BSA

INSTRUCTION MANUAL

ROYAL STAR	MODEL A50.1R
WASP	MODEL A50.2W
HORNET	MODEL A65.2H
LIGHTNING	MODEL A65.2L
THUNDERBOLT	MODEL A65.1T
SPITFIRE Mk. II SPECIAL	MODEL A65.SP

00–4121

28P

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Instruction Manual

for

BSA

500cc ROYAL STAR A50.1R **650cc LIGHTNING A65.2L**

500cc WASP A50.2W **650cc SPITFIRE Mk. II SPECIAL A65.2SP**

650cc HORNET A65.2H **650cc THUNDERBOLT A65.1T**

B.S.A. MOTOR CYCLES LIMITED

ARMOURY ROAD, BIRMINGHAM 11, ENGLAND

Telephone: Birmingham VICtoria 2381

Telegrams and Cables: "SELMOTO", Birmingham

WESTERN U.S.A.:

B.S.A. MOTORCYCLES—WESTERN
3074 BROADWAY, OAKLAND,
CALIFORNIA.

EASTERN U.S.A.:

B.S.A. INCORPORATED
639 PASSAIC AVENUE,
NUTLEY, NEW JERSEY.

B.S.A. Motor Cycles Ltd., reserve the right to alter the designs or any constructional details of their manufactures at any time without giving notice.

B.S.A. PRESS

This Instruction Manual is intended to acquaint the B.S.A. owner with details of the controls, general maintenance and technical data which may be required for normal operation of the machine.

It does not contain the information necessary to carry out stripping for maior overhauls, but if any owner feels competent to carry out this type of work, a comprehensive Service Manual and an illustrated Spares Catalogue can be obtained from his B.S.A. spares stockist or local dealer.

Owners in the British Isles can obtain these publications direct from B.S.A. Motor Cycles Ltd., Service Department, Birmingham 11. Always quote full engine and frame numbers when ordering.

INDEX

TECHNICAL DATA

Engine Number ...	On left side of crankcase below cylinder base.
Frame Number ...	At top of head tube.

	Royal Star	Wasp	Lightning	Thunder-bolt	Hornet	Spitfire Mk. II Special
ENGINE DETAILS:						
Bore (mm.) ...	65.5	65.5	75	75	75	75
Stroke (mm.) ...	74	74	74	74	74	74
Capacity (c.c.) ...	499	499	654	654	654	654
(cu. in.) ...	30.5	30.5	40	40	40	40
Valve clearance:						
inlet (in.) ...	.008	.008	.008	.008	.008	.008
exhaust (in.) ...	.010	.010	.010	.010	.010	.010
Valve timing with .015 clearance:						
inlet—						
opens b.t.d.c.	40	51	51	51	51	51
closes a.t.d.c.	60	68	68	68	68	68
exhaust—						
opens b.b.d.c.	65	78	78	78	78	78
closes a.t.d.c.	35	37	37	37	37	37
Compression ratio	9.0	10.5	9.0	9.0	10.5	10.5
Ignition timing ...	34°	34°	34°	34°	34°	34°
ELECTRICAL:						
Ignition timing, (degrees, fully advanced)	34	34	37	37	37	37
Contact points gap (in.)	.015	.015	.015	.015	.015	.015
Sparking plugs:						
Champion type	N4	N3	N3	N4	N3	N3
gap (in.) ...	.025	.025	.025	.025	.025	.025
Battery capacity (a.h.)	8 (2)	—	8 (2)	8 (2)	—	8 (2)
TRANSMISSION:						
Engine sprocket ...	28T	28T	28T	28T	28T	28T
Clutch chainwheel	58T	58T	58T	58T	58T	58T
Gear ratios ...	(See page 31)					
Clutch friction plates	6	6	6	6	6	6
Chains (front) ...	⅜ in. pitch triple					
(rear)	⅝ in. pitch × ⅜ in.					
WHEELS:						
Front brake ...	8 in. dia. × 1⅝ in. wide 190 mm. dia. × 2 in. wide (Mk. II model only)					
Rear brake ...	7 in. dia. × 1⅛ in. wide					
Front tyres and pressures ...	3.25–19 Ribbed, 18 p.s.i.; 3.50–19 K70, 16 p.s.i.; 4.00–19 K70, 16 p.s.i.					
Rear tyres and pressures ...	4.00–18 K70, 16 p.s.i.; 3.50–19 K70, 20 p.s.i.					

(SPECIAL NOTE:—For sustained high speeds, (i.e. in excess of 90 m.p.h.), the above tyre pressures should be increased by 5 p.s.i.

TECHNICAL DATA—(*continued*)

	Royal Star	Wasp	Lightning	Thunder-bolt	Hornet	Spitfire Mk. II Special
CAPACITIES:						
Fuel tank,						
(gallons) ...	4 or 2	2	4 or 2	4 or 2	2	2
(litres) ...	18 or 9	9	18 or 9	18 or 9	9	9
Oil tank,						
(pints) ...	5	5	5	5	5	5
(litres) ...	3	3	3	3	3	3
Gearbox,						
(pints) ...	⅞	⅞	⅞	⅞	⅞	⅞
(litres) ...	½	½	½	½	½	½
Primary chaincase,						
(pints) ...	¼	¼	¼	¼	¼	¼
(c.c.)	140	140	140	140	140	140
Front forks,						
(pints) ...	⅓	⅓	⅓	⅓	⅓	⅓
(c.c.)	200	200	200	200	200	200
CARBURATION:						
Carburettor type ...	Mono 376	Mono 389 & 689 L.H. R.H.	Mono 389 & 689 L.H. R.H.	Mono 389	Mono 389 & 689 L.H. R.H.	G.P. 10GP2
bore (in.) ...	1	1⅛	1 5/32	1⅛	1 5/32	1 5/32
main jet ...	260	200 (190 U.S.A.)	270	300 (310 U.S.A.)	270	250
pilot jet ...	25	25	25	25	25	25
Throttle valve ...	376/3½	389/3½	389/3	389/3½	389/3	5
Needle position ...	3	2	4	3	4	3
Needle jet	.106	.106	.106	.106	.106	.109
GENERAL DETAILS:						
Overall length,						
(in.)	85¼	85	85¼	85¼	85	85¼
(cm.)	216.5	216	216.5	216.5	216	216.5
Wheelbase,						
(in.)	55½	55½	55½	55½	55½	55½
(cm.)	141	141	141	141	141	141
Ground clearance, below engine (unladen)						
(in.)	8½	8	8½	8½	8	8
(cm.)	21.6	20.3	21.6	21.6	20.3	20.3
Seat height (unladen)						
(in.)	33	33	33	33	33	33
(cm.)	84	84	84	84	84	84
Overall height, (Western h/bars),						
(in.)	44	44	44	44	44	44
(cm.)	111.7	111.7	111.7	111.7	111.7	111.7
(Standard h/bars),						
(in.)	40½	40½	40½	40½	40½	40½
(cm.)	102.8	102.8	102.8	102.8	102.8	102.8
Weight,						
lbs.)	391 (4 gal. tank)	386	391 (4 gal. tank)	391 (4 gal. tank)	386	382
kg.)	177	175	177	177	175	173

TAKING OVER THE MACHINE

Before running the machine make sure that the oil tank, gearbox, primary chaincase and front forks are properly topped-up with oil and that the battery is filled and charged (see appropriate chapters for filling instructions). Normally these preparations will be carried out by the dealer who is selling the machine and the new owner has only to arrange the controls to his liking and the machine is ready for the road.

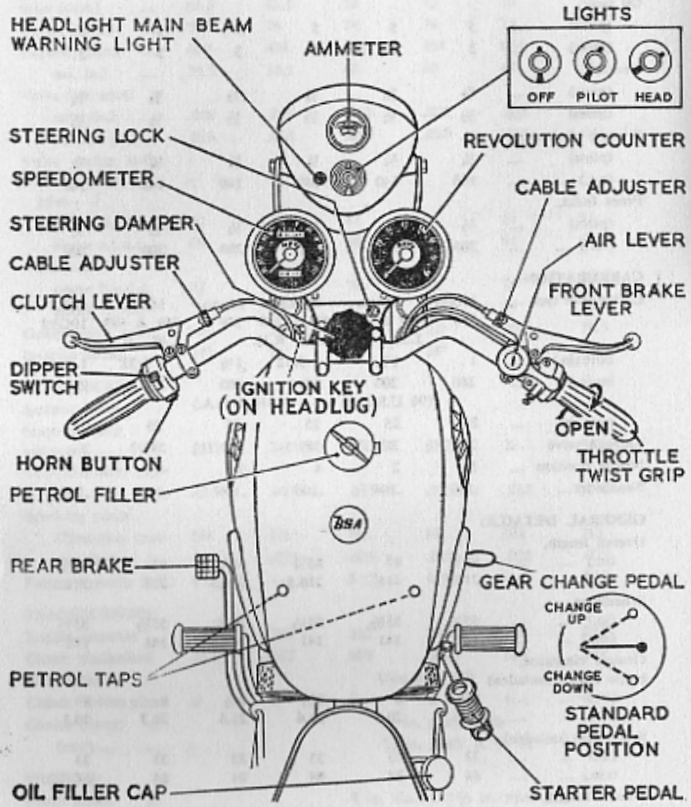


FIG. 1. *Controls for the Lightning. (Differences on remaining models comprise omission of electrical and other equipment).*

The new rider should make sure that he is quite familiar with all the controls before attempting to ride the machine. Most of the controls are adjustable and should be positioned so that they can be reached without moving the hands from the grips or the feet from the footrests. Handlebars and footrests should be adjusted so that a comfortable and natural riding position is

achieved. The handlebars are clamped to the fork yoke at their centre, and can be adjusted for position after the bolts have been slackened. Make sure that these bolts are tight after completing the adjustment. The footrests are mounted on taper lugs and after the nuts have been removed, can be set in the desired position. Note that the nut on the left footrest has a left-hand thread and must therefore be turned in a clockwise direction to unscrew it. After any adjustment is completed, reset the brake pedal stop so that the pedal is situated comfortably below the foot.

It is well worth while spending some time in setting both handlebars and footrests correctly, because badly positioned controls cause poor control of the machine and bring discomfort on long journeys.

HANDLEBAR CONTROLS:

Throttle Twist Grip.—Mounted on the right handlebar, it controls the throttle opening and consequently the engine speed. To open the throttle (i.e. to increase engine speed) turn the grip so that the top moves towards the rider. Excess slackness in the cables can be removed by means of an adjuster incorporated in each cable at the carburetter (twin carburetter models) or mid-way on the cable (single carburetter models).

The rotary stiffness of the twist grip can be varied by means of the adjuster screw and locknut. It is set for average requirements when leaving the factory, but can be re-adjusted to suit individual preference.

Front Brake.—The lever is mounted on the right handlebar in front of the throttle control. Grip the lever gently to operate the brake. Finger adjustment for the cable is provided at the adaptor on the lever, and at the brake plate.

Air Control (Carburettor).—Situated immediately above the front brake lever, and controls the amount of air admitted to the carburettor (see starting instructions, page 7).

When closed (moved away from rider) a rich mixture is provided for cold starting purposes. For normal running, the lever should be turned clockwise as far as possible. Cable adjustment is provided mid-way in the cable.

Clutch.—The lever is mounted on the left handlebar. Grip the lever to free the clutch, i.e. disengage the drive between the engine and the rear wheel. Finger adjustment for the clutch cable is provided at the adaptor on the lever.

Headlight Dipper Switch.—Incorporated in an annular housing at the left handlebar grip. Switches from main to dipped headlight beam as required. The housing can be adjusted for position after releasing the locking screw.

Horn Button.—Mounted in the same housing as the headlight dipper switch. On models without battery lighting, when a horn is fitted, the button is independently mounted on the left handlebar and the horn can be operated only when the engine is running.

OTHER HAND CONTROLS:

Petrol Taps.—These are located under the rear end of the tank, one on each side. To turn on the petrol, pull out the knurled button and lock in position by turning anti-clockwise. Both taps communicate with the main supply in the tank, but if one tap only is used, a reserve supply remains which can be fed to the carburettor when the second tap is turned on.

Lighting Switch.—The three positions of the switch are: (*a*) all lights off, (b) pilot, tail, and instrument lights on, (*c*) head, tail, and instrument lights on, with the separate switch on the handlebar controlling the main and dipped headlight beams.

In all switch positions, the charging rate from the alternator varies with the condition of the battery, decreasing as the battery becomes fully charged and vice versa.

Ignition Switch.—This is operated by a detachable key, which when in the anti-clockwise position, switches off the ignition and can be withdrawn. Always place in this position when the engine is stationary and remove the key when leaving the machine. Turn the key to the clockwise position to switch on the ignition and leave in this position when the engine is running. The switch is located on the left side of the steering head.

"Cut-out" Button.—On models fitted with direct ignition, a "cut-out" button is mounted on the handlebars. Depression of the button stops the engine.

Tickler (Carburettor).—Each carburettor float chamber is fitted with a spring loaded plunger which, when depressed, prevents the float from rising, thus rapidly replenishing the level of fuel in the chamber. The plunger (or tickler) should be used for a brief interval only, otherwise the level of petrol in the float chamber will rise excessively, resulting in flooding of the carburettor, and loss of fuel. (See starting instructions, page 7).

