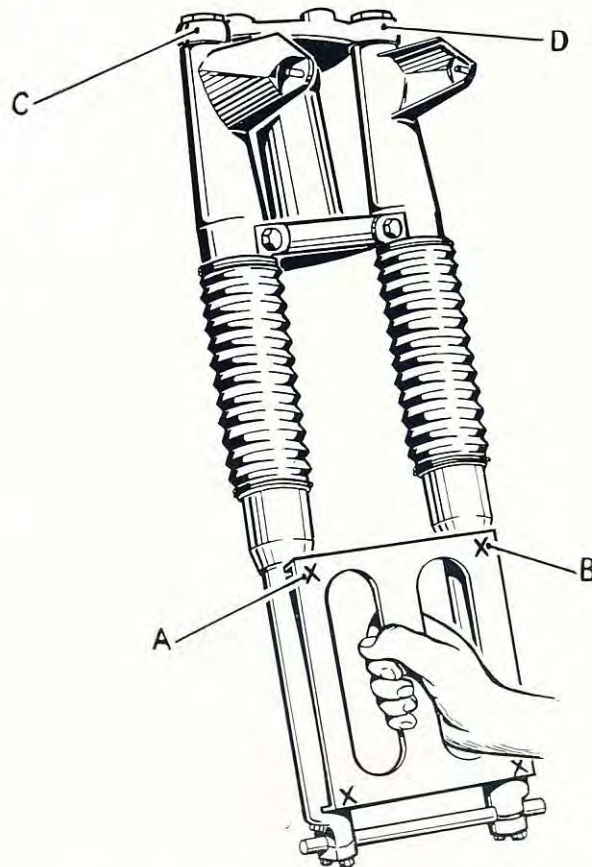


FIG. E18. *Checking fork alignment with service tool No. 61-6025.*

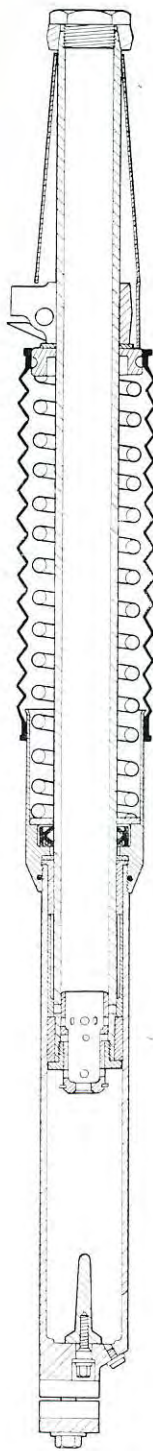


FIG. E19. *Telescopic front fork.*

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 E8 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.

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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 J1.

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.

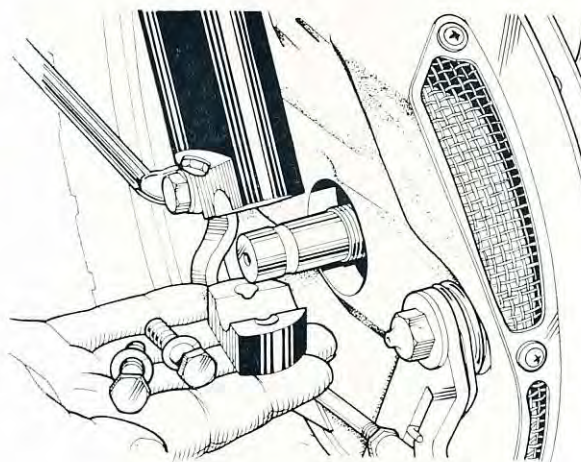


FIG. F1. Replacing front wheel.

To remove the brake shoes from the anchor plate, lever them upwards and outwards off 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 readjustment. If however the adjustment is upset either by damage or the need to replace a part of the assembly, the following notes on readjustment 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.

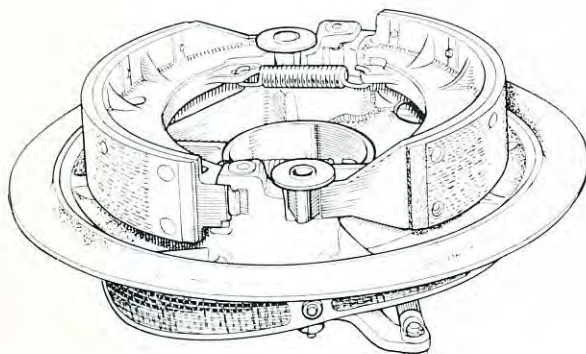


FIG. F2. *Front brake.*

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.

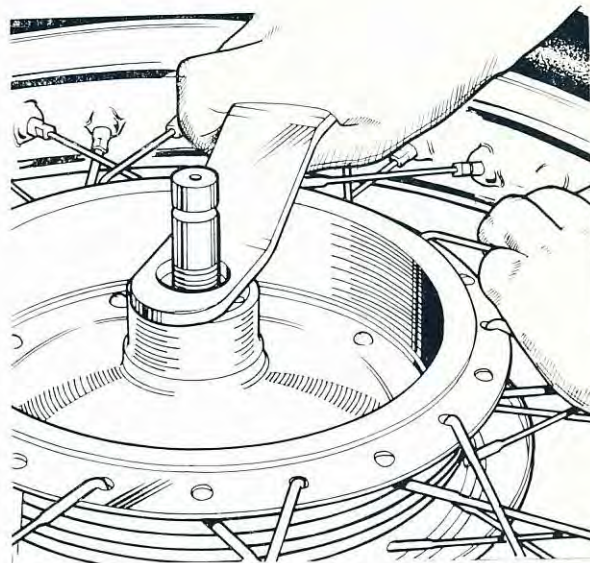


FIG. F3. *Removing locking ring.*

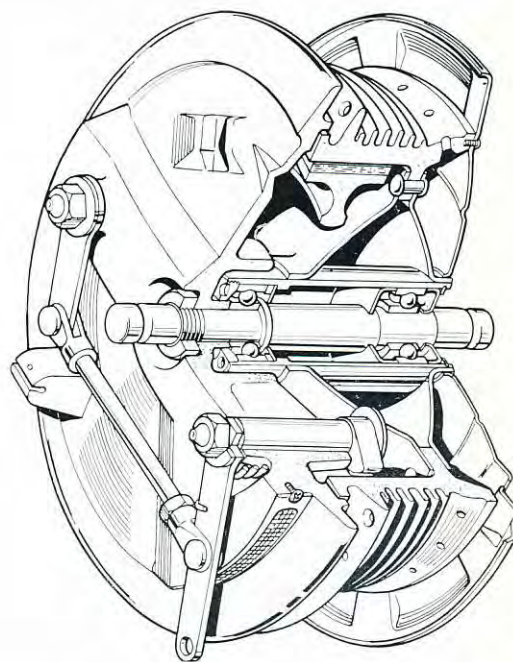


FIG. F4. *Front hub (cut away).*

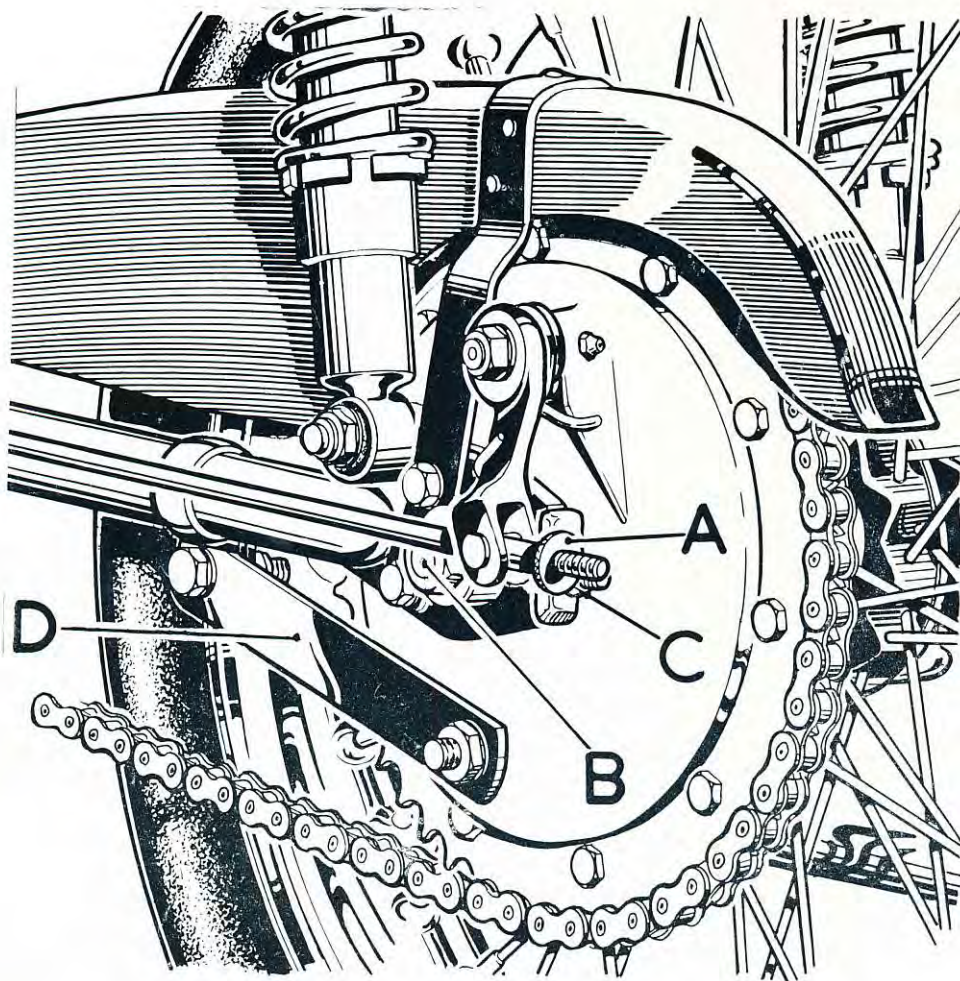


FIG. F5. Rear brake plate assembly.

REAR WHEEL

Rear wheel removal and replacement

Removal of the rear wheel does not affect the chain or brake adjustments.

Detach the speedometer drive cable then unscrew and withdraw the wheel spindle (D) Fig. F6, using a suitable steel bar through the head. It has a normal right-hand thread and is therefore unscrewed in an anti-clockwise direction.

The outer collar (E) should fall clear on removal of the spindle and the wheel can then be

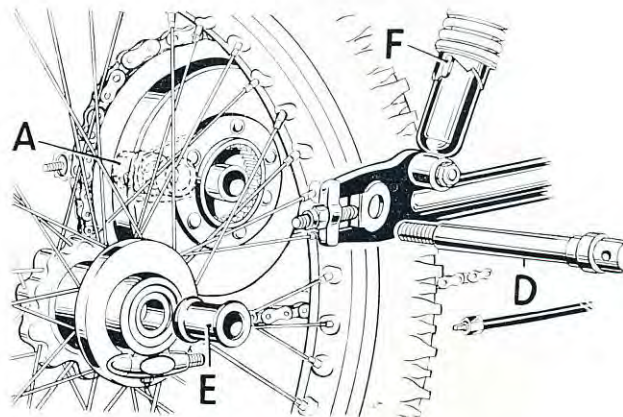


FIG. F6. Removal of rear wheel.

pulled away from the brake drum and withdrawn from the machine.

The speedometer drive unit can now be pulled away from the hub, and the end cover unscrewed.

It will not be necessary to disturb the wheel nut (A) on the left-hand side, as this retains the brake drum assembly.

Replace in the reverse manner but do not omit to refit the spindle outer collar.

Wheel hub bearings

The hub is fitted with two identical single-seal bearings which are a light press-fit on to the hollow spindle in the hub shell. The brake drum bearing is the same size as the hub bearings, but has a double oil seal.

To remove the bearings, first unscrew the bearing retainer on the left-hand side; this has a left-hand thread and is unscrewed in a clockwise direction.