Steering Lock.—Carried in the top fork yoke. To operate the lock, turn the handlebars to the left, then turn the key in the lock to release the plunger, which registers in a special lug on the frame. The machine cannot then be driven or wheeled away.

Steering Damper.—This is situated above the steering column at the centre of the handlebars, and tightening down the knob increases the damping action. At high speeds, or when a sidecar is fitted, the damper should be tightened slightly and adjusted according to requirements.

FOOT CONTROLS:

Gearchange Pedal.—Operated by the right foot, the gearchange mechanism is of the positive stop type and, following a change of gear, the lever returns to its central position as soon as foot pressure is released.

Neutral position is between first and second gears and downward movement of the lever selects a lower gear, while an upward movement selects a higher one. The pedal can be re-positioned as required after releasing its pinch bolt.

Starter Pedal.—This is on the right side of the machine and depression of the pedal rotates the engine.

Rear Brake Pedal.—Operated by the left foot. The pedal is equipped with an adjustable stop which should be set so that the pedal pad lies comfortably below the foot, ready for instant use. Any adjustment of this pedal position may require re-adjustment of the rear brake.

Stop Light Switch.—Actuated by an extension from the brake pedal and concealed behind the left side panel, this switch controls the stop-light in the tail lamp. Whenever the brake pedal is adjusted, check that the switch still functions and if necessary, re-position the extension arm slightly to ensure this condition.

INSTRUMENTS: (According to Specification)

Speedometer.—The "trip" mileage can be reset to zero by rotation of the control knob on the side of the instrument.

Revolution Counter.—Driven from the engine mainshaft this records the engine r.p.m.

Ammeter.—This instrument indicates the charging rate from the alternator or the discharge rate from the battery. The rates are shown as "Charge" (+) or "Discharge" (—).

DRIVING

To Start the Engine.

Stand astride the machine and make sure that the gears are in the neutral position, which lies between the first and second gears. If there is any doubt about this depress the gearchange pedal fully two or three times to engage successively lower gears, at the same time easing the machine backwards and forwards to allow the gears to rotate a little, and so facilitate gear engagement. When it is certain that first gear is obtained, raise the pedal through half of its normal stroke, so selecting the neutral position. Should the machine be in gear it will move forward as the starter pedal is depressed.

If the engine is quite cold, depress the carburettor ticklers momentarily. Note that it is neither necessary nor desirable to oscillate the ticklers rapidly, as this may damage the floats. Close the air control lever, thus giving a rich mixture for starting.

On models fitted with coil ignition, switch on the ignition by turning the key in a clockwise direction, see Fig. 1. Open the twist grip a small amount only, as excessive opening may prevent easy starting, and push down the starter pedal slowly, until resistance is felt; then, without releasing the pressure on the pedal, give a firm downward swing which should set the engine in motion. If the engine fails to start at the first attempt, repeat this procedure, being careful to avoid rapid kicking at the pedal which will serve no purpose and may damage the operating mechanism. The ignition control is set automatically in the retarded position for starting, and advances as the engine speeds up.

Note that while it is necessary to use the air control lever when starting from cold, this should not be necessary when the engine is warm, and should certainly not be so if a restart is made after a short wait only. On certain occasions, such as when the engine is not fully warmed up, or when it has cooled down a little during a temporary halt, it may be necessary for the engine to be only partially choked, when the lever should be set in its midway position, and the rider is advised to study this point. When starting with a warm engine, and during normal running, the lever should be set in its fully open position, so that the carburettor air slides are also kept fully open.

Engaging First Gear.
With the engine running slowly, disengage the clutch by gripping the left handlebar lever and after a brief interval press down the gearchange pedal as far as it will go, so selecting first gear. If the pedal will not move through its full travel, so that the gear does not engage, ease the machine backwards or forwards slightly, maintaining a light pressure on the pedal, until the gear is felt to engage.

Moving Off.
Open the throttle slightly, and gently release the clutch lever part way, until the clutch can be felt to take up the drive, and the machine tends to move forward. Open the throttle a little more to prevent the possibility of stalling the engine, and slowly release the clutch lever as the machine moves away. Until the lever is completely released the clutch is not fully engaged, so that the engine should not be speeded up excessively or the clutch remain partly engaged, for longer than is necessary to get the machine away in first gear.

Changing Gear (Up).
When the machine is moving steadily with the clutch fully engaged, the next operation is to engage second gear. Close the throttle, disengage the clutch, and raise the gearchange pedal as far as it will go, the three movements being performed simultaneously. Immediately the gear is felt to engage, re-open the throttle and re-engage the clutch.

Changing Gear (Down).
Open the throttle slightly, disengage the clutch and press the gearchange pedal down as far as it will go. Re-engage the clutch as soon as the gear is felt to engage. Violent pressure on the gear lever is unnecessary, a steady movement of the pedal being most effective.

Notes on Gearchanging.
When changing gear, not only should a suitable road speed be selected at which to perform the operation, but the gearchange should be timed in such a way that the relative speeds of the engine and gearbox coincide as closely as possible.

For this reason, when changing up, the throttle is momentarily closed when disengaging the clutch, so removing the power drive from the gearbox, allowing it to slow down to the lower speed at which it will operate in the next higher gear.

When changing to a lower gear, the engine speed has to be increased relative to the gearbox speed, and the throttle should not therefore be closed, but even opened slightly, while making the change. As soon as the clutch lever is gripped, the engine will automatically increase in speed, so that the lower gear will engage quietly at the correct speed.

Changing gear, therefore, whilst appearing complicated, is mainly concerned with the synchronization of engine speed and road speed, by co-ordination of hand and foot operations. After a little practise, smooth and quiet gearchanges will be possible at all times, and eventually become a purely automatic action.

Using the Gearbox.
Correct use of the gearbox must be made in order to obtain best results in all-round performance, especially with regard to acceleration and hill climbing capabilities (particularly motor cycles fitted with a sidecar), and to the attainment of maximum speeds by sports models.

It is not always appreciated that the power delivered by an I.C. engine depends upon engine speed. Hence, on a machine travelling uphill, the engine speed will fall as a result of the increased load, with a corresponding fall in power output. In order to maintain sufficient power, a lower gear must be selected in order to increase the engine speed and so obtain more power.

Similarly, for good acceleration from moderate speeds in top gear, more power is required and, here again, the solution is to change down to a lower gear. It is better to allow the engine to "rev" in a lower gear than to labour in a higher one.

It follows that the engine speed must be kept high in order to develop maximum power and this means that for maximum acceleration and maximum speed, the engine must be driven up to peak r.p.m. in the gears. **In particular, to attain maximum speed, it is essential to obtain peak r.p.m. in third gear, before changing into top gear.**

Note:—Maximum safe r.p.m. for "Wasp" ... ... = 8250
Maximum safe r.p.m. for "Hornet" ... ... = 7250
Maximum safe r.p.m. for all other twin-cylinder models = 7000

To Stop the Engine.
Select the neutral gear position and close the throttle, so reducing the engine speed to "tick-over". Turn the ignition switch to the "off" position.
N.B.— On models with direct ignition depress the "cut-out button".

Running-In.
The rider who has just purchased a new machine will do well to remember that all the internal parts are just as new as the enamel and plating which can be seen, and they must be well "run-in" before the engine can be given any really hard work.

The "running-in" process is the most important period in the life of the engine, and the handling it receives during the first 1,000 to 1,500 miles will determine the service it will provide in return.

Running-in should commence at one-third to half throttle, and the throttle opening should be progressively increased as the mileage builds up, until at the end of the running-in period full throttle can be employed.

If excessive speeds are used in the early stages, there is risk of seizure and other troubles, and in any case, until the machine has been properly "run-in", it cannot be expected to give its best performance.

Smooth throttle control and selection of the correct gear for the prevailing conditions will ease the work of the engine. In particular, avoid violent acceleration, and do not allow the engine to labour on hills in a high gear, when a change to a lower gear would ease the load. This ensures that all parts of the machine are properly run-in and are quite free.

When running-in is completed, balance the wheels (see page 43).

Do not let the oil level in the tank fall below the minimum mark, as economy in oil may prove very expensive at a later date and running consistently with the level too low may cause the oil to become unduly hot. It must be remembered that the oil cools as well as lubricates, and a new engine tends to run a little hotter than one that is well run-in. After the first 250 miles, and again at 500 miles, drain and refill the oil tank with fresh oil and clean the filters. The correct grades of oil are given in the lubrication chart. The oil in the gearbox should also be changed after the first 500 miles.

Further oil changes should be carried out in accordance with the instructions under "ROUTINE LUBRICATION."

During the running-in period it is advisable to check the various adjustments such as valve clearances, contact breaker gaps, clutch adjustment, etc., rather more frequently than usual, and to check the tightness of all nuts and bolts to make sure that the initial bedding-down does not loosen any components.

ROUTINE MAINTENANCE

The following list of items requiring regular attention will serve as a guide as to when maintenance should be carried out. The method of carrying out the various adjustments will be found under the appropriate headings in the later chapters. The mileage figures quoted are based on normal road work but for machines used for competition purposes, the periods between servicing should generally be reduced.

Whenever any work is carried out on the machine, attention to detail and scrupulous cleanliness must be observed. All joints must be clean and gaskets in good condition before reassembly. Threads must be kept clean and free from grit, and exposed threads should be oiled or greased before assembly. Good fitting spanners should be used at all times and nuts must be tightened firmly, but spanners of greater than standard length should not be employed as they may cause failure through overtightening.

Take care when cleaning the machine that dirt is not introduced into the carburettors, hubs, etc. Do not attempt to rub off dry dirt or mud as this will damage the enamel or plating. Wash off any dirt with a copious supply of clean water, preferably from a hose. Any oily areas should be treated with a proprietary detergent before being hosed down. Dry the machine with a piece of clean rag and if possible clean it on a warm dry day so that all moisture is removed. Finally, polish with a good quality polish such as Autobrite.

Every Week.

- Examine battery acid level (where applicable) ... ... Page 45
- Check brake adjustment ... ... Page 41
- Check tyre pressures ... ... Page 2

Every 2,000 Miles.

- Check and tighten all nuts and bolts
- Examine pump ball valve ... ... Page 15
- Check valve clearances ... ... Page 15
- Clean and adjust sparking plugs ... ... Page 16
- Check adjustment of primary chain ... ... Page 32
- Check clutch operation ... ... Page 34
- Check adjustment of rear chain ... ... Page 33
- Check wheel alignment ... ... Page 34
- Check adjustment of steering head ... ... Page 45
- Check contact breaker points gap ... ... Page 20
- Check lights (where applicable) ... ... Page 46
- Clean air filters (where applicable) ... ... Page 17

Every 5,000 Miles.

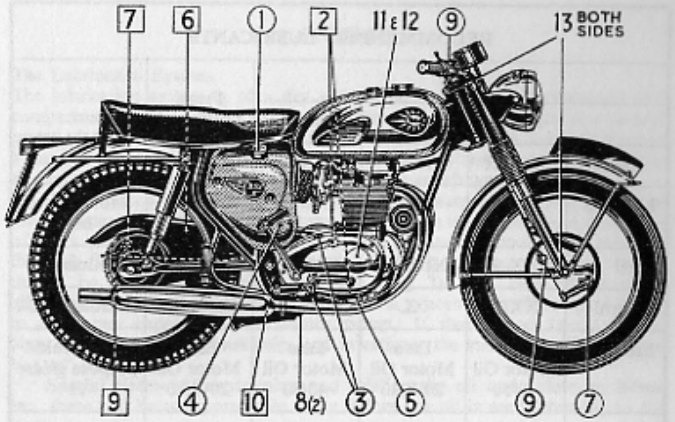
- Clean and adjust contact breaker points ... ... Page 20
- Examine auto-advance unit ... ... Page 20

Every 10,000 Miles.

- Examine brake linings, clean brake drums
- Examine front fork for correct action ... ... Page 44
- Check headlight beam setting (where applicable) ... ... Page 46
- Examine rear suspension for correct action ... ... Page 45

As required.

- Ignition timing ... ... Page 17
- Petrol tap filters.



Figures within squares refer to the left side of the machine.

Figures within circles refer to the right side of the machine

FIG. 2. *Lubrication Diagram.*

ROUTINE LUBRICATION

REF. NO.		
	Daily.	
1	Check oil level in tank	Page 13
	Every 1,000 Miles.	
2	Check oil level in primary chaincase	Page 31
	Every 2,000 Miles.	
3	Check oil level in gearbox	Page 29
4	Drain and refill the oil tank	Page 13
4	Clean oil tank filter	Page 13
5	Clean crankcase filter	Page 14
6	Lubricate rear chain	Page 33
7	Lubricate brake cam spindles (front and rear) ...	Page 41
8	Grease central stand (two points).	
9	Lubricate exposed cables and joints (oil or grease).	
10	Lubricate brake pedal pivot (oil).	
	Every 5,000 Miles.	
11	Lubricate contact breaker cam	Page 20
12	Lubricate auto-advance mechanism	Page 20
3	Drain and refill the gearbox	Page 29
2	Drain and refill the primary chaincase	Page 31
	Every 10,000 Miles.	
13	Drain and refill the front forks	Page 44

RECOMMENDED LUBRICANTS					
OILS				Front Forks and Primary Chaincase	GREASE
Engine			Gearbox		
Brand	Summer	Winter	All Year		
Mobiloil	BB	A	D	Arctic	Mobilgrease MP
Shell	X100-40	X100-30	X100-50	X100-20	Retinax A
Castrol	XXL	XL	Grand Prix	Castrolite	Castrolease LM
Esso	Esso Motor Oil 40/50	Esso Motor Oil 20W/30	Esso Motor Oil 40/50	Esso Motor Oil 20W/30	Esso Multi-purpose grease H
B.P. Energol	S.A.E. 40	S.A.E. 30	S.A.E. 50	S.A.E. 20	Energrease L2
Regent	Havoline S.A.E. 40	Havoline S.A.E. 30	Havoline S.A.E. 50	Havoline S.A.E. 20W	Marfak Multi-purpose 2

The grade of lubricant used depends to a certain extent on the use to which the machine is being put and the ambient temperature. The chart gives recommendations for conditions in temperate countries. In countries where the climatic conditions are extreme, some alteration may be necessary bearing in mind that the higher the temperature the higher is the S.A.E. number required.