Using a drift slightly under .875" diameter, drive out the hollow spindle from the left-hand side, releasing the right-hand bearing, inner collar and washers from the right-hand side.

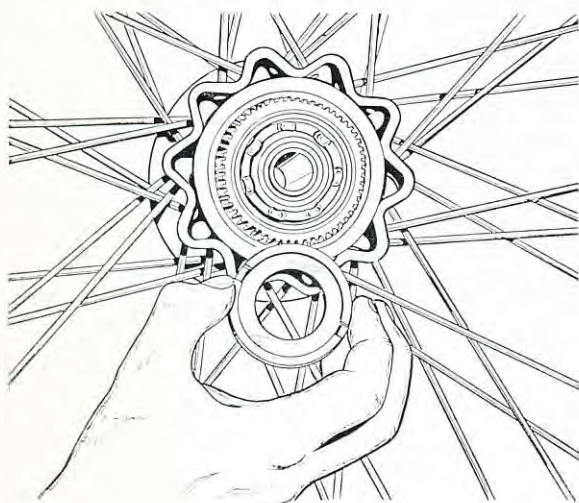


FIG. F7. *Bearing retainer.*

The left-hand bearing and its thrust washer can now be driven out from the right-hand side.

The rubber oil seal for the left-hand bearing need not be disturbed and may be left in the hub.

To examine the bearings, wash thoroughly in paraffin and if possible, blow out with a high-pressure air line. Examine each bearing carefully for signs of roughness indicating broken balls or damaged tracks, or excessive play.

Reassembly of the hub is simply the reverse of the dismantling procedure but, when pressing the bearings in, apply pressure only to the outside ring of the bearing and ensure that the retainer on the left-hand side is quite tight.

Note that the hollow spindle is fitted with the short end on the left-hand side and also that the bearings are fitted with their oil seals outwards.

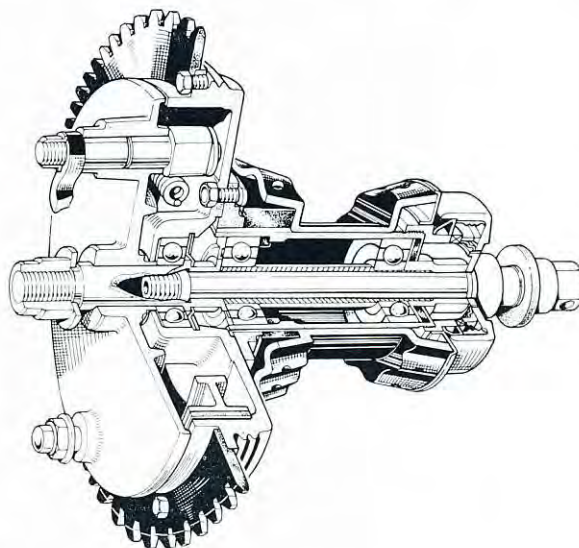


FIG. F8. *Section of rear hub.*

Rear brake drum and bearing

The brake drum is retained in the rear fork end by the spindle nut (B) and the self-locking nut securing the brake anchor strap (D) see Fig. F5, to the swinging arm lug.

To remove the drum, disconnect the rear chain at its spring link and unscrew the brake rod adjusting sleeve (A). Take off the spindle nut (B) and the anchor strap bolt, and withdraw the complete brake drum assembly.

The brake plate complete with brake shoes and springs, can now be lifted off the spindle.

There is no need to disturb the cam spindle unless it is to be replaced, in which case the position of the brake lever should be noted to assist in reassembly.

The brake shoes and springs can be removed in the usual way.

To remove the bearing, first drive out the spindle from the left-hand side and release the bearing circlip with steel washer. The bearing can now be driven out from the front of the drum using a suitable drift.

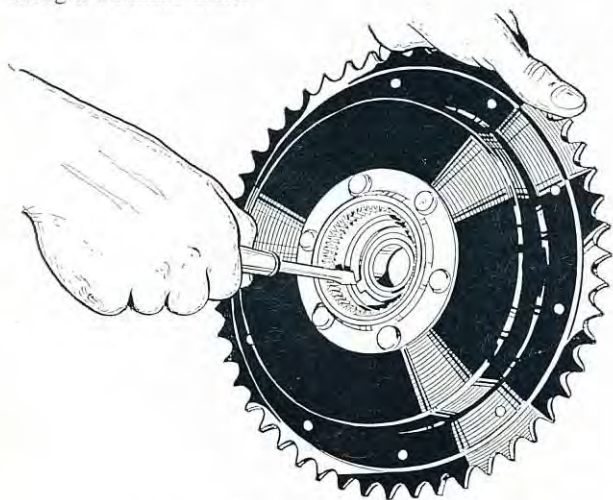


FIG. F9. Releasing bearing circlip.

Reassembly is the reverse of the dismantling procedure but, do not omit to replace the steel washer under the bearing circlip so that it seats on the outer ring of the bearing, not the inner ring.

It should not be necessary to disturb the driving flange unless it is known to be worn and is being replaced.

To remove the flange, flatten the locking plates, unscrew the six bolts and withdraw.

When fitting the new flange, see that it enters the drum squarely and that the mating surfaces are clean. Replace the six bolts and, after tightening the nuts evenly, turn the edges of the locking plates over.

If the chainwheel teeth are hooked or the inside of the brake drum is badly scored they should be replaced.

Brake drum replacement

See that the spindle is pressed well into the bearing and replace the cover plate complete with brake shoes etc. Place the assembly into the fork end, and fit the chain adjuster and nut (C), on to the spindle end (see Fig. F5). If the chain tension was correct, there will be no need to make any adjustment now. Do not tighten the spindle nut until the wheel has been replaced, so that the alignment can be made for the complete assembly.

See that the self-locking nut, securing the brake anchor strap to the swinging arm lug, is tightened securely.

BRAKE ADJUSTMENTS

The brakes must be adjusted to give maximum efficiency at all times and for this to be maintained, the shoes should be just clear of the drum when the brake is off, and close enough for immediate contact when the brake is applied. The brakes must not be adjusted so closely, however, that they are in continual contact with the drum; excessive heat may be generated, resulting in deterioration of braking efficiency.

The front brake adjuster is situated on the handlebar lever and rotation of the screwed locknut alters the effective length of the cable, so adjusting the position of the shoes in the drum.

The rear brake is adjusted by turning the self-locking sleeve in a clockwise direction (viewed from the rear of the machine), to shorten the effective length of the brake rod and so open the shoes in the drum.

Note that if maximum efficiency is to be obtained, the angle between the brake cable or rod and the operating lever on the brake plate should not exceed 90 degrees when the brake is fully applied.

Both front and rear brake operating levers have serrated cam holes, enabling them to be removed and replaced in a new position to give finer brake adjustment.

The rear brake shoes are of the fully-floating type (*i.e.*, they are not pivoted on a fulcrum) and are therefore self-centralising.

REAR CHAIN ADJUSTMENT

The rear chain must be adjusted when the wheel is at the lowest point of the suspension travel (when the wheel is raised clear of the ground).

Rotate the wheel slowly until the tightest point on the chain is found, then check its up and down movement in the centre of the chain run. The total movement should be $1\frac{1}{8}$ " and if it varies from this setting, the chain must be adjusted by moving the rear wheel either forwards, to increase slackness or backwards, to reduce slackness. As chains invariably stretch periodic inspection and adjustment is essential.

To adjust the chain, first slacken the wheel spindle nuts, the nuts retaining the anchor strap and the brake rod adjusting sleeve. Tighten both chain adjuster nuts evenly until the correct chain setting is obtained.

After adjustment, tighten the wheel spindle and anchor strap nuts, recheck the setting of the chain and adjust the rear brake.

It is advisable to check the wheel alignment after any adjustment to the rear chain has been made; full details of this are given on page F9.

RENEWING BRAKE LININGS

Hold the shoe firmly in a vice and, using a good sharp chisel, cut off the peened-over portion of the rivet as shown below.

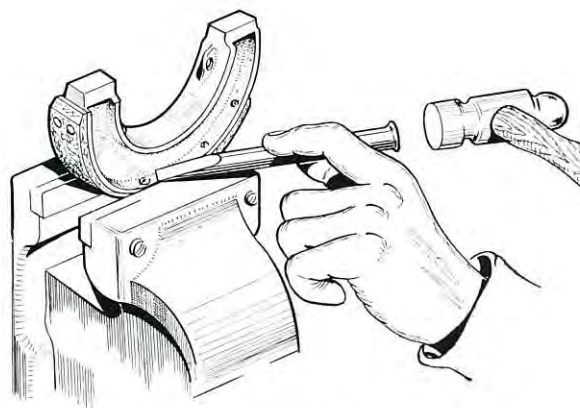


FIG. F10.

Drive out the rivets with a suitable pin punch and discard the old lining. Reverse the shoe in the vice and draw-file the face of the shoe to remove any burrs.

Clamp the new lining tightly over the shoe and, using the shoe holes as a jig, drill straight through the lining with a $5/32$ " diameter drill.

Remove the clamps and, holding the lining carefully in the vice, counterbore or countersink (according to the type of rivet used) each hole to no more than two-thirds the thickness of the

lining, *i.e.*, 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.

Place a suitable mandrel in the vice, clamp the linings to the shoes with either small "G" or tool-makers clamps and peen-over the rivets as shown in Fig. F11, working alternately outwards from the centre.

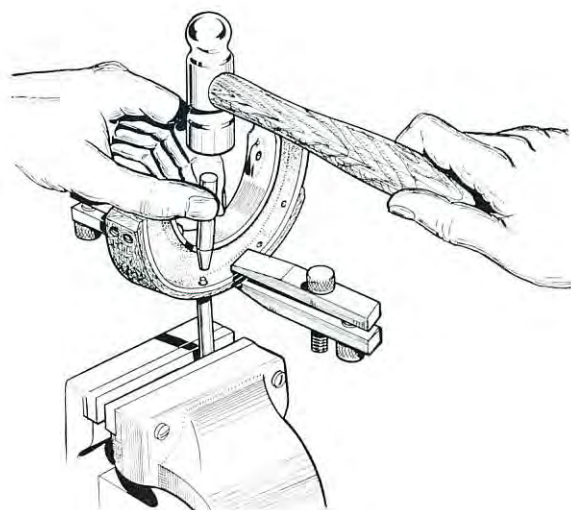


FIG. F11.

The mandrel used in the vice must be flat on the end and the diameter should be 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.

Note:—If the clamps are used correctly, that is, next to the rivet being worked on, the linings can be fitted tightly to the shoe.

If the linings are fitted incorrectly, a gap will occur between the lining and the shoe, resulting in inefficient and "spongy" braking.

When the riveting is completed, file a good chamfer at each end of the lining to approximately half its depth and lightly draw-file the face

of the lining to remove any fraze caused by the drilling.

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 truing 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, 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 it to stop on its own. Now mark the top of the wheel or tyre and repeat two or three times to check.

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 nipples and recheck until the wheel will stop in any position without moving.

Having ascertained how much weight is required, a balance weight of exactly the same amount must be attached to the spokes at the spot originally marked.

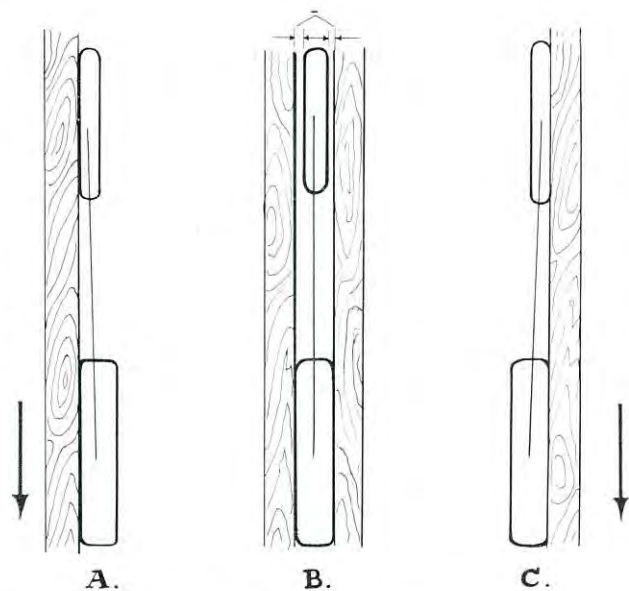


FIG. F13. *Checking alignment.*

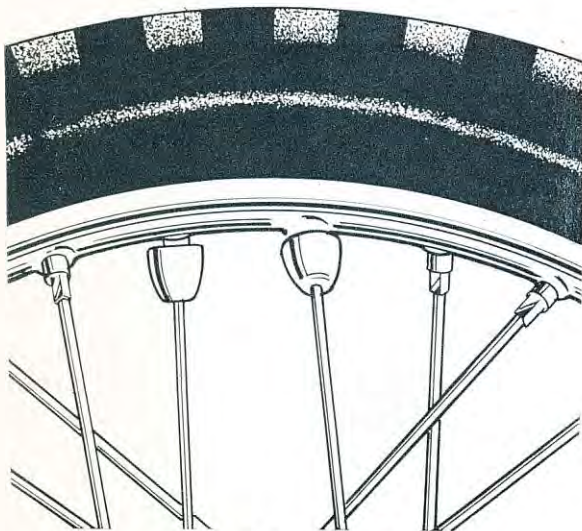


FIG. F12. *Balance weights.*

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. The adjustment will be necessary whenever the chain is adjusted or the wheel removed. It is also necessary to adjust the rear brake whenever realignment has been carried out.

To check the alignment of the wheels a straight-edge of timber or steel is required approximately 80" long.

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. F13.

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.



FIG. F14.

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 flanges without damage.
- (2) Removal and replacement will be simpler 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 of the rim.
- (3) The tyre beads will slip over the rim quicker and damage will be avoided if the beads and the 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.

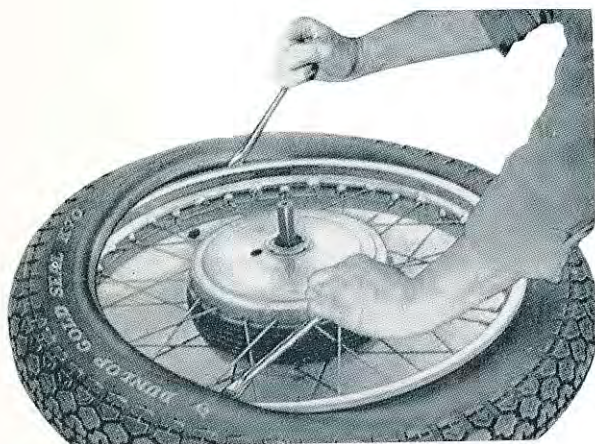


FIG. F15. *Removing the first bead.*

Press each bead off its seat into the well of the rim.

Insert the lever at the valve position, and while levering, press the bead into the well diametrically opposite the valve.

It will not be possible to pull the cover bead at (A) over the rim flange until the 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.



FIG. F16.

Insert a 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 to three inches until the bead is completely removed (see Fig. F15).

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. F16. 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.

TYRE REPLACEMENT

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 visible 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 petrol will help to clean the area, but it must be completely dry before solution is applied.

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 disturbed.

When there is a white spot near the tyre bead, it should be placed at the security bolt position on the rear wheel or at the valve position on the front wheel. This will ensure a high degree of tyre balance.

If the spokes have been tensioned, or replaced, see that they are not projecting through the nipples. File flush any that are showing through. Replace the rim tape with the rough side next to the rim.



FIG. F17.

Cover and tube assembled ready for fitting.

Fit 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" to 5" each side the valve as in Fig. F17.

Squeeze the beads together at the valve to prevent the tube slipping back and offer the cover to the rim as shown in Fig. F18, at the same time passing the valve through the holes in the tape and rim.

Allow the lower bead to go into the well of the rim and the upper bead to be above the rim flange.

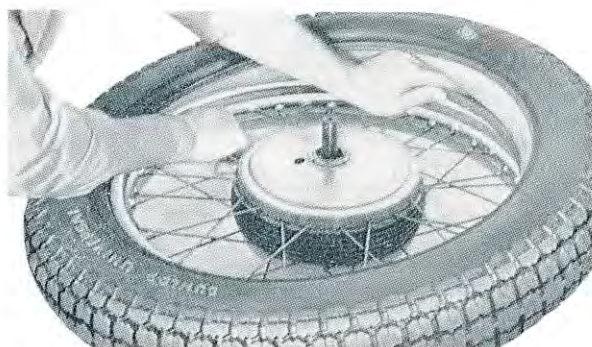
FIG. F18. *Commencing to fit the tyre.*

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. F19). If necessary use a tyre lever for the last few inches as in Fig. F20.

Turn the wheel over and check that the bead is concentric with the rim before proceeding further.

Reverse the wheel again and press the upper bead into the well of the rim diametrically opposite 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 a fitted portion into the well of the rim.

FIG. F19. *Fitting the first bead.*

Repeat progressively round the tyre until the bead is completely over the flange, finishing at the valve (see Fig. F21).

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. Also ensure that the tube is resting on the flap of the security bolt and is over-lapping the sides (rear wheel only).

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 bounce the wheel to help seat the tyre but, see that there is adequate pressure to



FIG. F20.

Completing the fitting of the first bead.

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 reinflate.

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.



FIG. F21.

Completing the fitting of the second bead.

See that the valve protrudes squarely through the valve hole before screwing down the knurled nut and finally, replace the dust cap.

TYRE PRESSURES

The recommended inflation pressures of 17 lb. (front tyre) and 17 lb. (rear tyre) are based on a rider's weight of 140 lb. If the rider's weight exceeds 140 lb. the tyre pressure should be increased as follows:—

Front Tyre

Add 1 lb. per square inch for every 28 lb. in excess of 140 lb.

Rear Tyre

Add 1 lb. per square inch for every 14 lb. in excess of 140 lb.

It is further recommended that when carrying a pillion passenger or equipment giving additional weight, the inflation pressures should be increased in relation to the actual load on each tyre, as indicated in the chart below. To find the load on each tyre, place the front and rear wheel in turn, on to a weighbridge. The reading should be taken when the rider is seated on the machine together with the additional weights.

| | Inflation pressures (lb. per sq. in.) | | | | | |
|-------|---------------------------------------|-----|-----|-----|-----|-----|
| | 16 | 18 | 20 | 24 | 28 | 32 |
| | Load per tyre (lb.) | | | | | |
| Front | 200 | 230 | 260 | 320 | 380 | 440 |
| Rear | 280 | 310 | 335 | 390 | 450 | 500 |

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INTRODUCTION

The electrical system is supplied from an A.C. generator, model RM19, contained in the primary chaincase and driven from the engine shaft.

A Zener diode is connected in circuit to control the battery charging current and thereby prevents over-charging.

The current supplied to the ignition system is interrupted by a contact breaker, driven direct from the camshaft.

Routine maintenance needed by the various components is detailed in the following sections. Whilst checking the electrical system, opportunity should be taken to ensure that all wiring connections and frame earthing points are clean and secure.

ALTERNATOR

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

There are no rotating windings, commutator, brushgear, bearings or oil seals and consequently the alternator requires no maintenance apart from occasionally checking that the snap connectors in the output cables are clean and tight.

If rotor removal is necessary, there is no need to fit magnetic keepers to the rotor poles. Wipe off any swarf which may have been attracted to the pole tips and put the rotor in a clean place until required for refitting.

BATTERY INSPECTION AND MAINTENANCE

Description

The container for the model PUZ5A battery is moulded in transparent material through which the acid can be seen. The tops of the containers are so designed that when the covers are 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. Polythene tubing may be attached to the vent pipe to lead the corrosive fumes away from any parts of the machine where they might cause damage.

PART "A"

Charging the battery

Whilst the battery leaves the factory in the fully "dry-charged" condition, it may require a pre-service charge after being taken from storage. Therefore the following filling instructions must be carefully observed.

With the acid, battery and room temperature between 60°F., and 100°F. (15.5—37.7°C.), remove the vent plugs and fill each cell to the coloured marker line.

Measure the temperature and specific gravity of the electrolyte in each of the cells.

Allow to stand for one hour and then re-check the temperature and specific gravity of the electrolyte in each cell and adjust the levels.

The battery is then ready for service unless the above checks show the electrolyte temperature to have risen by more than 10°F. (5.5°C.) or the specific gravity to have fallen by more than ten "points", *i.e.*, by more than 0.010 specific gravity. In this event, it will be necessary to re-charge the battery at the appropriate charge rate (1.0 ampere) until the specific gravity values remain constant for three successive hourly readings and all cells are gassing freely.

Before charging, keep the electrolyte in each cell level with the coloured marker line by adding distilled water—**not** acid.

PART "B"

Routine maintenance

Every 1,000 miles (1,610 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, or with a silicone grease.

The level of the electrolyte in each cell should be checked weekly or every 250 miles. 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 above 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 opposite. If a battery is suspected to be faulty it is advisable to have it checked by a Lucas depot or agent.

A lead/acid battery slowly loses its charge whilst standing—the rate of loss being greater in hot climates. If a battery is not being used, it is important to give it freshening charges at the appropriate re-charge rate. These should be given fortnightly in temperate climates and weekly in the tropics.

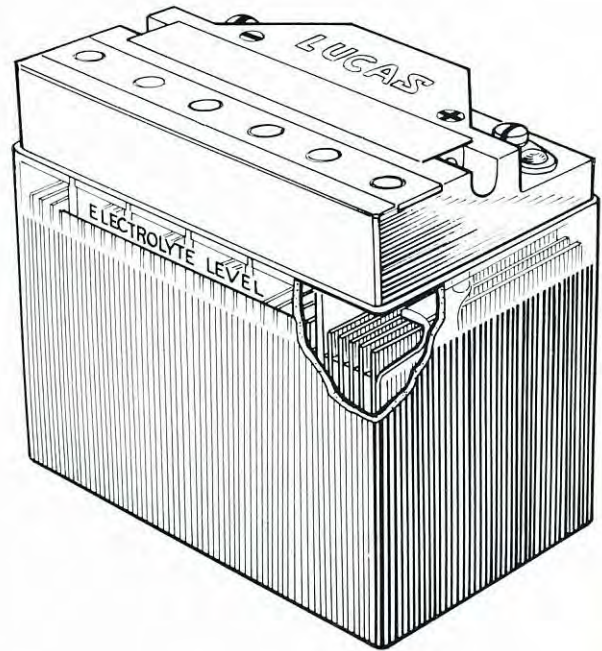


FIG. G1. The PUZ5A battery.

PART "C"

Specific gravity of electrolyte for filling the battery

| U.K. and climates normally below 80°F. (26.6°C.) | | Tropical climates over 80°F. (26.6°C.) | |
|--|---------------|--|---------------|
| Filling | Fully charged | Filling | Fully charged |
| 1.260 | 1.270—1.290 | 1.210 | 1.210—1.230 |

To obtain a specific gravity strength of 1.260 at 60°F. (15.5°C.), add one part by volume of 1.840 specific gravity acid to 3.2 parts of distilled water.

To obtain a specific gravity strength of 1.210 at 60°F. (15.5°C.), add one part by volume of 1.840 specific gravity acid to 4.3 parts of distilled water.

PART "D"**Maximum permissible electrolyte temperature during charge**

| | |
|--|--|
| Climates normally below 80°F. (26.6°C.) | Climates frequently above 80°F. (26.6°C.) |
| 100°F. (38°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 .002 from the observed reading to obtain the true specific gravity at 60°F. For every 5°F. above 60°F., add .002 to the observed reading to obtain the true specific gravity at 60°F.