All the above are mineral oils, but if it is desired to use vegetable oil then the engine and oil tank must be thoroughly cleaned out with flushing oil before changing over.

In no circumstances must the two types of oil be mixed. If they are, a sludge will be formed which may damage the engine. For similar reasons, B.S.A. oil (U.S.A.) should not be replaced with a detergent oil.

It is always advisable to make sure that the oil is warm before driving the engine hard. When taking part in competitive events advantage should be taken of any warming-up period to get the engine warm and the oil circulated.

RECOMMENDED OILS FOR U.S.A. ONLY			
We strongly recommend B.S.A. oils for use in B.S.A. motor-cycles, as detailed below:—			
Engine		Gearbox	Front Forks and Primary Chaincase
Summer	Winter	All Year	
S.A.E. 40	S.A.E. 30	S.A.E. 50	S.A.E. 20

The Lubrication System.
The lubrication system is of a dry sump type, i.e. the oil is contained in a compartment remote from the engine. One set of gears in the double-gear pump, situated within the inner timing cover, draws oil from the tank through a gauze filter and delivers it under pressure past a non-return valve, to the timing side main bearing, big-end bearings, camshaft and other parts.

The oil then drains down through another gauze filter in the bottom of the crankcase (Fig. 4) to a small sump, from which it is drawn by a second set of gears in the pump via the ball valve (Fig. 4), and returned to the tank. If the tank filler cap is removed whilst the engine is running, the returning oil should be seen issuing from the pipe (Fig. 3). The flow of oil will in all probability contain air bubbles, but this is a normal condition and is due to the larger capacity of the return pump. **If there is no flow from the pipe, stop the engine immediately, and investigate the cause** (see "PUMP BALL VALVE", page 15).

Special Note:—After draining and refilling the oil tank, cleaning filters, etc., there will be an appreciable delay before the oil is seen returning to the tank.

The rocker mechanism is lubricated by means of a by-pass feed from the oil return pipe, the oil draining to the crankcase by way of passages in the cylinder block.

Oil Tank and Filter. (FIG. 3).
Access to the rubber-mounted oil tank is provided by removal of the panel on the right side of the machine. It is quickly detachable and is held in position by snap-fasteners.

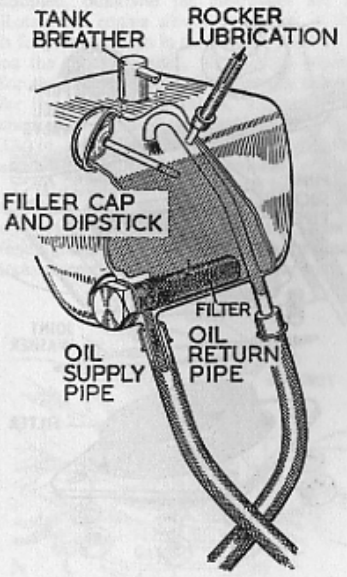


FIG. 3.
The oil tank and filter.
(Note that the supply and return pipes cross before attachment to the crankcase).

Unscrew the filter, which is fitted in the lower right side of the tank, and drain off the oil into a suitable receptacle, for which purpose it may be advisable to make a small chute of sheet metal or cardboard. Lean the machine to the right to drain off any remaining oil.

Wash the filter in petrol and before it is replaced make sure it is quite dry and that the fibre washer is intact. Tighten firmly to secure an oil-tight joint. Refit the panel in position, locking in position with the snap-fasteners.

Note:—The operation of draining the tank will be simplified if it is drained while the oil is still warm, and is therefore best carried out immediately after a run.

Refill the tank with engine oil in accordance with the recommendations contained in the lubrication chart (page 11).

The tank capacity is approx. 5 pints and the maximum and minimum oil levels are shown on the dipstick attached to the filler cap.

Oil Pipes.

If at any time the oil pipes are disconnected it is essential that they are crossed over when reconnected, (i.e. the outer pipe from the tank is attached to the inner connection at the crankcase, Fig. 3).

Crankcase Filter. (FIG. 4).

This is integral with the small sump carried below the crankcase, and removal of four nuts and spring washers allows the filter to be withdrawn. Wash thoroughly in petrol and make sure that all the petrol has evaporated before replacing. Check also that the joint washer is in good condition, renewing if necessary, so that the joint is made oil-tight.

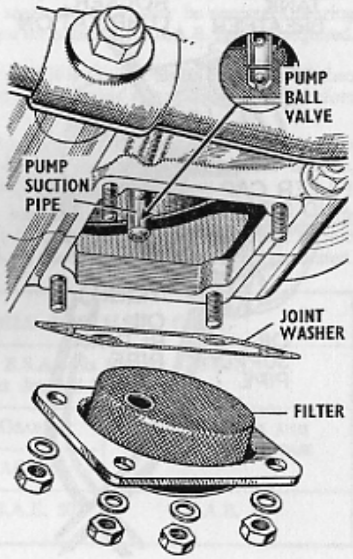


FIG. 4.
Crankcase filter and pump ball valve.

Pump Ball Valve. (FIG. 4).

When the crankcase filter is removed, the end of the pump suction pipe is exposed. It carries a small ball which acts as a non-return valve, and it is advisable at this time to check that the ball is free on its seating by inserting a piece of wire into the valve orifice. If the ball adheres to its seating, there will not be a return flow of oil to the tank and the crankcase may become flooded. The returning oil can be seen issuing from the pipe if the oil tank filler cap is removed whilst the engine is running (see page 13). Alternatively, if the crankcase contains an excessive quantity of oil after, say, an overnight stop (indicated by voluminous smoke from the exhaust when starting up), this may be due to the ball not seating properly, caused by a particle of foreign matter, so allowing oil to pass through the pump to the crankcase.

Valve Clearances.

It is necessary to remove the petrol tank in order to lift off the rocker cover, and thus expose the adjusting screws on the ends of the rocker arms.

Turn off the petrol taps, unscrew the pipe connections, and disconnect the strap beneath the front of the tank (fitted to steel tanks only). The latter is held in position by a captive bolt and nut, which is exposed when the rubber cap is removed. Unscrew the nut and note carefully the sequence in which the various components are withdrawn so that they can be reassembled in the same manner, and remove the tank.

Next remove the high-tension leads and the sparking plugs, to enable the engine to be rotated easily without any resistance due to compression. Take off the rocker cover, taking care not to damage the gasket between the cover and cylinder head.

The valve clearance is measured by means of feeler gauges inserted between the valve stem and rocker adjusting screw (Fig. 4), and as the cams are of special design it is essential that the following procedure is adopted, otherwise the clearances are likely to be inaccurately measured. Rotate the engine slowly by means of the starter pedal until one inlet valve is fully open. This is the correct position for checking the inlet valve clearance on the other cylinder. Rotate the engine again and adopt similar measures for the inlet valve on the opposite side of the engine. Repeat the procedure for the two exhaust valves. Correct clearance, which in all cases should be checked or adjusted when the engine is quite cold, are: inlet, .008 in.; exhaust, .010 in. For competition purposes only, these figures can be increased to .010 in. and .012 in. for inlet and exhaust respectively.

If adjustment is found to be necessary, first slacken the locknut. The adjusting screw should then be screwed up or down until the gap between the end of the valve stem and the screw is just sufficient for the appropriate feeler gauge to enter. Retain the adjuster in this position, and tighten the locknut securely against the rocker arm.

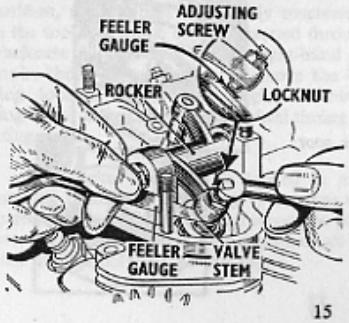


FIG. 5.
Measuring the valve clearance.

Sparking Plugs.

The sparking plug is of great importance to satisfactory engine performance and it is necessary that it should be the correct type and in good condition. Champion plug types N.3 or N.4 are recommended according to model. For competition purposes a suitable racing plug should be fitted.

The condition of a sparking plug can be helpful in determining the condition and tune of an engine, and it is recommended that the plug be removed from time to time for examination.

A plug running at the correct temperature in a healthy engine will be indicated by blackish or greyish/tan deposits on the end of the plug body and earth electrode. The firing-end of the insulator will vary from a very light tan to a darkish brown.

A sooty deposit on the firing end of the plug is generally an indication of over-rich mixture, whereas a fine light grey deposit on the end of the plug and a whitish appearance on the firing end of the insulator may indicate a lean mixture. If carburation appears correct, but the plug insulator at the firing end is black with carbon or oily deposit, this is generally an indication that the grade of plug in use is too cold.

Plugs should be cleaned on an abrasive blast machine and afterwards, the sparking surfaces of the electrodes on standard type plugs should be dressed with a fine file in order to restore clean, flat, parallel faces. It is most important that the gap should be reset to specification; .020 to .025 in. Gap adjustment should be made by bending the side wire. The threads of the plug, and the gasket seat, should be wiped clean before refitting plug to the engine. The upper portion of the insulator should also be wiped clean after fitting and prior to connecting the high-tension cable. It is good practice to wipe periodically the top of the insulator with a clean cloth in order to remove any accumulation of grime or dust, etc., as such deposits can be conductive and result in poor plug performance.

The special non-detachable steel gaskets fitted to Champion standard sparking plugs are designed to last the life of the plug.

When refitting the plug, screw in as far as possible by hand, and then use a box-spanner for final tightening to avoid possibility of damage to the insulator. An adjustable spanner should not be used.

FIG. 6.
The spark plug.

(ABOVE)—*Fouled with burnt oil, or soot.*

(BELOW)—*Correct.*

Air Filters. (FIG. 7).

The filters can be detached from the carburettor intake, and the ends of the perforated band are held together by means of a small nut and bolt which must be unscrewed before the band can be opened to allow the whole filter unit to be dismantled. The element must be washed thoroughly in petrol and dried.

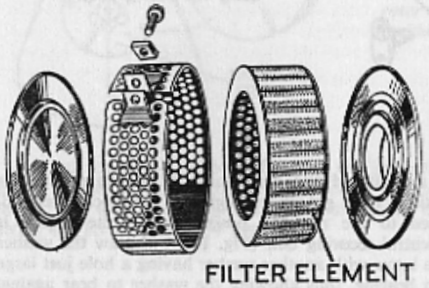


FIG. 7.
The air filter dismantled into its component parts.

Ignition Timing.

It is a rare occurance for the ignition timing to alter and it is not advisable to interfere with the setting unless it is strongly suspected of being incorrect. The importance of accurate ignition timing cannot be over-emphasised. Care and patience must be used to ensure that the final setting is in accordance with recommendations.

Before checking the timing, the contact breaker gaps must be set to the correct clearance, since any variation in the gaps from the recommended clearance will effect the timing (opening the points advances the timing; closing them retards it). The correct gap when the contact points are in the fully open position is .015 in., and if different from the setting, they must be re-adjusted (see page 20).

As a preliminary operation, remove both sparking plugs so that the engine can be rotated without resistance due to compression and engage top gear to enable the engine to be turned either backwards or forwards by moving the rear wheel.

In order to assist the owner in setting the piston in the correct timing position, the flywheel is specially machined to accept a timing plug (supplied in the tool kit) which can be inserted through an aperture in the front of the crankcase (Fig. 8). First, set the right-hand piston at the top of its compression stroke (both valves closed). Remove the detachable cover (A), and insert the plug loosely. Rotate the engine backwards **very slowly** until the timing plug is felt to engage in the flywheel timing keyway, then add and tighten the fixing nuts.

The engine will now be locked in position with the right-hand piston correctly positioned for timing. Note that the timing plug is reversible, but the correct timing will be obtained when the plug is fitted with the symbol A50 in the upper position only. **This applies to all models.** The plug **must not** be fitted with the symbol A65 at the top.

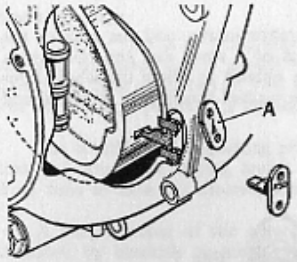


FIG. 8.
Using the timing plug.

The next step is to set the auto-advance mechanism of the contact breaker in the fully advanced position. (The governor weights in the mechanism will automatically have returned to the retarded position when the engine is stationary.) Remove the central securing bolt (Fig. 10), withdraw the washer and temporarily replace the latter with another washer having a hole just large enough to fit over the cam bearing, thus allowing the washer to bear against the side face of the cam. Replace the bolt, but before tightening rotate the cam to its limit in an anti-clockwise direction, hold in position, and tighten the bolt. This will lock the auto-advance mechanism in the **fully advanced position,** which is the correct position for timing the ignition.