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

COIL IGNITION SYSTEM**Description**

The coil ignition system comprises an ignition coil, mounted below the petrol tank, and a contact breaker unit fitted in the timing cover. Apart from cleaning in-between the terminals, and checking the connections for soundness, the coil will not require any other attention. Testing the ignition coil is amply covered in Part "C", page G5, whilst testing the contact breaker is detailed in Part "D".

The best method of approach to a faulty ignition system is to first check the low-tension circuit for continuity as shown in Part "A", then follow the procedure laid out in Part "B" to locate the fault(s).

Failure to locate a fault in the low-tension circuit indicates that the high-tension circuit or sparking plug is faulty, and the procedure detailed in Part "E" must be adopted. Before commencing any of the following tests, however, the contact breaker and sparking plug gaps must be cleaned and adjusted to eliminate this possible source of fault.

PART "A"**Checking the low-tension circuit for continuity**

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

First inspect the in-line fuse in the battery supply cable and replace if suspect.

Turn the ignition on and slowly crank the engine. At the same time, observe the ammeter needle, which should fluctuate between zero and a slight discharge, as the contact breaker points open and close respectively.

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 points for pitting, pilling or presence of oxidation, oil or dirt, etc. Clean and ensure that the gap is set correctly to .015" (.381 mm.) as described on page B21.

PART "B"**Fault-finding in the low-tension circuit**

To trace a fault in the low-tension wiring, turn on the ignition switch and crank the engine until the contacts are opened, or alternatively, place a piece of insulating material between the contacts whilst the following test is carried out.

For this test it is assumed that the wiring is fully connected as shown in the wiring diagram, page G17. With the aid of a 0—15 volt 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 coil, stage by stage, in the following manner, referring to the relevant wiring diagram.

- (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.
- (2) Connect the voltmeter between both the ammeter terminals in turn and earth. No reading on the battery side indicates that the fuse has blown or there is a bad connection along the brown and blue lead from the battery, and no reading on the load side indicates a faulty ammeter.
- (3) With the voltmeter between the ignition switch “feed” terminal and earth. No reading indicates a fault in the brown and white lead. Connect the voltmeter to the “load” side of the switch and turn key to “on” position. No reading indicates a faulty switch.
- (4) Connect the voltmeter between ignition coil (—) terminal and earth. No reading indicates a breakdown between the battery and the coil (—) terminal, possibly due to an “open circuit” (broken or disconnected) white lead.
- (5) With the contact points open connect the voltmeter across the (+) terminal of the coil and earth. No reading on the voltmeter indicates that the coil primary winding is faulty and a replacement ignition coil should be fitted.
- (6) Connect the voltmeter across the contact points. No reading indicates that there is

either a fault in the lead from the coil (+) terminal and contact breaker unit, or the internal insulation has broken down in the contact breaker capacitor. If the capacitor is suspected, then a substitution should be made and a retest carried out.

PART “C”

Ignition coil

The ignition coil consists of a primary and secondary winding, wound concentrically about a laminated soft iron core, the secondary winding being next to the core.

The primary and secondary windings of the coil have 280—372 turns and 19,000 turns respectively of enamel-covered wire, the secondary being much finer. Each layer is paper insulated from the next on both primary and secondary windings.

To test the ignition coil on the machine, first ensure that the low-tension circuit is in order as described in Part “A”, then disconnect the high-tension lead from the sparking plug. Turn the ignition switch to the IGN position and crank the engine until the contacts are closed.

Flick the contact breaker lever open a number of times whilst the high-tension lead from the ignition coil 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.

Before a fault can be attributed to the ignition coil it must be ascertained that the high-tension cable is 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 coil and test it by the method described below.

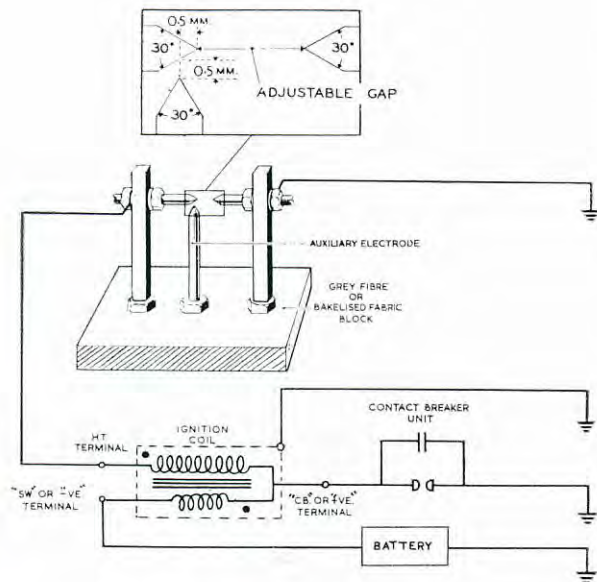


FIG. G2. Ignition coil test rig.

Bench testing ignition coil

Connect the ignition coil into the circuit shown in Fig. G2, and set the adjustable gap to 9 mm. Using a single-lobe contact breaker (160 degree closed period) running at 600 revs per minute, not more than 5 per cent missing should occur at the spark gap over a period of fifteen seconds. The primary winding can be checked for short-circuit coils by connecting an ohmmeter across the low-tension terminals. The reading obtained for the 17M12 coil should be within the figures quoted below (at 20°C.).

| Primary resistance | |
|--------------------|----------|
| minimum | maximum |
| 3.3 ohms | 3.8 ohms |

PART "D"

Contact breaker

Faults occurring at the contact breaker are in the main due to, incorrect adjustments of the con-

tacts 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 B21.

To test for a faulty capacitor, first switch on the ignition, then take voltage readings across the contacts when 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 A9. When lubricating the parts ensure that no oil or grease gets on to the contacts, or cam centre spindle.

If it is felt that the contacts require surface grinding then the complete contact breaker unit should be removed as described on page B21, and the moving contact disconnected by unscrewing the securing nut from the terminal. 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 (gasolene) 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 refitting the moving contact do not forget to refit the insulating shield to the terminal and apply a smear of grease to the contact breaker cam and moving contact pivot post. Lubricate the felt pad with two drops of light engine oil when required.

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 coil as described in Part "C". If the coil proves satisfactory, ensure that the high-tension cable is 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 on page G8 and then reset the engine for running performance. If the fault re-occurs then it is likely that the suppressor cap is faulty and should be renewed.

SPARKING PLUG

It is recommended that the sparking plug be inspected, cleaned and tested every 2,000 miles (3,200 km.) and a new one fitted every 10,000 miles (16,000 km.).

To remove the sparking plug a box spanner (13/16", 19.5 mm. across flats) should be used and if any difficulty is encountered a small amount of penetrating oil should be placed at the base of the sparking plug and time allowed for penetration.

Examine the plug for signs of petrol (gasolene) 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 faulty contact breaker, coil or condenser defects, or a broken or worn out cable may be additional causes.

Examine the 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 bore is worn.

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 electrode is indicated by severely eroded electrode and a white, burned or blistered insulator. This type of fault can be caused by weak carburation or over-advanced ignition timing 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. To achieve a good seal between the plug and cylinder head, screw the plug in by hand on to its gasket, then lightly tighten with a box-spanner.

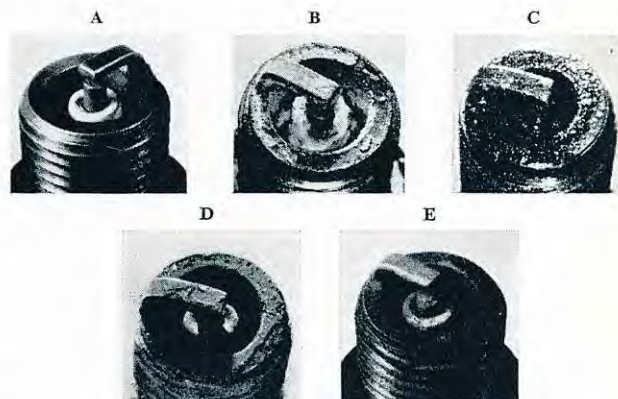


FIG. G3. *Sparking plug diagnosis.*

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 its 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 in need of replacement.

To clean the plug it is preferable to make use of a properly designed proprietary plug cleaner. The makers instructions for using the cleaner should be followed carefully.

When the plug has been carefully cleaned, examine the central insulator for cracking and the centre electrode for excessive wear. In such cases the plug will have completed its useful life and a new one should be fitted.

Finally, the sparking plug electrode should be adjusted to the correct gap setting of $\cdot 025$ " ($\cdot 635$ mm.). Before refitting sparking plug 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 plug has 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 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 plug quoted in General Data is 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.

CHARGING SYSTEM

Description

The alternator gives "maximum" output with the lighting switch in all switch positions, the coils being permanently connected across the rectifier.

Excessive charge is absorbed by the Zener diode which is connected in parallel with the battery.

Always ensure that the ignition switch is in the "off" position whilst the machine is not in use.

Proceed to test the alternator as described in Part "A". If the alternator is satisfactory, the fault must lie in the charging circuit, hence the rectifier must be checked as given in Part "B" and then the wiring and connections as shown in Part "C."

PART "A"

Checking the alternator output

Disconnect the two lead alternator output cables and run the engine at 3,000 revs per minute.

An A.C. voltmeter (0—15 volts) with a 1 ohm load resistor in parallel is required for this test.

A suitable 1 ohm load resistor can be made from a piece of Nichrome wire as shown in Part "D", page G11.

The test is conducted by connecting a voltmeter and the 1 ohm load resistor between the following cables and note the readings.

The test procedure is as follows:—

Disconnect the two alternator leads, then connect the voltmeter with 1 ohm load resistor between the white/green and green/yellow cables, and with the engine running at 3,000 revs per minute the voltmeter should read 9.0 volts minimum.

From the results obtained, the following deductions can be made.

- (1) If the reading is equal to or higher than those quoted then the alternator is satisfactory.
- (2) A low reading indicates either that the leads concerned are chafed or damaged due to running on the chains or that some turns of the coils are short-circuited.

- (3) A low reading would also occur if the rotor had become partially demagnetised. As this is an extremely rare occurrence it is advisable to check by substitution before returning the rotor to the manufacturer for remagnetisation. If it is found that the rotor has become demagnetised, check that it has not caused by a faulty rectifier and that the battery is of correct polarity
- (4) A zero reading indicates that a coil has become disconnected, is open-circuit, or is earthed
- (5) A reading obtained between green/yellow 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 renewing the stator.

PART "B"

Rectifier maintenance and testing

The rectifier is a silicon semi-conductor device which allows current to flow in one direction only. It is connected to provide full-wave rectification of alternator output current.

The rectifier requires no maintenance beyond checking that the connections are clean and tight. The nuts clamping the rectifier plates together must not under any circumstances be slackened. A separate nut is used to secure the rectifier to the back of the toolbox and it is important to check periodically that the rectifier is firmly attached.

When tightening the rectifier securing nut, hold the spanner as shown in Fig. G4, for if the plates are twisted, the internal connections will be broken. Note the circles marked on the fixing bolt and nut indicating that the thread form is Unified Fine.

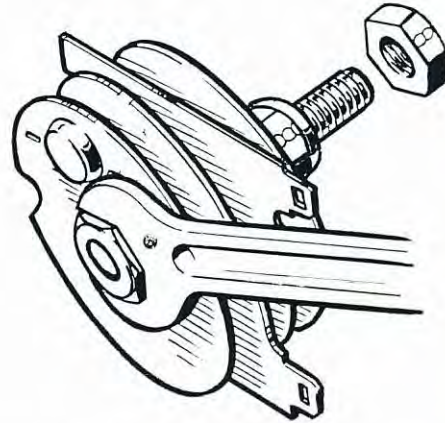


FIG. G4. Refitting the rectifier.

Testing the rectifier

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.

Ensure that all the temporary connections are well insulated to prevent a short-circuit occurring then turn the ignition switch to IGN position and start the engine.

With the engine running at approximately 3,000 revs per minute 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.

All the above conclusions are made with the assumption 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 fully charged 12 volt battery of approximately 40 ampere/hours capacity at the 10 hour rate, and 1 ohm load resistor, and then connect the D.C. voltmeter in the V2 position, as shown in Fig. G6.