Now check that the upper pair of contact breaker points are just opening. If incorrect, slacken the two screws which secure the back-plate (Fig. 10) and rotate it until the points are just opening. Retighten the screws and check the whole setting carefully. The best way of determining the precise point of opening of the contact breaker points is to connect a small battery and bulb in series with the points.

When the right-hand cylinder has been timed, first temporarily remove the timing plug, rotate the engine through one revolution, and replace the timing plug. Check that the lower pair of contact points are just opening. In this case however if the setting is incorrect, do not adjust the back-plate but re-adjust the contact points until the correct condition is obtained, thus timing the left-hand cylinder. This naturally, will effect the fully open gap, but to a small extent only.

Do not forget to remove the timing plug before attempting to move the engine, nor to remove the special washer fitted temporarily behind the contact breaker central bolt, otherwise the auto-advance mechanism will be inoperative.

It cannot be too strongly emphasised that the ignition timing must be **correctly set for** satisfactory engine performance, and that any attempt to "improve" on the above settings should be avoided, as they have been determined after careful development.

Special Note for Energy Transfer Ignition:—If the alternator has been removed it is essential that it is replaced correctly, otherwise the ignition timing will be effected. The inner face of the rotor is drilled with holes marked "S" and other letters. For both engines this hole must be located on the driving peg. **None of the other holes is to be used.** The relationship between the driving peg and crankshaft splines is also important (see Fig. 9).

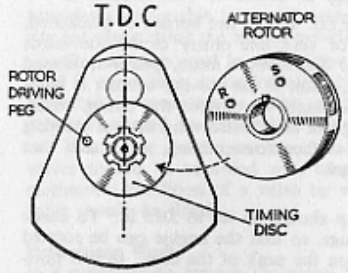
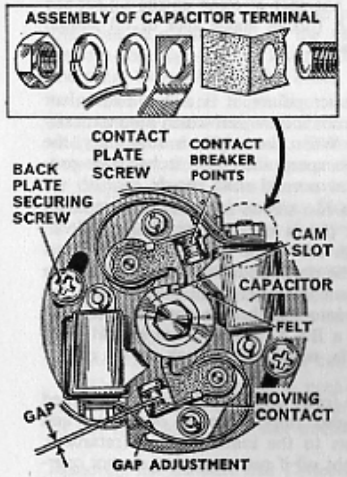


FIG. 9.
Assembly of the alternator rotor (energy transfer ignition).

As an alternative method of setting the ignition timing accurately, many dealers possess electronic equipment specially designed for this purpose. For owners who wish to take advantage of this service, the fully advanced ignition setting for all models is 34 degrees.



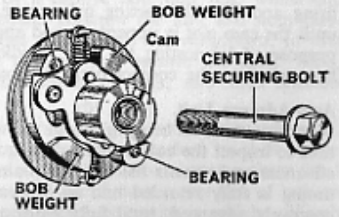


FIG. 10.
The illustration shows:—
The contact breaker assembly (left), and the governor mechanism which lies beneath it (above).

Contact Breaker. (FIG. 10).

The unit is contained within a separate compartment and becomes accessible when the inspection cap is removed from the timing cover. It is driven from the intermediate timing gear and the compartment is fitted with a special seal to prevent any possibility of engine oil finding its way on to the contact points. If it becomes necessary to replace the seal, it must be fitted so that the lip which bears on the shaft faces the interior of the crankcase. Separate coils are used for each cylinder necessitating two pairs of contact points which are operated by a single cam.

Cleaning.
The contacts must be free from grease or oil. If they are burned or blackened, clean with a fine carborundum stone or very fine emery cloth, afterwards wiping away any trace of dirt or metal dust with a clean, petrol-moistened cloth. Cleaning of the contacts is made easier if the moving contact is withdrawn, for which purpose it will be necessary to remove the timing cover. The moving contact can be lifted off its pivot after unscrewing the nut securing the end of the spring to the capacitor. When reassembling, make sure that the insulating tag has not been disturbed.

Gap Setting.
When the points are fully open, the gap should be set to .015 in. To check the setting first remove the sparking plugs, so that the engine can be rotated slowly until one of the rocker arms is on the peak of the cam. In this position the gap will be at its maximum, when the setting can be varified with the aid of a feeler gauge. If incorrect, slacken the screw and adjust the plate carrying the fixed point until the gap is correct. Retighten the screw and check for adjustment. Repeat this procedure for the other pair of points.

Lubrication.
Apply a **very small amount** of thin grease, or clean engine oil, to the felt pad which lubricates the cam. Do not use an excessive quantity, as it is most important that the contact points are kept free from lubricant, otherwise misfiring and difficult starting may occur. At the same time, turn the engine until the cam slot is uppermost and apply **one spot** of clean engine oil for the purpose of lubricating the cam spindle. A further **single spot** of oil should be applied to the contact breaker pivot posts.

Auto-Advance Unit. (FIG. 10).
When attention is being given to the contact points, it is also a convenient time to inspect the bob-weights of the governor mechanism which automatically advances and retards the ignition timing. When the engine is stationary, the timing is fully retarded and as the engine speed increases, it becomes progressively advanced, until fully advanced at normal road speeds.

To expose this mechanism, remove the two screws and detach the contact breaker back-plate complete with contact points etc. It is not necessary to unscrew the central bolt, because although the whole mechanism is retained on a tapered shaft, to do so may release the unit, requiring complete retiming of the ignition. If however, the mechanism is to be taken out, remove the central bolt and insert an extractor bolt into the threads specially provided for this purpose. The bolt is available as a B.S.A. Service Tool No. 61–5005 and should be screwed in as far as possible, when a sharp jerk on the end of the spanner will release the unit.

Make sure that the bob-weights move freely and that if the cam is turned by hand to the advanced position (weights fully extended outwards) and released, the springs withdraw the weights to the inner position (retarded). Lubricate their bearings with a drop of light oil if necessary, but do not overlubricate or the excess may find its way on to the contact points. Note that the ignition timing should be checked after the contact breaker back-plate is replaced, when slight re-setting of the plate may be required.

Decarbonisation.
Decarbonisation should be carried out only when there are definite symptoms that excessive carbon build-up inside the engine is interfering with performance. The usual indications are an increasing tendency to "pink" (a sharp metallic knocking when under load), a general falling-off in power noticeable mainly on hills, and a tendency for the engine to run hotter than normal.

It is customary to attend to the valves during decarbonisation, as this provides a reasonable interval between valve overhaul, and avoids the necessity for dismantling the engine especially for this purpose at a later date.

On machines used in competitive events, the need to remove the cylinder head is more likely to be indicated by the condition of the valves, which are subjected to considerable stress at high engine speeds. The exhaust valve especially should be replaced at reasonable intervals.

If for any reason, maximum safe engine speed has been exceeded the valves should be regarded with suspicion. It is difficult to determine the mechanical condition of a valve by visual inspection, and if in doubt a new valve should be fitted.

Preliminary Work.
It is necessary to remove the petrol tank in order to carry out decarbonisation, and advisable to remove both side panels, which are quickly detachable, each being held in position by two snap-fasteners.

Turn off the petrol taps, and unscrew the pipe connections at both ends (bolt fixing at the carburettor), taking care not to lose the sealing washers, otherwise it will be impossible to remake a petrol-tight joint.

Disconnect the strap beneath the front of the tank (steel tanks only). The latter is insulated from direct contact with the frame by rubber mountings on the top tube and is held in position by a captive bolt and nut, which are exposed when the rubber cap is removed. Unscrew the nut, and note carefully the sequence in which the various components are withdrawn, so that they can be reassembled in the same manner, and remove the tank. Next, remove the high-tension leads from the sparking plugs, and then unscrew the plugs from the cylinder head.

Remove the air filters from the carburettors which can now be taken off, and, to save disturbing the slides etc., can remain attached to their cables and tied up out of the way. Examine the special heat-resistant gaskets fitted between the carburettor flanges and the head and if there is any sign of leakage or damage on the faces they must be replaced, otherwise it will be difficult to obtain correct carburation. Similarly the paper washer at each side of the gasket should be replaced if necessary. The face of the carburettor flange incorporates a synthetic rubber ring to preserve an air-tight joint, and this too, should be examined for soundness.

Next, disconnect the oil feed pipe to the rockers at its union on the back of the cylinder head, and then remove the engine steady between the frame front and cylinder head.

Remove the exhaust pipe connections followed by the pipes themselves.

The exhaust pipes are a push-fit in the head, and any tendency for the pipes to adhere to the head or the silencers, due to carbon, can be overcome by the application of a soft mallet, which will avoid damage to the plating.

Removing the Rockers and Cylinder Head.
The rocker assembly is enclosed by an aluminium cover, which can be lifted off its studs after the six nuts have been removed. If the engine is in the frame it will be necessary for the front centre stud to be unscrewed in preparation for cylinder head removal. Examine the gasket carefully, and replace with a new one if there is any sign of damage, in order to ensure an oil-tight joint.

Now remove the push-rods. These must be dealt with individually, the engine being first rotated so that the normal valve clearance is present, and the rocker adjusting screw and the push-rod are not subjected to spring pressure. Unscrew the adjuster completely, when the rocker arm can be depressed sufficiently for the push-rod to be taken out (Fig. 11).

Two of the cylinder head bolts cannot be removed without first dismantling the exhaust rocker assembly. Take off the nut and spring washer from the end of the spindle and tap it out of its supports, applying a soft punch to avoid damage to the threads. Note that the rockers are spring-loaded at their outer ends with a thrust washer at the inner end. It is essential that the washers are fitted in their correct relationship with the rockers, to ensure that the adjusting screws are central with the valve stem, and that the push-rods are positioned correctly.

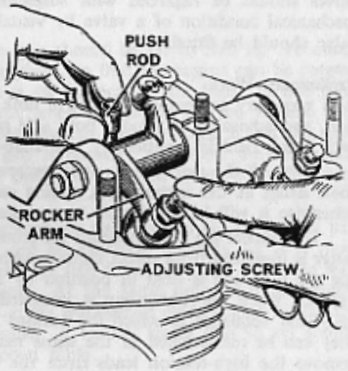


FIG. 11.
Removing the push-rods. Each rod and rocker must be treated individually.

The inlet rockers need not be disturbed. If, however, the inlet rocker spindle is removed, it is preferable to replace it in the same mountings.

There are nine attachment points between the cylinder head and barrel, five of which are by means of bolts, and, following the removal of the exhaust rockers, all can now be removed. The remaining four fixing points are by studs, and their nuts are directly accessible. Gently tap the underside of the exhaust ports with a soft mallet to free the joint, and lift the head clear.

Note that a split metering pin is used at the centre mounting of the inlet rocker spindle to regulate the flow of oil to the rockers etc. If defective, this pin must be replaced by another of the same diameter for which purpose it will be necessary to unscrew the oil feed union at the back of the head. Do not disturb unnecessarily.

Cylinder Head Gasket.

Examine this carefully for defects. Dark stained patches, especially between the cylinder bores, may indicate a leakage of gas. Any signs of burning at the edges of the copper-abestos gasket round the cylinder bores will be self-evident, and in either of these instances the gasket must be replaced with a new one.

Later models are fitted with solid copper gaskets which should be annealed before re-using (see page 28).

Removal of the Valves. (FIG. 12).

The operation is greatly simplified if the proper tool is used, and this is available as B.S.A. Service Tool No. 61-3340. The illustration shows the application of the valve spring compressor, when it is only a matter of closing the spring sufficiently for the split collets to be removed. A sharp tap on the top of the tool may be necessary to free the collets.

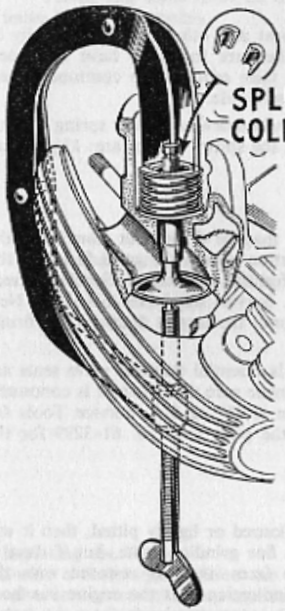


FIG. 12.
Removing a valve with the aid of Service Tool No. 61-3340.

The valve stems must also be examined for wear. If an appreciable ridge has formed at the end of the portion bearing in the valve guide, the valve must be replaced.

Decarbonising.

Scrape all the carbon from the combustion chambers, taking great care not to scratch the soft aluminium surface or to damage the sparking plug threads. The ports must also be scraped free from carbon, and every care taken not to damage the valve seat faces with the decarbonising tool. A suitable instrument for this job is an old screwdriver, the edges of which have been rounded by wear, and provided that a little patience is employed, all traces of carbon can be removed to leave the surfaces smooth and unmarked.

On no account must the cylinder head be submerged in a solution of caustic soda in an effort to dissolve the carbon, because of the harmful effects of this solution on aluminium.

Plug the push-rod tunnel with clean cloth to keep out foreign matter, depress the starter pedal gently until the pistons are at the top of their stroke, and remove all the carbon from the crowns and valve pockets. Here, too, great care must be used not to damage the soft aluminium surfaces. The piston crowns and combustion chambers can be polished with fine metal polish. Finally, rotate the engine to lower the pistons to the bottom of the bore and wipe all loose carbon from inside the bore.

The Valve Springs.

These tend to lose their efficiency due to heat and other causes, especially in the case of the exhaust springs, and if they are found to have shortened appreciably they should be replaced. It is false economy to continue to use them when they are at the end of their useful life.

The correct free lengths of these springs when new are: outer spring 1¾ in.; inner spring 1$\frac{7}{16}$ in. On Wasp models only, the spring lengths are: 1⅝ in. and 1½ in. respectively.

Replacing the Valve Guides.

If the valve guides are worn, the old ones may be driven out from inside the cylinder head using a drift with a pilot portion which is a good fit inside the guide. It is advisable to warm the head for this operation. Specially made drifts for this job are available as B.S.A. Service Tool No. 61–3382. New guides should be driven in from the top, until the largest diameter fits firmly against the head.

When new guides have been fitted, it is essential that the valve seats are refaced with a proper valve seat cutter, to make sure that the seat is concentric with the guide bore. The valve seat angle is 45°. B.S.A. Service Tools for this particular task are No. 61–3293 for the pilot and No. 61–3299 for the cutter.

Examination of the Valves and Seats.

If the valves and their seats are only discoloured or lightly pitted, then it will be sufficient to grind them in with a little fine grinding paste, but if there is considerable evidence of pitting then the faces must be restored with the proper equipment. This also may be an indication that the engine has been run with insufficient valve clearance, or with incorrect mixture from the carburettor, or late ignition timing.

An excessively pitted valve must be refaced by mechanical means, as attempts to grind-in the valve with paste will only result in the removal of too much metal from the seats in the head, with consequent "pocketing" and its attendant adverse effect on performance. This is all the more important with an aluminium head, where the valve seats are cast in position and cannot be replaced.

It is probable that the seats in the head will be in good condition, as the valves are usually the first to require attention, but if they are badly pitted, the seats should be refaced with a proper seat cutter.

Valve Grinding.

Grinding with fine-grade paste should be sufficient to ensure that a good gas seal is created. If the valves are in poor condition, but not bad enough to warrant machine grinding, start with the coarse-grade of paste and finish off with the fine, being careful to remove all traces of the coarse paste before changing over.

Smear a small quantity of grinding paste on to the face of the valve and return the valve to the same seat from which it was removed. A light spring inserted under the valve head greatly facilitates the grinding operation, as it assists in raising the valve so that it can be rotated to a new position periodically. Grip the valve head with the special suction cup available as B.S.A. Service Tool No. 65–9240 and rotate the valve backwards and forwards whilst maintaining a light pressure. Grinding should be continued until the mating surfaces of the valve and seat show a uniformly matt metallic surface all round.

Valves and seats must be thoroughly cleansed of all traces of grinding paste before reassembly.

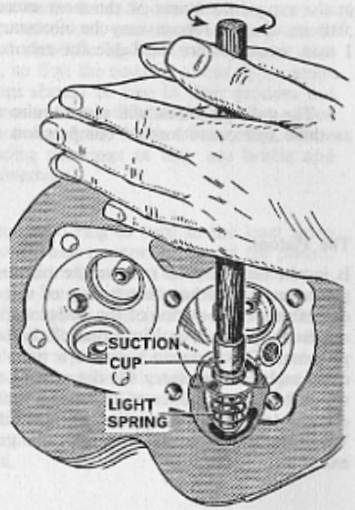


FIG. 13.
Grinding-in the valves, showing the method of using B.S.A. Service Tool No. 65–9240.

Replacing the Valves.

Smear a little engine oil on the valve stem and replace the valve. Refit the valve spring retaining cup against the cylinder head, followed by the springs and the top collar. Using the same tool as for dismantling the valves, compress the springs until the two collets can be inserted, when the springs can be gently released.

A coat of grease on the exposed end of the valve stem will assist in keeping the collets in position as the spring is released. Make sure that the collets are correctly seated in the recess on the valve stem. One end of the outer spring has reduced pitch coils (i.e. the coils are closer together) and the springs must be assembled with this end nearest to the cylinder head seating. Wasp valve springs are similar at both ends.

Removing the Cylinder Block.

Unless the condition of the engine indicates that the piston, rings, or cylinder bores require attention, it is not advisable to disturb the cylinder block. Symptoms indicating faulty piston rings might include heavy oil consumption, poor compression (but only if the valves are in good order, otherwise they are much more likely to be the cause) and excessive piston slap when warm. The latter might be due to worn bores which can be checked without removing the block if the pistons are moved to the bottom of their stroke, thus exposing the bores for examination and measurement.

If it is decided to take off the block, first set the pistons at the bottom of their stroke, then remove the nuts round the cylinder base flange and gently lift the block upwards until the pistons slide out from the bores. It is as well to have an assistant to steady the pistons as they emerge, to avoid possible damage. As soon as the block has been withdrawn, cover the crankcase mouth with a clean piece of cloth to keep out any foreign matter. Scrape the paper washer off the cylinder base flange and/or the crankcase face.

The tappets are retained in the block by means of circlips at their upper end.

Checking the Cylinder Block.

Examine the cylinder block carefully for wear, and if a deep ridge has formed at the top of the bores or the wear exceeds a maximum permissible figure of .010 in. then a rebore may be necessary. Pistons and blocks ½ mm. and 1 mm. oversizes are available for rebore purposes.

The cylinder block will also require a rebore if there are any deep scores, as these will cause loss of compression and excessive oil consumption.

The Pistons.

It is not necessary to remove the pistons or the rings unless they require replacement or further dismantling of the engine is to be carried out, in which case, first prise out one of the gudgeon pin circlips in each piston, by inserting a suitably pointed tool into one of the notches provided in the piston for this purpose. The gudgeon pins are a tight fit in the pistons when the latter are cold, and it is necessary for the pistons to be warmed by wrapping in a cloth which has been immersed in boiling water and wrung out. Alternatively, an electric iron can be applied to the piston crowns until thoroughly warm. When the piston is warm remove the gudgeon pin with the aid of a suitable extractor.

Mark the inside of each piston to enable it to be replaced the correct way round, and in the same bore from which it was removed.

If there are any obvious high spots on the piston, indicated by highly polished areas, they should be smoothed down with a smooth file. While it is important that all serious high spots are removed, this form of attention should not be overdone. An adequate running-in period is the best safeguard against piston troubles.

Warm each piston before refitting its gudgeon pin, which should be dipped in engine oil and tapped into position while the piston is supported from the opposite side. On no account must the replacement of the circlip be overlooked. Always use new ones and make certain they are pressed firmly into their grooves, because if they should come adrift, the cylinder bore will be damaged.

While the pistons are removed it is a good opportunity to check the connecting rods for any signs of wear. The rods should revolve freely without any signs of up and down movement at the big-end. Rotate the crankshaft until the crankpins are uppermost. With each connecting rod set vertically in turn, grasp it firmly and try to move it up and down. If any play can be detected the big-end bearings will require replacement. Do not confuse sideways movement at the little-end with up and down play. The big-end should have approximately .020 in. side-play and this permits some sideways movement at the other end of the connecting rod.

The Piston Rings.

The faces of the piston rings in contact with the cylinders should possess a smooth metallic surface, and any sign of discolouration or shiny portions means that the rings are defective and must be replaced. They must also possess a certain amount of springiness, so that the ends lie about $\frac{1}{16}$ in. apart when released from the block. The rings should be free in their grooves but if they are stuck, they must be prised free and removed from the piston, when all carbon can be cleared from the grooves and the inside of the rings. Care is necessary when removing and replacing the rings as they are brittle and only permit a minimum amount of movement.

To check the piston ring gaps, place each ring in turn in the least worn part of the bore from which it was removed, and temporarily insert the piston, pushing it against the ring to make sure it is truly located in the cylinder bore. Withdraw the piston and measure the gap between the ends of the ring with the aid of a feeler gauge (Fig. 14). The correct gap is .008—.013 in., and although an increase of a few thousandths of an inch is not important, any large increase means that the ring should be replaced. It is unlikely that new rings will have gaps of less than the amount specified, but if so, the gaps can be opened out to the correct figure with the careful use of a very fine file. Make sure that there is no fraze on the edges of the joint after filing. The lower compression ring has a taper contact face and a replacement must be fitted in the correct manner, as marked.

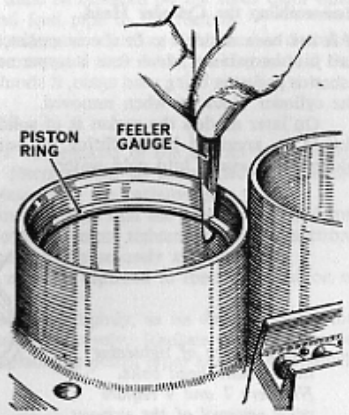


FIG. 14.
Checking the piston ring gap. The ring must be fitted parallel with the end-face of the bore.

Replacing the Cylinder Block. (FIG. 15).

Fit a new paper washer to the crankcase face, lightly smearing with jointing compound before doing so. Before replacing the block, prepare two pieces of wood, ½ in. square by about 8 in. long, so that they can be laid across the crankcase mouth under the pistons, one in front and one behind. These will enable the pistons to be held square while the block is lowered, and at the same time prevent them from descending into the crankcase.

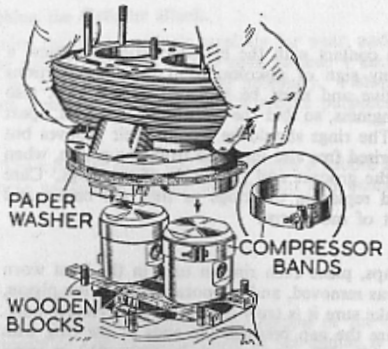


FIG. 15.
Replacing the cylinder block. The compressor bands are B.S.A. Service Tools 61–3682 (500 c.c. engines), 61–3707 (650 c.c. engines).

It will simplify the fitting of the block if the piston rings are compressed into their grooves with the aid of "slippers" as shown in the illustration. These are obtainable under B.S.A. Service Tool No. 61–3707. Apply a liberal coating of clean engine oil to the pistons and position the ring gaps equally round the piston. Using two slippers compress the rings so that they are just free to move, then replace the block, removing the slippers after the rings have entered the bores. Remove the two wooden bars and lower the cylinder block into position. Replace all nuts and washers round the cylinder base flange, tightening down firmly and evenly.

Reassembling the Cylinder Head.

If it has been decided to fit a new gasket, this can now be placed in position, and it is immaterial which face is uppermost. Alternatively, if the old copper-asbestos gasket is being used again, it should be fitted with the same face against the cylinder block as when removed.

On later models the gasket is of solid copper and if it is being re-used it should be annealed before fitting by heating to a dull red appearance and plunging edgeways into cold water.

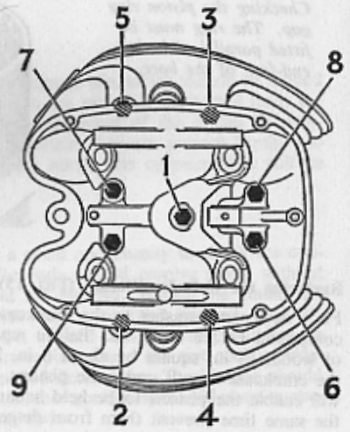


FIG. 16.
The sequence of tightening the cylinder head bolts. Numbers 7 and 9 require prior removal of the exhaust rocker spindle.

Having ground the valve seats and replaced the valves, springs, etc., in position the head can now be lowered into position and bolted down. To ensure even distribution of pressure with consequent freedom from distortion, tighten the bolts and nuts in rotation, as shown in Fig. 16. This sequence should be followed several times, tightening a little more each time, until all fixing points are really tight. The bolts should be tightened with a torque spanner set to 25 lbs./ft. When the machine has covered its first 250 miles after decarbonisation, or when new, check the tightness of the cylinder head bolts and nuts. The engine must be quite cold when this is done.

The push-rods are in pairs of different lengths, the longest operating the exhaust rockers from the two centre tappets, and the rods can now be loosely placed in position. Tap the rocker spindles into place with their rockers, thrust washers and springs in their correct order, and tighten the spindle end nut. The spindles should be assembled in the same mountings from which they were removed.

Each rocker must be dealt with in turn. As the engine is rotated slowly, the push-rods will be seen to rise and fall according to the action of the camshaft on the tappets. As soon as one of the push-rods has reached its lowest position, insert the appropriate rocker ball-end into the cup on the upper end of the rod, and screw up the adjuster on the opposite arm of the same rocker to give approximately the correct valve clearance. Repeat this procedure for the remaining rockers and push-rods, and when all are in position, set the valve clearances accurately in accordance with the instructions given on page 15.

Having decided whether or not a new gasket is necessary for the rocker cover joint, this can be fitted in position and the rocker cover replaced. Excessive tightening of the nuts should be avoided, otherwise the cover may be damaged. The two domed nuts must be replaced on the studs from which they were removed. Connect the oil feed pipe to the rockers.

Examine the sparking plugs, cleaning and adjusting if required as described on page 16. Replace these, and then connect their leads, making certain they are coupled to the correct plug.

Final Reassembly.

The carburettor flange gaskets must be replaced in the correct order before fitting the carburettors and the air filters should be dismantled and cleaned, as detailed on page 17, before replacing on the carburettors.