Note the battery voltage (should be 12 volt) and then connect the voltmeter in V1 position whilst the following tests are conducted.

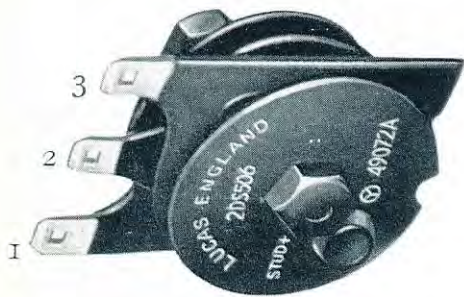


FIG. G5. The rectifier showing terminal connections.

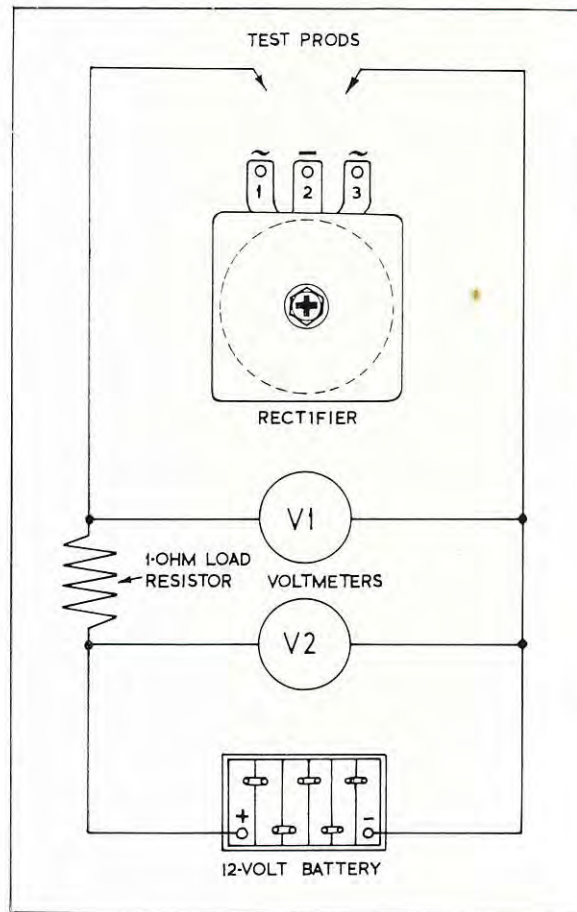


FIG. G6. Bench testing the rectifier.

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.

In Fig. G7, the rectifier terminal markings 1, 2 and 3 are as shown physically in Figs. G5 and G6, while terminal 4 represents the rectifier centre bolt. One and 3 are the A.C. input terminals while 2 and 4 are the D.C. output terminals (—ve and —ve respectively).

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

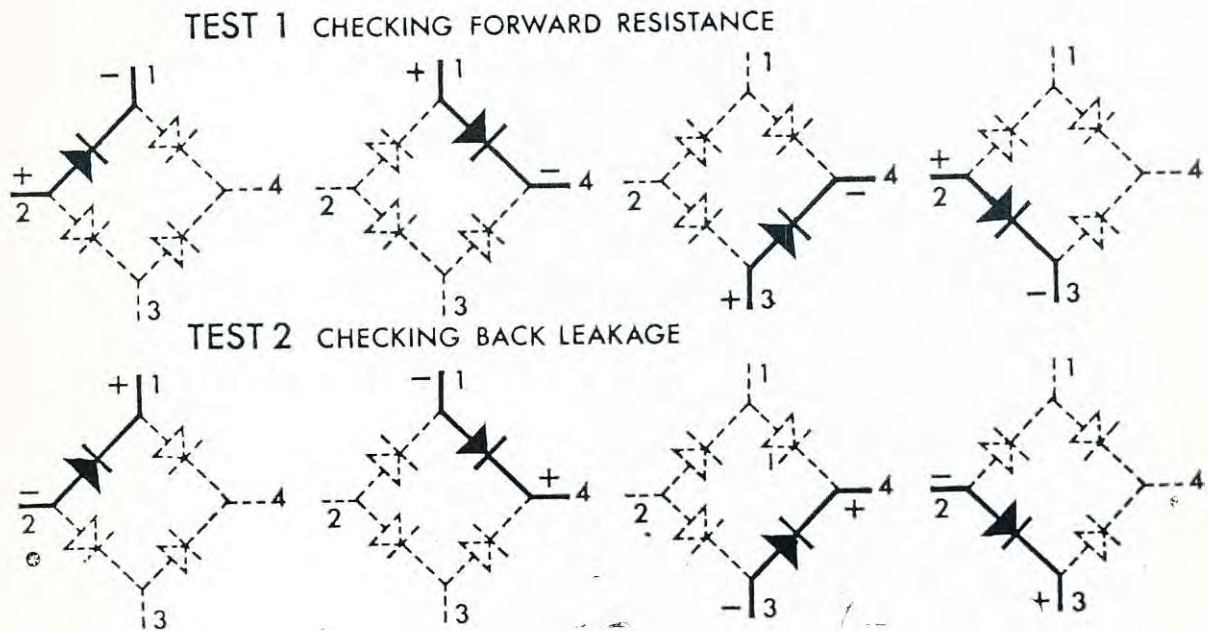


FIG. G7. Rectifier test sequence.

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 reading obtained should not be more than 1.5 volts below battery voltage (V2) *i.e.*, 10.5 volts minimum.

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

PART "C"

Checking the charging circuit for continuity

This test utilises the machine's own battery to test for continuity or breakdown in the D.C. section of the charging system.

The battery must be in a good state of charge and the alternator leads must be disconnected at the snap connectors so that there is no possibility of demagnetising the rotor.

First, check that there is voltage at the rectifier centre terminal by connecting a D.C. voltmeter, with 1 ohm load resistor in parallel, between the rectifier centre terminal and earth, remember (+ve) positive earth (ground). The voltmeter should read battery volts. If it does not, there is a faulty connection in the wiring and test 1, 3 and 4 in Part "B", page G5, should be carried out to locate the fault.

PART "D"

Constructing a 1 ohm load resistor

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

A suitable resistor can be made from 4 yards (3.7 metres) of 18 standard wire gauge (.048" *i.e.*, 1.22 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 6 volt 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 which uses the coils of the alternator connected permanently across the rectifier, provides automatic control of the charging current. It will only operate successfully on a 12 volt system where it is connected in parallel with the battery as shown in the wiring diagram, page G17.

Assuming the battery is in a low state of charge its terminal voltage (the same voltage is across the diode) will also be low, therefore the maximum charging current will flow into the battery from the alternator. At first none of the current is by-passed by the diode because of it being non-conducting due to the low battery terminal volts. However, as the battery is quickly restored to a full state of charge, the system voltage rises until at 13.5 volts the Zener diode becomes partially conducting, thereby providing an alternative path for a small part of the charging current. Small increases in battery voltage result in large increases in Zener conductivity until, at approximately 15.5 volts about 5 amperes of the alter-

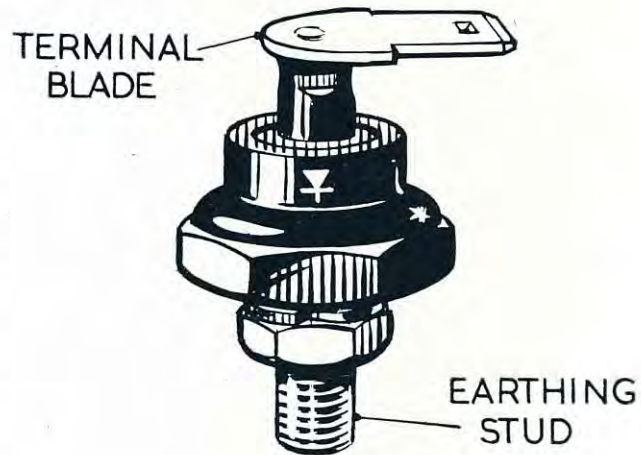


FIG. G8. Zener diode.

nator 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.

PART "A"

Maintenance

The Zener diode is mounted on a finned aluminium heat sink below the bottom yoke of the steering head. Providing the diode and the heat sink are kept clean, and provided with an adequate airflow, to ensure maximum efficiency, no maintenance will be necessary.

The "earthing" stud which secures the diode to the heat sink, must not be subjected to a tightening torque greater than 24—28 lb./in. The earth wire must be fitted under the fixing nut, **not** between the diode and heat sink.

PART "B"

Checking performance of Zener diode

The following procedure enables the Zener diode to be tested on the machine. Only suitably calibrated first-grade moving coil instruments should be used.

Note:—It is essential that the battery is in good condition and in reasonably good state of charge. If the battery condition is uncertain, it should be temporarily replaced by a good battery for this test.

- (1) Withdraw the cable from the Zener diode terminal blade.
- (2) Connect a suitable ammeter between the end of the cable removed and the Zener diode terminal blade, using a suitable jumper lead. *N.B.*—The ammeter red or positive lead must be connected to the Zener diode.
- (3) Connect a suitable voltmeter between the Zener diode terminal blade and the heat sink. *N.B.*—The voltmeter red or positive lead must be connected to the heat sink.
- (4) Check that all lights are switched off.
- (5) Start the engine and gradually increase the speed while observing both meters:—
 - (a) When the voltage across the Zener diode reaches 12·75 volts, the Zener current ammeter must indicate zero.
 - (b) Increase engine speed until a Zener current of 2 amperes is indicated on the ammeter. At this value, a satisfactory Zener diode should cause a reading on the voltmeter of between 13·5 and 15·5 volts.
- (6) If the Zener current ammeter in test (a) registers any current at all before the Zener voltmeter indicates a voltage of 12·75 volts across the Zener, then a replacement Zener diode must be fitted.

If test (a) proves satisfactory but in test (b) a higher voltage than that stated is registered on the voltmeter, before the Zener current ammeter registers 2 amperes, then a replacement Zener diode must be fitted.

ELECTRIC HORN

Description

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

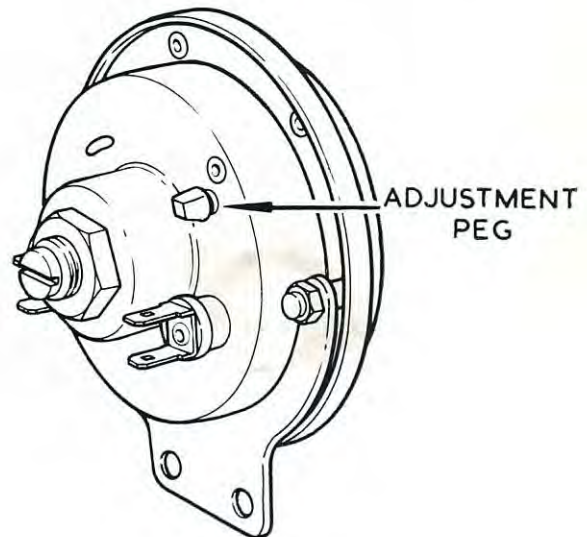


FIG. G9.

If the horn fails to work, check the mounting bolts etc., and horn connection wiring. Check the battery for state of charge. A low supply

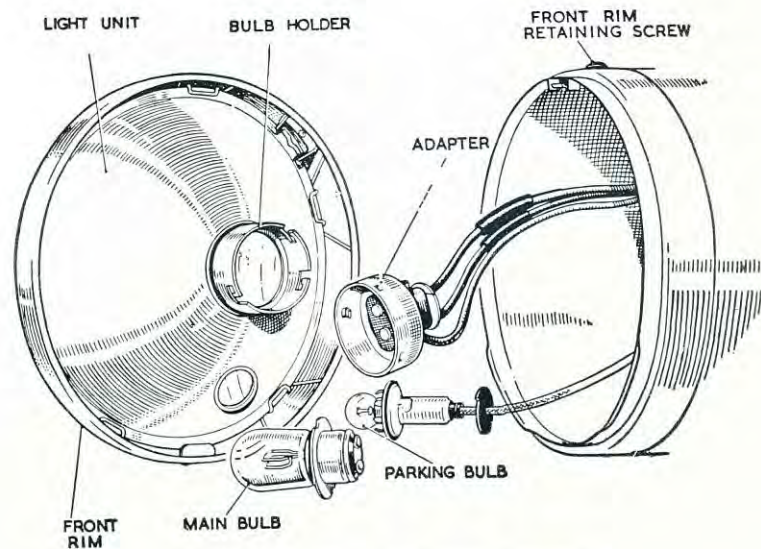


FIG. G.10. *Headlamp dismantled.*

voltage at the horn will adversely effect horn performance. If the above checks are made and the fault is not remedied, then adjust the horn as follows.

Horn adjustment

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

A small adjustment peg situated near the terminals (see Fig. G9) is provided to take up wear in the internal moving parts of the horn. To adjust, turn this peg anti-clockwise until the horn just fails to sound, and then turn it back (clockwise) about one-quarter to half a turn.

HEADLAMP

Description

The headlamp is of the pre-focus bulb light unit type and access is gained to the bulb and bulb holder by withdrawing the rim and light unit assembly. To do this slacken the screw at the top of the headlamp shell just behind and adjacent to the rim and prise off the rim and light unit assembly.

The bulb can be removed by first pressing the cylindrical adapter inwards and turning it anti-clockwise. The adapter can then be withdrawn and the bulb is free to be removed.

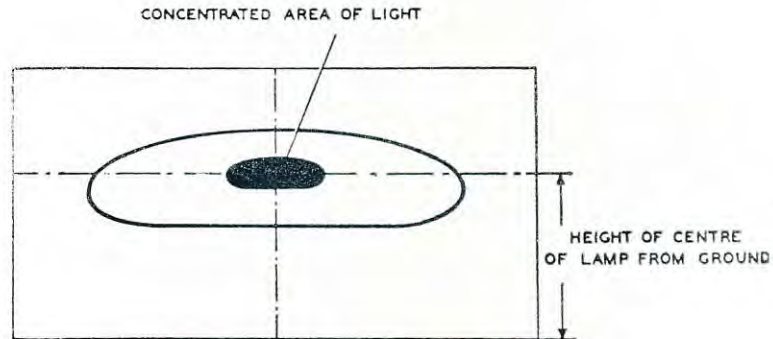
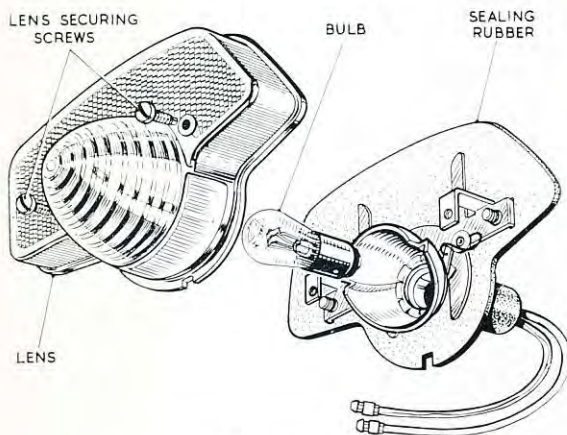
When fitting a new bulb, note that it locates by means of a cut-away and projection arrangement. Also note that the adapter can only be replaced one way, the tabs being staggered to prevent incorrect reassembly. Check the replacement bulb voltage and wattage specification and type before fitting.

Focusing with this type of unit is unnecessary and there is no provision for such.

Beam adjustment

When the motor-cycle carries its normal load, the headlamp full-beam should project straight ahead and parallel with the road surface.

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 headlamp fixing bolts at either side and tilt the beam unit until the beam is focused as indicated in Fig. G11. Do not forget that the headlamp should be on "full-

FIG. G11. *Beam adjustment.*FIG. G12.
Stop and tail lamp dismantled.

beam" lighting during this operation. Tighten the bolts fully after adjustment.

TAIL AND STOP LAMP UNIT

Access to the bulb 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.

OTHER LIGHT UNITS

The headlamp shell contains the ignition warning light and the parking light, access being gained to each of them by first removing the rim and light unit assembly.

The speedometer light is housed within the base of the speedometer head.

Each bulb holder is a push-fit into its respective component, and the bulbs are located by means of a peg arrangement, except for the speedometer light which has a screw-type bulb.

ALTERNATOR—ADDITIONAL INFORMATION

Specifications and output figures

| Stator number | System voltage | Alternator output minimum A.C. volts at 3,000 r.p.m. (with 1 ohm load) | | |
|---------------|----------------|--|-----|-----|
| | | A | B | C |
| 47204 | 12 volt | 4·0 | 6·5 | 8·5 |

A—White/green and green/black.

B—White/green and green/yellow.

C—White/green and green/black—green/yellow connected.

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PRIMARY CHAIN:

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| Chain and sprocket inspection | H3 |

PRIMARY CHAIN

An early indication that the primary 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, this could be caused by a leaky primary chain gasket or the fact that the oil seal at the back of the clutch is faulty, in both cases replacements should be carried out.

Rear chain (lubrication)

Periodically, the chain should be removed, washed in paraffin and, after allowing the paraffin to dry off, immersed in grease lubricant which has been heated in a container until liquid. After about ten minutes' immersion, during which the chain is moved about with a stick to "work" the joints and ensure penetration of the lubricant, the latter is allowed to cool with the chain in it. After cooling, the chain is removed and the surplus grease wiped off. The chain can then be refitted to the machine after cleaning the sprockets. It should be noted that not all greases are suitable for heating to thinness without deterioration and when purchasing, the purpose for which the lubricant is required should be stated, as special types are marketed for the job. As an alternative to grease a heavy oil of S.A.E. 140 grade may be used.

Rear chain adjustment—(See page F7).

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 $\frac{1}{4}$ " per foot of chain length is accommodated by the depth of hardening of the bearing surfaces, and when this limit is reached the chain should be replaced.

With a new $\frac{5}{8}$ " pitch chain, sixteen pitches will come to the 10" mark on the rule, and a sufficiently accurate check for subsequent wear is to take a limit of $10\frac{7}{32}$ " for sixteen pitches. For a $\frac{3}{8}$ " pitch chain, twenty-four pitches of a new chain will come to the 9" mark on the rule, and the limit of $9\frac{3}{16}$ " for twenty-four pitches should be taken as the maximum permissible wear for this size of chain.

Naturally, the test should be made carefully to obtain an accurate result. The chain is first washed in paraffin 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 measuring between the centres of the bearing pins.

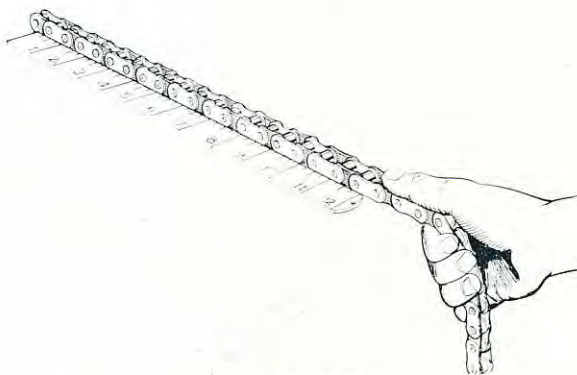


FIG. H1.

It is important to note that the closed end of the spring clip must point in the direction of chain travel.

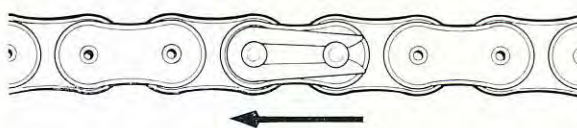


FIG. H2.

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.

Chain alterations and renewals

To **shorten** a chain containing **an even number of pitches**: remove the shaded parts shown in Fig. H3A, replace by cranked double link and single connecting link, parts shaded in Fig. H3B.

To **shorten** a chain containing **an odd number of pitches**: remove the parts shown shaded in Fig. H3C, replace by single connecting link and inner link, parts shaded in Fig. H3D.

To **repair** a chain with a broken roller or inner link, remove the shaded parts shown in Fig. H3E, replace by two single connecting links and one inner link, parts shaded in Fig. H3F.

The illustrations show temporary repairs on the roadside; for permanent repairs, the parts should be replaced by a riveted outer link.

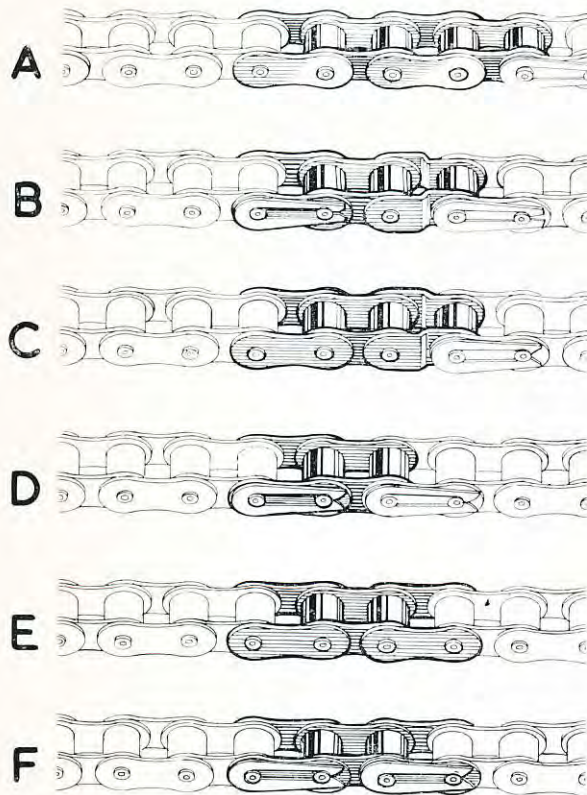


FIG. H3

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 detrimental. However, if one side shows considerably more wear than the other it indicates that the shafts are not parallel (as viewed from 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 possible that one sprocket is further out on its shaft than the other.

Sprockets which are excessively worn assume a "hooked" appearance, as shown in Fig. H4. 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



FIG. H4. *Worn sprocket.*

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.

Listed below are a number of nuts and bolts for which it has been found necessary to determine torque settings. It is most important that these settings are strictly adhered to. 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 Dia. and Form | T.p.i. | Hexagon A/F | Torque lb./ft. (kg./m.) |
|---------------------------------|-------------------------|--------|----------------|----------------------------|
| Carburettor flange nuts (SL) .. | 0.3125" B.S.C. | 26 | 0.525" | 10 (1.383) |
| Clutch centre nut | 0.50" B.S.C. | 20 | 0.820" | 60/65 (8.295-8.987) |
| Con-rod end cap nuts (SL) B25 | 0.3125" B.S.C. | 26 | 0.525" | 25/27 (3.456-3.733) |
| Crankpin nuts (B44) | 0.875" W.F. | 20 | 1.480" | 200 (27.65) |
| Crankshaft pinion nut | 0.625" B.S.F. | 20 | 0.919" | 35/40 (4.839-5.530) |
| Cylinder barrel nuts (B25) .. | 0.375" UN.F. | 24 | 0.558" | 26/28 (3.595-3.871) |
| Cylinder barrel nuts (B44) .. | 0.4375" UN.F. | 20 | 0.608" | 30/33 (4.148-4.562) |
| Cylinder head stud nuts | 0.3125" B.S.C. | 26 | 0.525" | 18/20 (2.489-2.765) |
| Fork leg cap nuts | 1.0625" UN.F. | 28 | 1.300" | 50/55 (6.913-7.604) |
| Fork leg pinch bolts | 0.3125" UN.F. | 24 | 0.500" | 18/20 (2.489-2.765) |
| Kickstart ratchet nut | 0.50" B.S.C. | 20 | 0.705" | 50/55 (6.913-7.604) |
| Oil pump stud nuts (SL) | 0.25" UN.F. | 28 | 0.436" | 5/7 (0.691-0.968) |
| Rotor fixing nut | 0.625" B.S.C. | 20 | 1.010" | 60 (8.295) |
| Valve cover nuts | 0.3125" B.S.C. | 26 | 0.525" | 10 (1.383) |
| Valve cover nuts | 0.25" B.S.C. | 26 | 0.440" | 5/7 (0.691-0.968) |

Abbreviations:—

A/F Across flats.