Now refit the exhaust system, making sure that the pipes are pushed into their original positions in the cylinder head before tightening their connections, and then add the engine steady, locking this securely at both ends.

The petrol tank rubber blocks must be replaced in the same position on the frame tube.

The central nut should be screwed up tightly, as its design ensures that the rubber bush cannot be compressed excessively. Replace the strap beneath the front of the tank and, finally, replace the petrol pipes and the side panels.

THE GEARBOX

Lubrication.

The oil level is pre-determined by means of a stand pipe built-in with the drain plug, and for the purpose of checking or replenishing the oil level, the drain plug must be left in position. Remove the level screw in the centre of the drain plug and add a quantity of the correct grade of oil through the filler aperture on top of the gearbox until the surplus flows from the level screw hole. When the flow ceases, replace the plug, after making sure its fibre washer is intact (Fig. 17).

Note:—For the level to be correct, the machine should be standing on its wheels on horizontal ground.

To drain the oil, which should preferably be undertaken while the oil is warm after a run, the drain plug and level screw can be removed together. Examine the rubber "O" ring before replacing the plug and renew if necessary. The gearbox capacity is ⅞-pint, and after adding this quantity, the level should then be checked as described above. Suitable oils for gearbox lubrication are given on page 12.

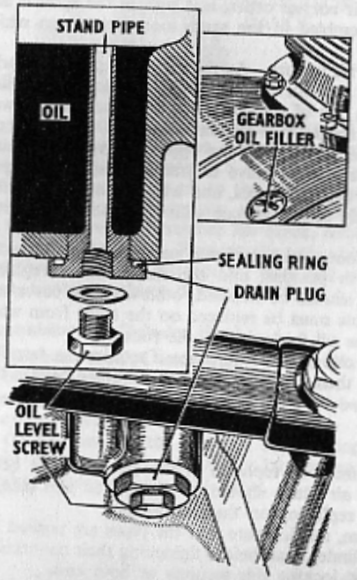


FIG. 17.
The gearbox oil level and drain plugs.

Replacing the Starter Pedal Spring. (FIG. 18).

This spring is enclosed within the outer timing case and becomes readily accessible when the cover is removed.

The starter shaft carries the spring retainer plate, which must be prised off the shaft, so releasing the spring. Note that the inner end of the spring hooks over a special anchor stud, which should remain undisturbed, otherwise its fixing nut on the inside of the case may be released. Fit the new spring loosely in position, with the inner hook looped round the anchor stud, and replace the plate so that its tongue overlaps the spring coils and engages with the outer spring hook. Turn the plate in an anti-clockwise direction (i.e. against the spring pressure), until it is possible to push the plate on to the flats on the spindle. Press firmly into position to provide correct clearance when the timing cover is replaced.

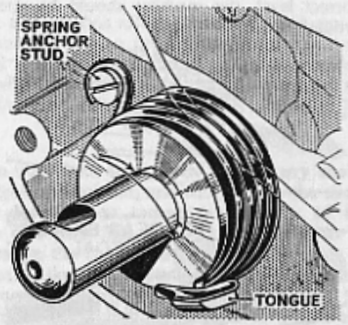


FIG. 18.
The starter pedal return spring.

Ratios.

Sprockets used for standard ratios are: engine 28T, clutch 58T. Engine and clutch sprockets are not variable, but changes in gear ratios can be made by altering the gearbox sprockets, which range from 17T to 21T inclusive.

Standard gear ratios for the various models are as follows:—

Model	*Gearbox Sprocket*	*Rear Wheel Sprocket*	*Top Gear*
ROYAL STAR	18T	47T	5.41
WASP	18T	47T	5.41
	17T (WEST U.S.A. ONLY)	47T	5.72
LIGHTNING	20T	47T	4.87
THUNDERBOLT	20T	47T	4.87
HORNET	20T	47T	4.87
	17T (WEST U.S.A. ONLY)	47T	5.72
SPITFIRE MK. II SPECIAL ...	21T	47T	4.64

THE CHAINS AND CLUTCH

Primary Chaincase.

There is a small, but regular, oil supply from the primary chaincase through the non-adjustable metered feed on to the rear chain, so that the oil level can be expected to fall very slowly.

The chaincase cover is retained by screws of varying lengths and one of these (Fig. 19), identified by its red painted head, determines the oil level. To replenish with oil, first remove this screw and then the filler cap. Add oil of the correct grade (see "RECOMMENDED LUBRICANTS", page 12) and allow to stand until any surplus oil has drained off. Replace the level screw, together with the filler cap. For draining purposes, the screw (also painted red) at the lowest point on the chaincase, should be removed. This screw must be replaced firmly to prevent accidental loss of oil. Too little oil will not lubricate the primary chain properly and, alternatively, an excessive quantity may cause the clutch to slip.

The chaincase capacity is ¼-pint of an S.A.E. 20 oil, and to ensure a correct level, the machine should be standing on its wheels on horizontal ground.

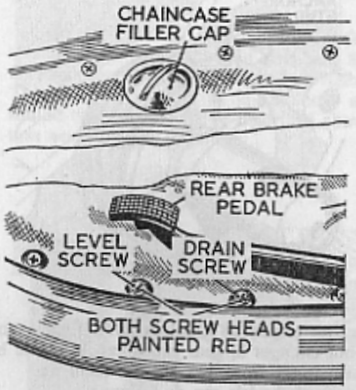


FIG. 19.
The primary chaincase oil level.

Primary Chain Adjustment. (FIG. 20).
Excessive slackness in the primary chain is undesirable and an adjustable slipper-type tensioner is provided on the lower run of the chain.

The chain is in correct adjustment when there is ⅛ in. of free play at the midway position between the sprockets. **It is most important that the chain should never be taut,** as this will cause undue loading of engine and gearbox bearings.

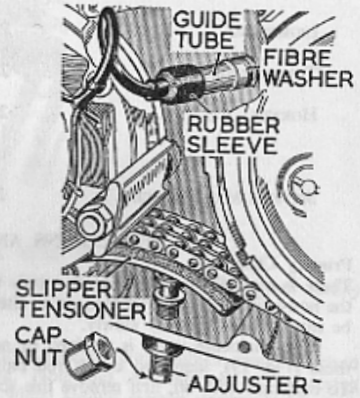


FIG. 20.
Adjustment of the primary chain.

The adjustment can be checked without removing the chaincase cover. Unscrew the filler cap, when the chain can be felt and its slackness gauged with the fingers. If adjustment is necessary, remove the adjuster cap nut (below the chaincase) and tighten the adjuster screw by means of the flats provided for the purpose (Fig. 20). When the chain slackness is correct, replace and tighten the cap nut securely and be sure to replace the fibre washer.

Primary Chain Removal.
The unit construction of the engine and gearbox allows the use of fixed centres between clutch and engine sprockets, so that a pre-stretched, endless chain of the triple-row type is fitted and a spring link connection is not provided. Because of this, in order to remove the chain, it is necessary to remove the chain, clutch, and generator together and full details for this operation are given in the Service Manual.

Rear Chain Lubrication.
Lubrication is provided by a chain oiler from the rear of the primary chaincase, which provides a metered supply of lubricant, and should keep the chain in good condition. **This supply is dependent on correct maintenance of the oil level in the primary chaincase (see page 31).** If maximum life is to be achieved, however, periodically remove the chain and wash it thoroughly in petrol to remove all dirt and grease. Allow the chain to dry completely then immerse it in a tray containing warm graphited grease. When replacing the chain make sure that the spring clip of the connecting link has its closed end pointing in the direction of travels of the chain (i.e. forwards on the top run).

Rear Chain Adjustment.
Put the machine on its centre stand. To adjust the chain, the rear wheel must be moved. First, the nut securing the torque arm to the brake plate must be slackened slightly so that the plate may pivot freely. Slacken the spindle (B) Fig. 21, on the right-hand side of the machine, a few turns, and then nut (A) just sufficiently to allow the wheel to move.

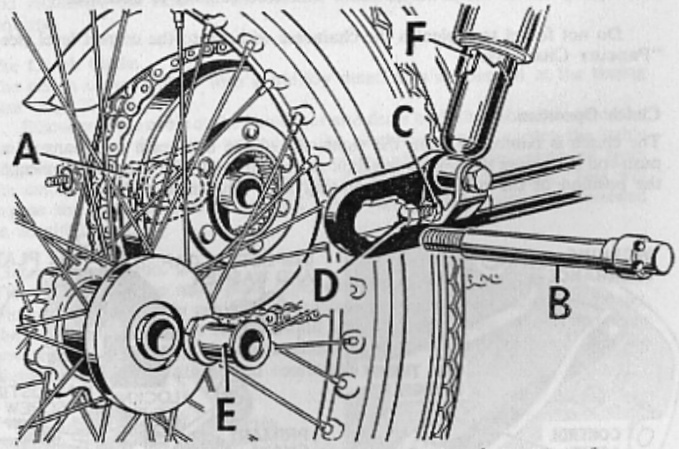


FIG. 21. *Rear wheel removal, also showing the position of the adjuster bolts for moving the wheel. (Speedometer drive not shown).*

Slacken the locknuts (C) and unscrew the adjusters (D) to tighten the chain. With the wheel in its lowest position, there should be a total up and down movement of 1¼ in. in the centre of the chain at its tightest point. Ensure that the wheel spindle is against the adjusters and that the wheels are in line (see "WHEEL ALIGNMENT").

Tighten the nut (A) first, then the spindle (B) and finally the nut securing the torque arm to the brake plate. Re-check the chain adjustment and the wheel alignment.

Wheel Alignment.

It is advisable to check the wheel alignment whenever the rear chain is adjusted, and this is checked preferably by means of a long straight-edge placed along the sides of the wheels, but it must be remembered that the edge must be stepped to clear the stand and to suit the difference in tyre sizes between front and rear wheels. Apply the straight-edge at a point as much above ground level as possible and keep in a horizontal position. With the front wheel set straight ahead, the straight-edge should touch both wheels at two points.

Clutch Spring Pressure.

The clutch is contained within the primary chaincase and its springs are controlled by sleeve nuts, each of which can be screwed up in turn. It must be emphasised that each nut must be tightened exactly the same amount in order to preserve parallelism of the plates. A normal setting of the nuts is such that their faces are level with the pressure plate. This position is given as a guide only and it is a simple matter to vary it according to circumstances. If it is suspected that the plates are not running parallel with each other, individual adjustment of the springs may be necessary and in this case the chaincase cover must be removed. Depress the clutch lever, and operate the starter pedal so that the clutch plates rotate without turning the engine, when it can be seen whether or not the plates spin truly. If not, the sleeve nuts must be adjusted separately, either inwards or outwards, until each spring exerts the same pressure and true running is obtained.

Do not forget to replenish the chaincase with oil to the correct level (see "PRIMARY CHAINCASE").

Clutch Operation.

The clutch is controlled from the right side of the crankcase by means of a push-rod traversing the hollow gearbox mainshaft, and with increasing mileage the position of the rod and its operating lever may have to be reset.

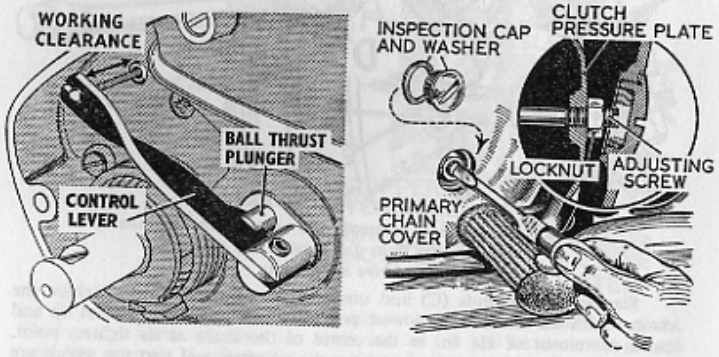


FIG. 22. *The clutch operation,*
(left) the control lever and its plunger,
(right) method of adjustment of push-rod.

When this becomes necessary, remove the inspection cap from the primary chaincase to reveal the adjusting screw and locknut at the centre of the clutch pressure plate. Slacken the cable adjustment at the handlebar and screw the adjusting screw inwards until all movement has been taken up. **Light pressure is all that is required.** Then unscrew the adjuster by one-half to three-quarters of a turn and tighten the locknut. This ensures a satisfactory working clearance for the control lever (Fig. 22). Any slackness in the cable can now be taken up by means of the finger adjustment at the handlebar lever. This should be set so that there is definite but not excessive amount of free play at the lever to ensure that the clutch is fully engaged. If the play is excessive the clutch will not disengage fully, resulting in a tendency for the machine to move forward when in gear with the clutch disengaged and for noisy gear engagement. Conversely, if there is no play present, the clutch will be liable to slip.

Should it be desired to examine the clutch control (and this should rarely be required) remove the gearchange and starter pedals followed by the outer timing cover. Slacken the cable adjuster at the handlebar and disconnect the cable at the control lever so that the latter can be moved aside for inspection of the push-rod end and the ball thrust plunger, which is a sliding fit in the crankcase (Fig 22). The end of the rod should be flat and if the ball shows signs of undue wear it should be replaced with another of 7/32 in. diameter. Smear with grease before assembly. Replace the plunger in the crankcase and reconnect the cable to the control lever, adjusting at the handlebar as required.

The Clutch Cable.

The clutch cable is fitted with a quickly detachable connection at the timing case (Fig. 23).