B.S.C. British standard cycle.

B.S.F. British standard fine.

SL Self-locking.

T.p.i. Threads per inch.

UN.F. Unified fine.

W.F. Whitworth form.

Torque wrench extensions

The torque figures listed above, indicate the load exerted at the end of a torque wrench. In some cases where space is restricted, the direct application of a torque wrench may be found impossible and a suitable extension or adaptor must be used.

When using an extension however, the wrench dial reading must be altered according to the following formula, in order to achieve the recommended torque load.

$$\text{Wrench dial reading} = \frac{\text{Recommended torque load} \times \text{length of torque wrench (in.)}}{\text{Length of torque wrench (in.)} + \text{length of extension (in.)}}$$

For Example:—To obtain a torque load of 30 lb./ft. when using a two-foot long wrench with a six inch extension, the dial reading would be calculated in the following manner:—

$$\begin{aligned} \text{wrench dial reading} &= \frac{30 \times 24}{24 + 6} \\ \text{therefore} &= 24 \text{ lb./ft.} \end{aligned}$$

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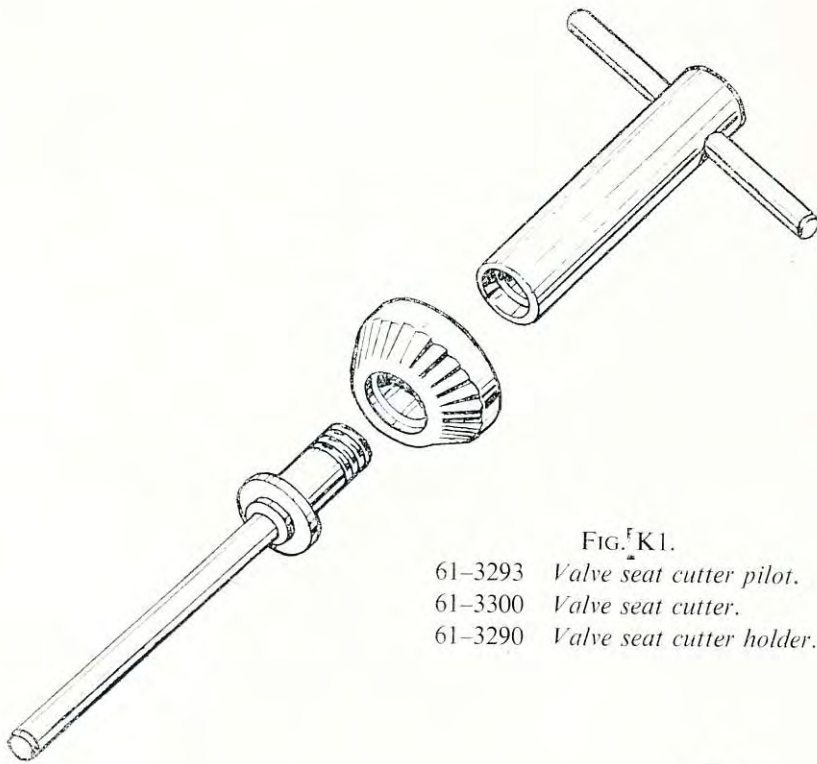


FIG. K1.

- 61-3293 *Valve seat cutter pilot.*
- 61-3300 *Valve seat cutter.*
- 61-3290 *Valve seat cutter holder.*

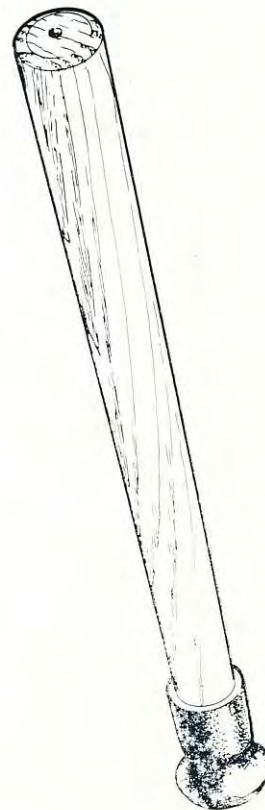


FIG. K2.

- 61-5035
Valve grinding tool.

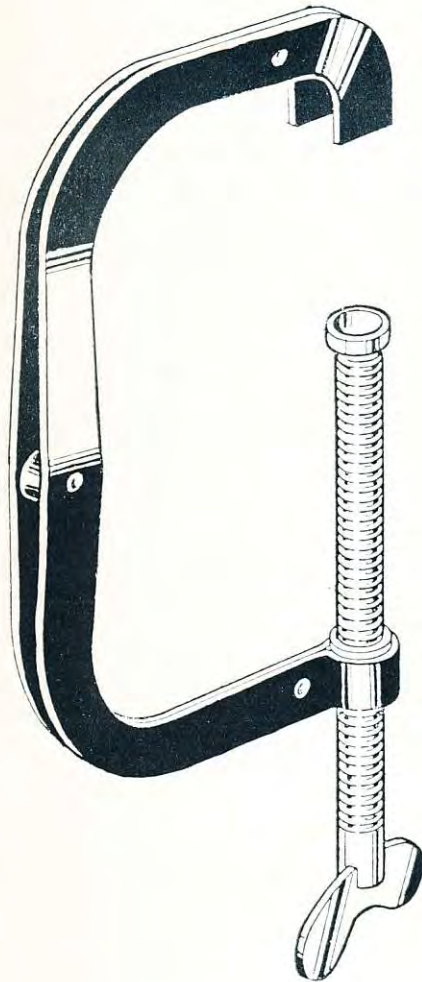


FIG. K3.
61-3341
Valve spring compressor.

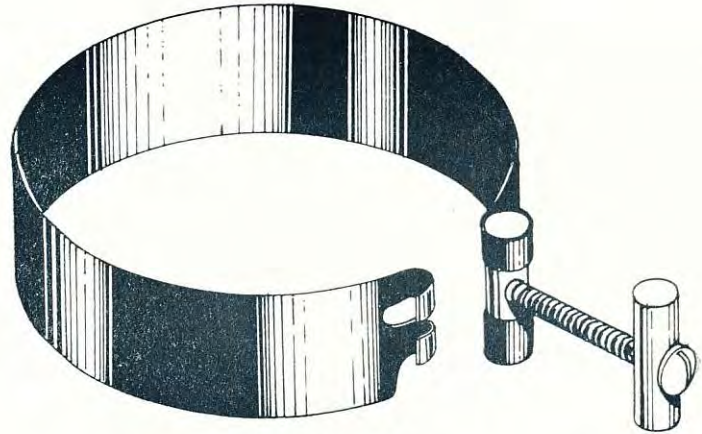


FIG. K4.
Piston ring slipper
(B44) 61-3707, 75-80 mm.
(B25) 61-3682, 65-70 mm.



FIG. K5.
61-3382
*Valve guide fitting and
extracting punch.*

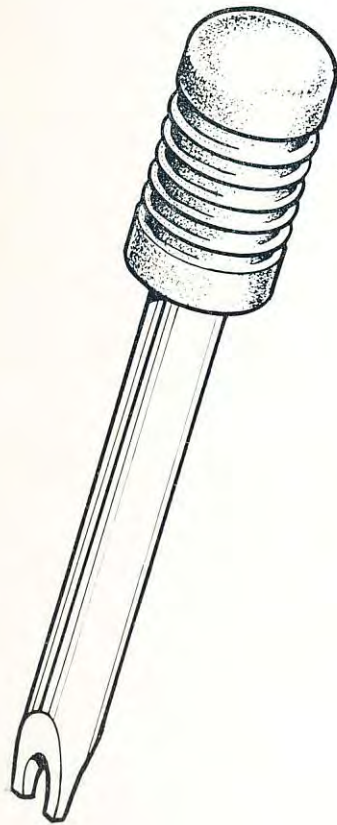


FIG. K9.
61-3700
Clutch nut screwdriver.

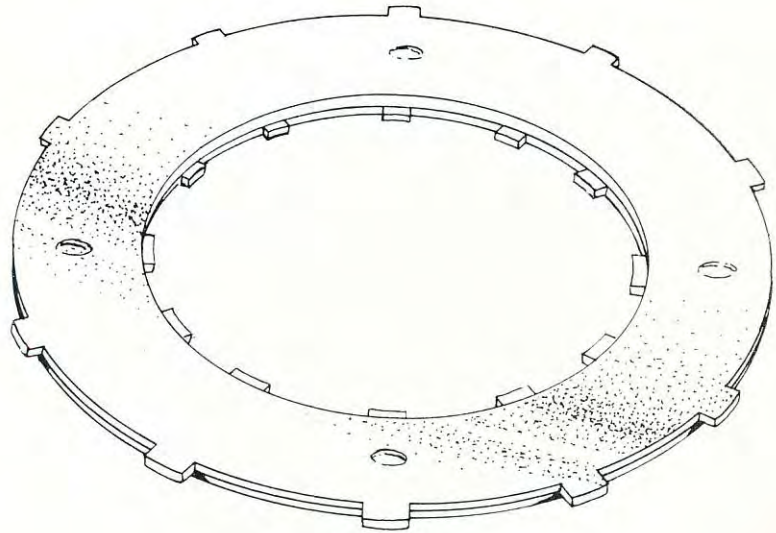


FIG. K10.
61-3774
Clutch locking tool.

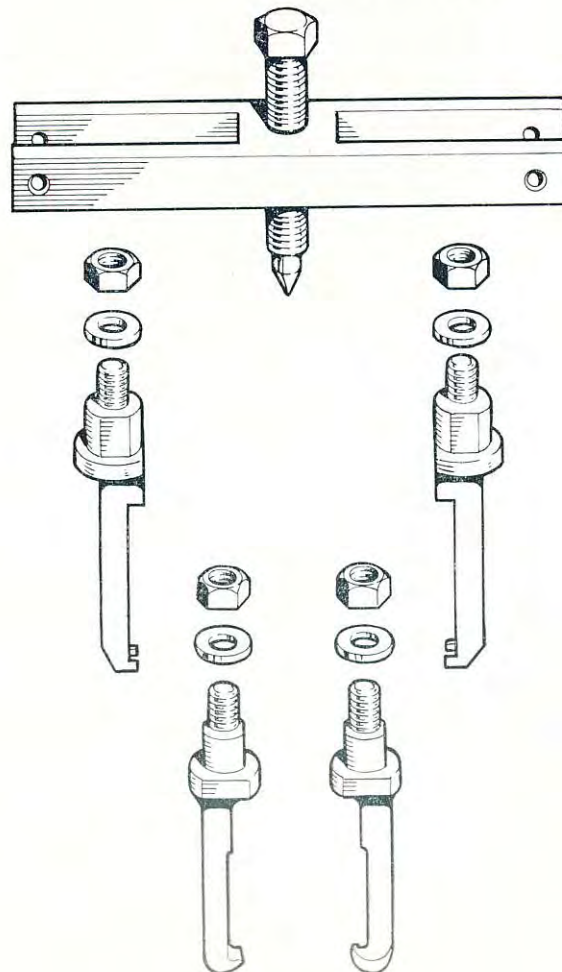


FIG. K.11.
Pinion extractor set
No. 61-3773.

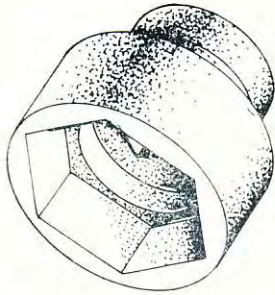


FIG. K12.
(B44) 61-3770
Crankpin nut socket.

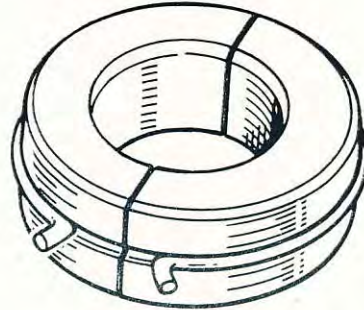


FIG. K13.
(B25) 61-3809
Crankshaft balance weight.

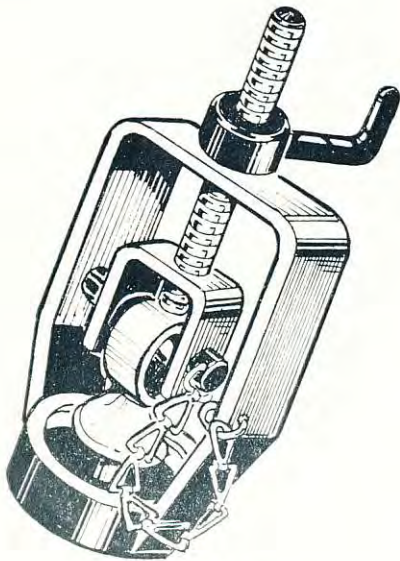


FIG. K14.
61-3503
*Rear damper dismantling
and assembly tool.*

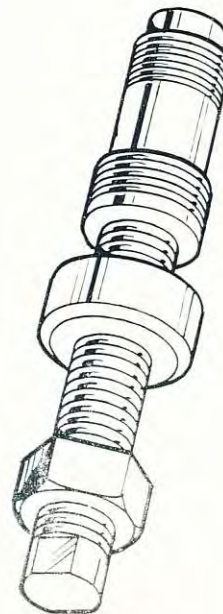


FIG. K15.
61-3824
*Fork leg removal and
assembly tool.*

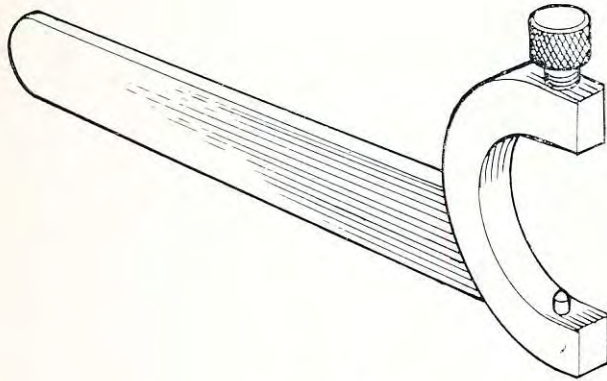


FIG. K16.
61-6017
Fork sleeve nut spanner.

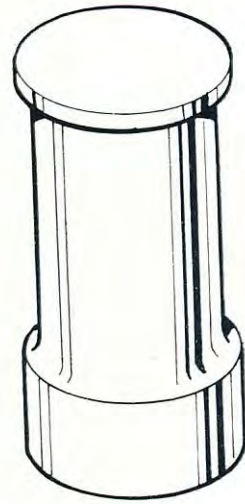


FIG. K17.
61-3007
Fork oil seal assembly tool.

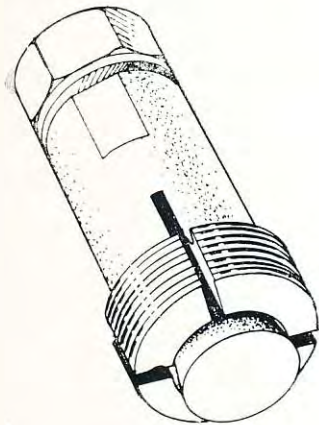
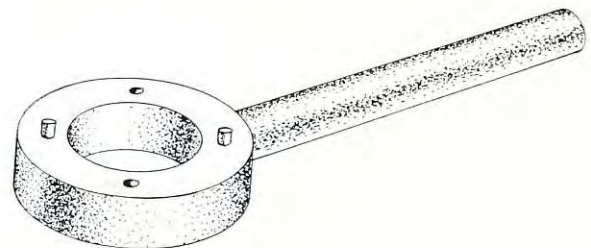


FIG. K18.
61-3063
Steering head cup extractor

FIG. K19.
61-3694
*Wheel bearing retainer
peg spanner.*



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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.

To convert sqr./inches to sqr./cm. multiply the sqr./inch figure by 6.4516

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 | .708125 | 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 | | | 1 | 25.4000 |

MILLIMETRES TO INCHES — UNITS

| MM. | 0 | 10 | 20 | 30 | 4 |
|-----|--------|--------|---------|---------|---------|
| 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 |

DRILL SIZES

| 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 |

| 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 | | | | HEX. | | NUT THICKNESS (MEAN) |
|---------------------|------------------|-----------------------|-----------|---------------------------|----------------|--------|--------|--------|--------------|---------|----------------------|
| | | | | | NUT | | BOLT | | FLATS (MEAN) | CORNERS | |
| | | | | | MAX. | MIN. | MAX. | MIN. | | | |
| 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 | | | | HEX. | | NUT THICKNESS (.005) |
|---------------------|------------------|-----------------------|-----------|---------------------------|----------------|-------|-------|-------|--------------|---------|----------------------|
| | | | | | NUT | | BOLT | | FLATS (MEAN) | CORNERS | |
| | | | | | MAX. | MIN. | MAX. | MIN. | | | |
| 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 | 3/16 | .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 |

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 |

B.A. SCREW THREADS

| NO. | DIA. OF BOLT | THDS. PER INCH | DIA. TAP DRILL | CORE DIA. | AREA AT THD. ROOT SQ. IN. | PITCH DIAMETER | | | | HEX. | | NUT THICKNESS |
|-----|--------------|----------------|----------------|-----------|---------------------------|----------------|-------|-------|-------|-------|---------|---------------|
| | | | | | | NUT | | BOLT | | FLATS | CORNERS | |
| | | | | | | MAX. | MIN. | MAX. | MIN. | | | |
| 0 | .2362 | 25.4 | .1960 | .1890 | .0281 | .2165 | .2126 | .2126 | .2087 | .413 | .47 | .236 |
| 1 | .2087 | 28.2 | .1770 | .1661 | .0217 | .1908 | .1875 | .1878 | .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 | 6.89 | 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 | 109.103 | 113.649 | 118.195 | 122.741 | 127.287 | 131.833 | 20 |
| 30 | 136.379 | 140.924 | 145.470 | 150.016 | 154.562 | 159.108 | 163.654 | 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 | 263.665 | 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 |
| 20 | 1.406 | 1.476 | 1.547 | 1.617 | 1.687 | 1.758 | 1.828 | 1.898 | 1.969 | 2.039 |
| 30 | 2.109 | 2.179 | 2.250 | 2.320 | 2.390 | 2.461 | 2.531 | 2.601 | 2.672 | 2.742 |
| 40 | 2.812 | 2.883 | 2.953 | 3.023 | 3.093 | 3.164 | 3.234 | 3.304 | 3.375 | 3.445 |
| 50 | 3.515 | 3.586 | 3.656 | 3.726 | 3.797 | 3.867 | 3.937 | 4.007 | 4.078 | 4.148 |
| 60 | 4.128 | 4.289 | 4.359 | 4.429 | 4.500 | 4.570 | 4.640 | 4.711 | 4.781 | 4.851 |
| 70 | 4.921 | 4.992 | 5.062 | 5.132 | 5.203 | 5.273 | 5.343 | 5.414 | 5.484 | 5.554 |
| 80 | 5.624 | 5.695 | 5.765 | 5.835 | 5.906 | 5.976 | 6.046 | 6.117 | 6.187 | 6.257 |
| 90 | 6.328 | 6.398 | 6.468 | 6.538 | 6.609 | 6.679 | 6.749 | 6.820 | 6.890 | 6.960 |

FOOT POUNDS TO KILOGRAMMETRES

| | 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 |
| 20 | 2.765 | 2.093 | 3.042 | 3.180 | 3.318 | 3.456 | 3.595 | 3.733 | 3.871 | 4.009 |
| 30 | 4.148 | 4.286 | 4.424 | 4.562 | 4.701 | 4.839 | 4.977 | 5.116 | 5.254 | 5.392 |
| 40 | 5.530 | 5.668 | 5.807 | 5.945 | 6.083 | 6.221 | 6.360 | 6.498 | 6.636 | 6.774 |
| 50 | 6.913 | 7.051 | 7.189 | 7.328 | 7.466 | 7.604 | 7.742 | 7.881 | 8.019 | 8.157 |
| 60 | 8.295 | 8.434 | 8.572 | 8.710 | 8.848 | 8.987 | 9.125 | 9.263 | 9.401 | 9.540 |
| 70 | 9.678 | 9.816 | 9.954 | 10.093 | 10.231 | 10.369 | 10.507 | 10.646 | 10.784 | 10.922 |
| 80 | 11.060 | 11.199 | 11.337 | 11.475 | 11.613 | 11.752 | 11.890 | 12.028 | 12.166 | 12.305 |
| 90 | 12.443 | 12.581 | 12.719 | 12.858 | 12.996 | 13.134 | 13.272 | 13.411 | 13.549 | 13.687 |

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 |
| 20 | 32.187 | 33.796 | 35.406 | 37.015 | 38.624 | 40.234 | 41.843 | 43.452 | 45.062 | 46.671 |
| 30 | 48.280 | 49.890 | 51.499 | 53.108 | 54.718 | 56.327 | 57.936 | 59.546 | 61.155 | 62.765 |
| 40 | 64.374 | 65.983 | 67.593 | 69.202 | 70.811 | 72.421 | 74.030 | 75.639 | 77.249 | 78.858 |
| 50 | 80.467 | 82.077 | 83.686 | 85.295 | 86.905 | 88.514 | 90.123 | 91.733 | 93.342 | 94.951 |
| 60 | 96.561 | 98.170 | 99.780 | 101.389 | 102.998 | 104.608 | 106.217 | 107.826 | 109.436 | 111.045 |
| 70 | 112.654 | 114.264 | 115.873 | 117.482 | 119.092 | 120.701 | 122.310 | 123.920 | 125.529 | 127.138 |
| 80 | 128.748 | 130.357 | 131.967 | 133.576 | 135.185 | 136.795 | 138.404 | 140.013 | 141.623 | 133.232 |
| 90 | 144.841 | 146.451 | 148.060 | 149.669 | 151.279 | 152.888 | 154.497 | 156.107 | 157.716 | 159.325 |

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 |
| 20 | 9.072 | 9.525 | 9.979 | 10.433 | 10.886 | 11.340 | 11.793 | 12.247 | 12.701 | 13.154 |
| 30 | 13.608 | 14.061 | 14.515 | 14.968 | 15.422 | 15.876 | 16.329 | 16.783 | 17.237 | 17.690 |
| 40 | 18.144 | 18.597 | 19.051 | 19.504 | 19.958 | 20.412 | 20.865 | 21.319 | 21.772 | 22.226 |
| 50 | 22.680 | 23.133 | 23.587 | 24.040 | 24.494 | 24.948 | 25.401 | 25.855 | 26.308 | 26.762 |
| 60 | 27.216 | 27.669 | 28.123 | 28.576 | 29.030 | 29.484 | 29.937 | 30.391 | 30.844 | 31.298 |
| 70 | 31.751 | 32.205 | 32.659 | 33.112 | 33.566 | 34.019 | 34.473 | 34.927 | 35.380 | 35.834 |
| 80 | 36.287 | 36.741 | 37.195 | 37.648 | 38.102 | 38.555 | 39.009 | 39.463 | 39.916 | 40.370 |
| 90 | 40.823 | 41.277 | 41.731 | 42.184 | 42.638 | 43.091 | 43.545 | 43.998 | 44.452 | 44.906 |

PUBLISHED BY SERVICE DEPARTMENT, B.S.A. MOTOR CYCLES LTD., ARMOURY ROAD, BIRMINGHAM 11, ENGLAND.
Printed in England at the B.S.A. Press

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