Disconnect the cable at the handlebar and draw back the rubber sleeve at the gearbox end of the cable to expose the abutment which carries the cable adaptor. The latter can be drawn out of the abutment, and removed from the cable, when the abutment itself can be taken out of the case. This will expose the cable connector, and the cable can be disconnected or renewed as required.

Clutch Plates. (FIG. 24).

The clutch is of the multi-plate type, comprising steel plates carrying special friction pads bonded in position, alternating with plain steel plates. Normally, the pads will not require renewal until after a considerable mileage has been covered, but when this becomes necessary, new plates can be fitted with the clutch in a partially dismantled condition.

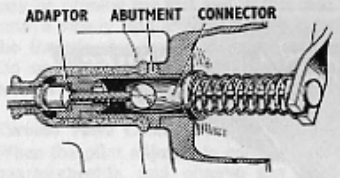


FIG. 23.
The clutch cable connection.

The plates are contained in the chainwheel mounted on the gearbox mainshaft, and it therefore requires removal of the primary chaincase cover to expose the clutch.

Examine the plates, and if the plain ones are scored they should be replaced by new ones. It will be obvious if the friction pads are excessively worn, but as an indication of the amount of wear which has taken place, they were approximately $\frac{1}{4}$ in. thick when new.

After reassembly, check that the plates run parallel with each other when the clutch is disengaged (see "CLUTCH SPRING PRESSURE", page 34). Re-adjust the clutch control as detailed under "CLUTCH OPERATION", page 34.

Do not forget to replenish the chaincase with oil to the correct level (see "PRIMARY CHAINCASE", page 31).

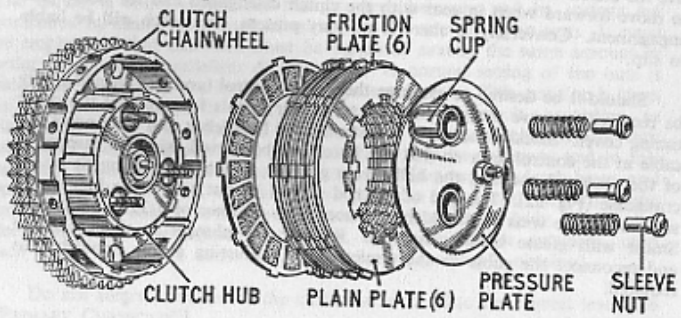


FIG. 24. *Assembly of the clutch plates.*

THE AMAL MONOBLOC CARBURETTORS

An exploded view of a carburettor is shown in Fig. 25. Opening the twist grip throttle control raises the throttle slide, thus controlling the supply of air to the engine. The tapered needle controlling the supply of fuel is attached to the throttle slide so that a balanced mixture is always provided. The needle has five notches at its upper end and it is secured in the throttle slide by a spring clip which locates in one of these notches. The throttle valve size and the needle position are carefully set before despatch from the factory and no alteration to these settings is necessary or desirable. The air valve is controlled by the handlebar lever and is used to restrict the air supply when starting the engine from cold.

Mixture control at tick-over, and low speeds is controlled by the pilot jet which has an adjustable air supply. An adjustable throttle stop is also provided to regulate the slow-running speed.

For normal road purposes, the standard settings will prove suitable. Under racing conditions the main jet size may require some alteration to comply with the atmospheric conditions, and, the fuel used. Always check the carburation in the following order and always at normal engine temperature:—

(1) Main jet for power at full throttle.
(2) Pilot jet for idling.
(3) Throttle cutaway for correct pick-up from idling.
(4) Needle position for good acceleration from quarter to three-quarter throttle.
(5) Finally re-adjust the pilot jet setting.

Main Jet Size.

The smallest jet which gives the greatest maximum speed should be selected, keeping in mind that if too small a jet is fitted overheating may occur. Provided that the correct sparking plug is being used, see page 16, it can provide an indication of whether the mixture is correct. After a run at full throttle stop the engine at once, without allowing it to run slowly, and remove the plug. If the plug end is grey put in a bigger main jet. The plug end should be a smooth jet black, but if it is a sooty black the mixture may be too rich. The air lever must be fully open during these tests.

Pilot Jet Adjustment.

Screwing in the pilot air screw restricts the air supply, thus giving a richer mixture, and unscrewing it weakens the mixture. The best way to adjust is to screw in the pilot air screw until the mixture is obviously too rich and the engine starts to run irregularly, then unscrew the adjuster until the engine runs evenly. When the proper adjustment has been determined, the engine may be running too fast and in this case the throttle stop should be unscrewed until a steady and even tick-over is achieved. If considerable alteration to the throttle stop has been made, the pilot air screw should be re-adjusted. Do not attempt to obtain an excessively slow tick-over as it will probably become unreliable under different atmospheric conditions.

Throttle Valve Cutaway.

When the pilot adjuster is correctly set, open the throttle progressively up to quarter-throttle, and observe any points where the exhaust note becomes irregular. If such a point is reached leave the throttle in that position and close the air lever slightly; this will indicate whether the spot is rich or weak. To cure richness fit a throttle valve with more cutaway on the intake side, and less cutaway to counteract weaknesses.

Jet Needle Position.

The needle jet is the major controlling factor from quarter to three-quarter throttle. Run the machine at these throttle openings and test for rich or weak spots as described above. The needle can be raised or lowered by re-locating the spring clip in one of the grooves at the top of the needle. Raising the needle gives a richer mixture and vice versa, but normally the needle should only be moved one notch at a time.

Finally, re-adjust the pilot jet and then a properly balanced mixture should be obtained throughout the full throttle range.

The settings given on page 3 are those normally recommended and will be suitable for most atmospheric conditions. They are intended for use at altitudes of 0—3,000 feet. Above this height some reduction in main jet size is necessary to provide a balanced mixture. At altitudes of 3,000—6,000 feet a reduction in main jet size of 5% is usually necessary, and for every 3,000 feet increase over 6,000 feet a further 4% reduction is required.

THE AMAL 10 G.P.2 CARBURETTOR

Tuning—General.

The tuning sequence of the G.P.2 carburettor follows the well established Amal principles, inasmuch as there is a main jet controlling the fuel supply at full throttle, a needle jet, the emission from which is controlled by the position of a taper needle and at the lower throttle openings by the cutaway of the throttle valve, a detachable pilot jet and a pilot air adjusting screw controlling the mixture strength for idling; an air jet controls the amount of air which primarily atomises the fuel as it leaves the needle jet before going into the spray tube and thence to the heart of the choke.

Sequence of Tuning.

This follows the standard Amal practice and should be carried out in the following order: 1st, main jet size; 2nd, pilot adjustment; 3rd, throttle valve cutaway and 4th, needle position.

(1) MAIN JET SIZE.
This should be determined first; the smallest jet which gives the greatest maximum speed should be selected, keeping in mind the safety factor for cooling. The air lever should be fully opened during these tests.

(2) PILOT ADJUSTMENT.
Before attempting to set the pilot air adjuster the engine should be at its normal running temperature otherwise a faulty adjustment is possible, which will upset the correct selection of the throttle valve. The pilot air adjuster is rotated clockwise to enrich the mixture and anti-clockwise to weaken it. Adjust this very gradually until a satisfactory tick-over is obtained, then reset the locknut, but take care that the achievement of too slow a tick-over (that is slower than is actually necessary) does not lead to a "spot" which may cause stalling when the throttle is very slightly opened.

(3) THROTTLE CUTAWAY.
Having set the pilot air adjuster, open up the throttle progressively and note positions where, if at all, the exhaust note becomes irregular. If this is noticed, leave the throttle open at this position and close the air lever slightly; this will indicate whether the spot is rich or weak. If it is a rich spot, fit a throttle valve with more cutaway on the air intake side (or vice versa if weak).

(4) JET NEEDLE POSITION.
Tuning sequence 2 and 3 will affect carburation up to about over one-quarter throttle, after which the jet needle, which is suspended from the throttle valve, comes into action and when the throttle is opened further and tests are again made for rich or weak spots, as previously outlined, the needle can be raised to enrich, or lowered to weaken the mixture, whichever may be found necessary. With these adjustments correctly made, and the main jet size settled, a perfectly progressive mixture will be obtained from tick-over to full throttle.

Float Chambers.

The float chamber fitted to the G.P.2 carburettor is a remotely mounted type 510 and is of bottom feed design incorporating a lever-type operated float.

Petrol Level.

The petrol level in the type 510 float chamber is .640 in. below the cover joint and is marked with a raised line on the outside of the body. In positioning the float chamber, this line should be level with the lowest point of a circular scribe mark on the air jet plug.

Setting Twin Carburettors.

Slacken the throttle stop screws and close the twist grip at the same time, ensuring that some slack is present in the cables by resetting the cable adjusters above the carburettor. Now reset the cable adjusters (with the throttles closed) so that the slightest movement of the twist grip causes both throttles to open simulanteously.

Set the carburettor in accordance with the procedure given on page 37.

For slow-running, set the twist grip to make the engine run slowly but just faster than tick-over and carefully screw in the throttle stop screws to retain the throttle in their respective positions. Close the twist grip leaving the engine running on the throttle stops.

Set each carburettor as outlined under "PILOT JET ADJUSTMENT", page 37 to obtain idling, by unscrewing the throttle stop screws gently and adjusting the pilot air screws accordingly. This can be carried out on one cylinder at a time by disconnecting the sparking plug lead from the other cylinder. It is essential that the speed of idling on both cylinders is the same.

It is worthwhile taking care to ensure that the control cables are accurately adjusted without any difference in slackness or excessive slackness otherwise one throttle slide will be out of phase with the other, causing "lumpy" running.

Check for simultaneous opening of the throttles by closing the twist grip so that the slides rest on their stop screws in their final position of adjustment. Then, with a finger on each of the throttles, open the twist grip with the other hand and feel that the slides lift off their stops at the same time.

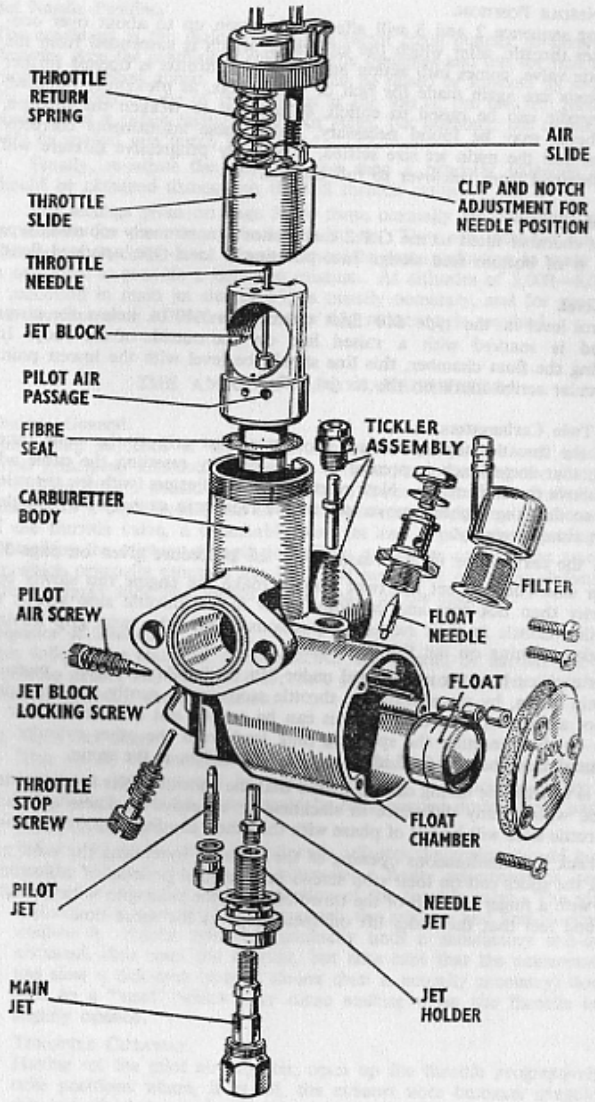


FIG. 25. *The Monobloc carburettor (settings for the various models are given on page 3).*

Tyres.
At weekly intervals and always before setting out on a long journey, the inflation pressures should be checked carefully. Under-inflation will not only seriously affect the life of the tyre, but will also affect the steering of the machine.

Correct pressures are given in the "TECHNICAL DATA" pages, and it should be noted that these are given for a rider of 140 lb. weight. If the rider's weight exceeds 140 lb. increase the tyre pressure as follows:—

FRONT TYRE: Add 1 lb. per sq. in. for every 28 lb. increase above 140 lb.
REAR TYRE: Add 1 lb. per sq. in. for every 14 lb. increase above 140 lb.

For sustained high speeds (i.e. in excess of 90 m.p.h.) normal pressures should be increased by 5 lb. per square inch. If a pillion passenger or luggage is carried, the actual load upon each tyre should be determined, and the pressures increased in accordance with the Dunlop Load and Pressure Schedule.

Hubs.
Both hubs are fitted with ball journal bearings which do not require adjustment. The bearings are packed with grease during assembly and no further greasing is required until the hubs are dismantled for overhaul.

Speedometer Drive.
The speedometer is driven from the back wheel spindle by means of a reduction gear unit, the ratio depending upon tyre size. If the tyre is changed to a different size then a different reduction gear unit will be required, otherwise the speedometer will give incorrect readings.

Brake Cams.
The cam on the front wheel is fitted with a grease nipple, but it must be emphasised that greasing must not be carried to excess. All that is required is a single application of the grease gun. For the rear brake cam, apply two or three drops of oil to the spindle through the hole revealed after rotating the spring clip.

Brake Adjustment.
Both brakes are provided with knurled finger adjusters. The front brake also has an additional adjuster on the handlebar lever so that the brake can be re-adjusted from the seat. For obvious reasons the brakes should always be kept at maximum efficiency and for this to be maintained the brakes should be adjusted whenever the hand lever or foot pedal movement has become excessive. Shoes should be just clear of the drum when the brake is off, but close enough for immediate contact when the brake is applied. The brakes must not be adjusted so closely, however, that they are continually in contact with the drum, otherwise excessive heat may be generated, resulting in deterioration of braking efficiency.

If necessary, the front brake cam lever can be fitted on a different serration or turned over to give a "half-way" position to provide further cable adjustment.

Front Wheel Removal and Replacement.
To detach the wheel first disconnect the brake cable by withdrawing it from the slotted clevis at (E) Fig. 26. and unscrewing it from the bracket at (F). Remove the torque arm nut (C) slacken nuts (D) and undo the pinch bolt (A). Insert a tommy bar in the hole in the head of the spindle at (B) and unscrew the spindle, noting that it has a left-hand thread and therefore unscrews in a clockwise direction. Support the wheel as the spindle is withdrawn, and when it is clear the wheel can be pulled away from the right-hand fork leg and removed from the machine.

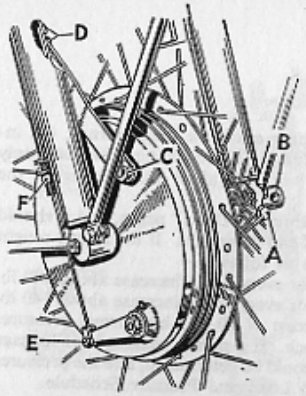


FIG. 26.
Front wheel removal.

After removal do not let the wheel fall on to the bush which projects rom the brake drum side of the hub. Although the bush is pressed in, it may, if subjected to a sharp blow, be forced back into the hub. If this should happen the bush can be retrieved and re-positioned with the aid of the wheel spindle.

When the wheel is replaced it is most important that after the spindle has been tightened but before the pinch bolt is tightened, the forks are depressed once or twice to enable the left-hand fork end to position itself on the spindle shank. If this precaution is not observed, the fork leg may be clipped out of position and will not function correctly.

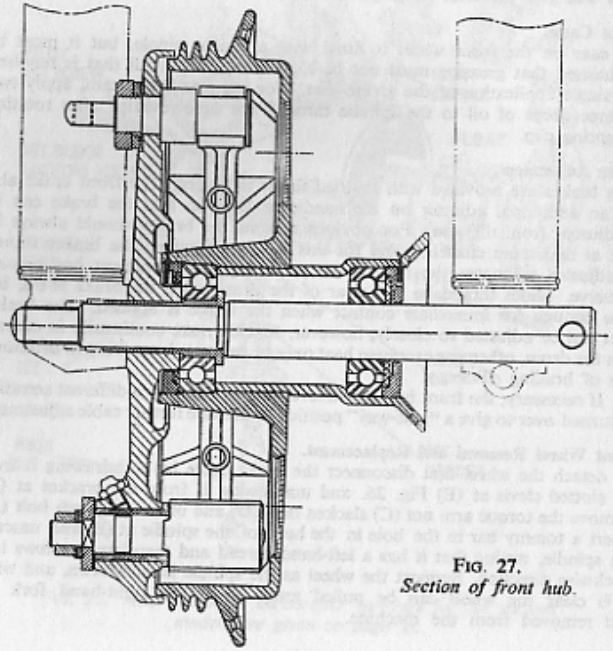


FIG. 27.
Section of front hub.

Rear Wheel Removal.
Removal of the wheel does not affect the chain or brake adjustment. Remove the spindle (B) Fig. 21. It has a normal right-hand thread and therefore unscrews in an anti-clockwise direction. The distance bush (E) falls clear when the spindle is removed and the wheel can then be pulled away from the brake drum and withdrawn from the machine.

When detaching the rear wheel it is unnecessary to touch the hexagon nut (A) on the left-hand side.

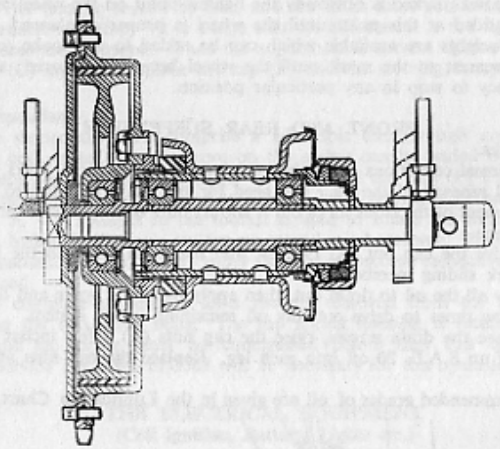


FIG. 28. *Section through rear hub*

Brake Shoe Removal and Replacement.
After the brake plate has been removed from the wheel, the brake cam lever should be detached and the cam spindle pushed in slightly to allow the shoes to clear the brake plate. Insert a screwdriver between the brake shoes at the fulcrum pin and twist the screwdriver.

Place a small lever between one of the shoes and the cover plate and lever the shoe away from the plate until the spring pressure is released. Both shoes can then be lifted away from the cover plate.

The shoes can be replaced by the reverse procedure. Hook the springs on to the shoes and place the ends of the shoes in position on the fulcrum pin and cam lever. Then push the shoes outwards until the springs pull them into their correct position.

Note:—The brake shoe springs are quite strong and care should be taken that the fingers are not trapped by the brake shoes during these operations.

Wheel Balancing.
Wheels which are out of true or out of balance will have a detrimental effect on steering. Wheel trueing is a job best left to the specialist, but the spokes should be examined occasionally to see that none of them show any signs of working loose. Single spokes can often be retightened or replaced without affecting the true of the wheel, but if a number of spokes have been affected the wheel should be re-trued.

As soon as the machine has been run-in, the wheels should be balanced, and they should be re-balanced whenever new tyres or other components have been fitted.

Support the machine so that the wheel is off the ground and make sure that it spins freely. If there is any sign of stiffness investigate the cause, as unless the wheel is free it will be impossible to balance it correctly. Rotate the wheel slowly and allow it to settle. Mark the uppermost point of the tyre. Repeat the operation to check that the wheel always stops in the same position.

The point marked is obviously the lightest point on the wheel and weight must be added at this point until the wheel is properly balanced. Specially designed weights are available which can be added to the spoke (or spokes) that are nearest to the mark until the wheel becomes balanced, and shows no tendency to stop in any particular position.

FRONT AND REAR SUSPENSION

Front Forks.

Under normal conditions the only servicing which the front forks require is occasional renewal of the oil. The need for this may be indicated by excessive movement of the front forks but it should only be necessary after considerable mileage.

Remove the cap nut (A) Fig. 29, and the drain screw in the lower end of the fork sliding member.

Allow all the oil to drain out, then apply the front brake and depress the forks a few times to drive out any oil remaining in the system.

Replace the drain screws, raise the cap nuts (A) a few inches and pour ⅓-pint of an S.A.E. 20 oil into each leg. Replace the cap nuts and tighten firmly.

Recommended grades of oil are given in the Lubrication Chart, page 12.

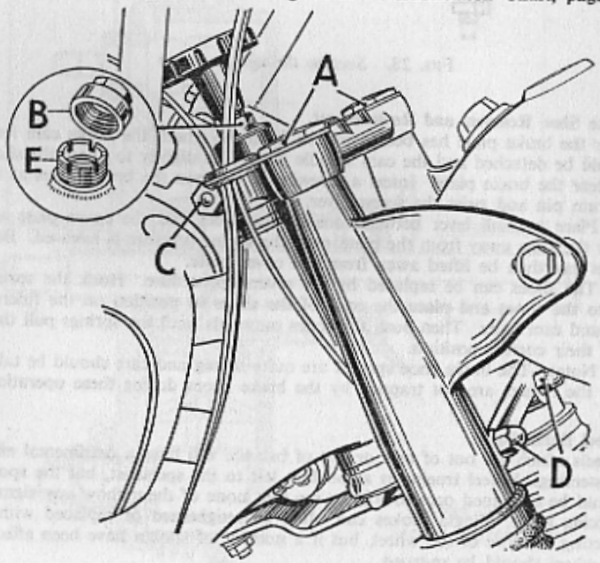


FIG. 29. *Steering head adjustment.*

Steering Head Adjustment.

The steering head should be tested occasionally for play and to ensure that it rotates freely. Support the crankcase on a box so that the front wheel is clear of the ground, then grasp the front fork legs and attempt to push them backwards and forwards. If any play is detected the steering head must be adjusted.

Unscrew the steering damper and remove the top cap (B) Fig. 29. Slacken the clamping nuts (C) and (D), then tighten down the sleeve (E) until the adjustment is correct. Hold the handlebars lightly and move them round slowly. The steering should be free, and the forks must rotate smoothly. If the movement is "lumpy" it is a sign that the adjustment is too tight, or that the ballraces are damaged. When the adjustment is correct tighten the clamping nuts (C) and (D), replace the cap (B) and the steering damper.

Rear Suspension.

The two suspension units comprise a telescopic damper unit and a totally enclosed coil spring. The pressure on the spring can be varied by means of a three-position cam adjuster at the lower end of the unit (F) Fig. 21. The springs can therefore be adjusted to suit the load conditions or nature of the ground. A "C" spanner in the toolkit is used to rotate the cam ring.

The hydraulic dampers require no attention whatsoever. They are sealed during manufacture and if they suffer damage or become ineffective they must be replaced.

The complete suspension units can be removed from the frame after detaching the two pivot bolts. The top spring housing is retained by two collets and the spring must be compressed before they can be removed. B.S.A. Service Tool No. 61-3503 will be necessary for this operation.

THE ELECTRICAL EQUIPMENT
(Coil Ignition, Battery, Lights etc.)

Electrical energy in the form of rectified alternating current passes through the battery from the Lucas A.C. lighting/ignition unit, which comprises a 6-pole alternator and rectifier. The rectifier converts the alternating current output of the alternator to uni-directional current which is essential for battery charging.

Rectifier.

The nuts clamping the rectifier plates together must not under any circumstances be slackened, as the pressure has been carefully set during manufacture to give correct rectifier performance. A separate nut is used to secure the rectifier to the frame of the motor-cycle.

Battery Topping-up.

At weekly intervals (see "ROUTINE MAINTENANCE", page 10), and more frequently in warm climates, check the electrolyte level in the battery cells; if neceesary, add distilled water to maintain the level indicated by the blue line. Do not add the water while the battery is on charge (either on or off the machine), nor use naked lights when examining the condition of the cells.

Battery—Maintaining Condition.

Never leave the battery in a discharged condition. If the motor-cycle is to be out of use for any length of time, have the battery fully charged, and every two weeks give it a short refreshing charge at .7 ampere to prevent any tendency for the plates to become permanently sulphated.

The A.C. lighting/ignition unit has been designed for positive (+) earth systems. If the battery connections are reversed the equipment will be damaged, and it is therefore most important that, whenever the battery leads are being attached, **the positive (+) lead must be connected to the frame.**

Contact Breaker Unit.
The contact breaker points must always be kept free from grease or oil, and the gaps checked at intervals. It is also advisable to check the gaps after the first 500 miles (see page 20).

Lighting Equipment—Headlight Beam Setting.
When the motor-cycle carries its normal load the headlight driving beam should be projected straight ahead and parallel with the road surface.

Note:—This instruction may require amendment to suit local (overseas) lighting regulations.

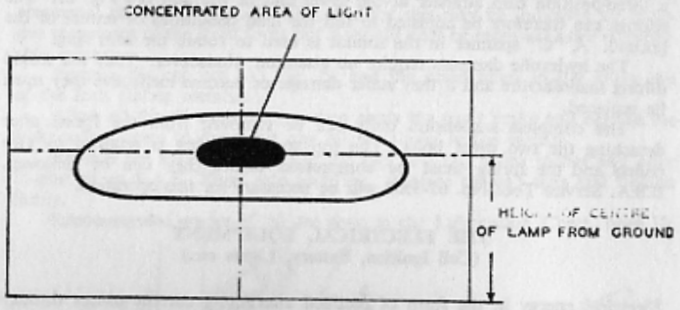


FIG. 30. *Headlamp beam setting pattern.*

When checking setting:—
(*a*) Front of motor-cycle should be square with screen.
(*b*) Motor-cycle should be carrying normal load and standing on level ground.
(*c*) Recommended distance for setting is at least 25 feet.

To make an adjustment, slacken the screws securing the headlight and move it until the correct setting is obtained. Finally retighten the securing screws.

With the Lucas pre-focus bulbs fitted in these lamps, the filament is correctly positioned during manufacture in relation to the focal point of the reflector. No further focusing is necessary.

Bulb Replacement—Headlight. /FIG. 31).
Bulb No. 446, 12-volt, 50/40 watts., prefocus. To gain access to the headlight bulb, slacken the front rim retaining screw situated at the top of the fixing rim. Disengage and withdraw the front rim and light unit assembly, removing the upper edge first. Press the adapter inwards and turn it to the left. Lift off the adapter and withdraw the defective bulb. After fitting the replacement bulb reverse the above procedure to reassemble the light.

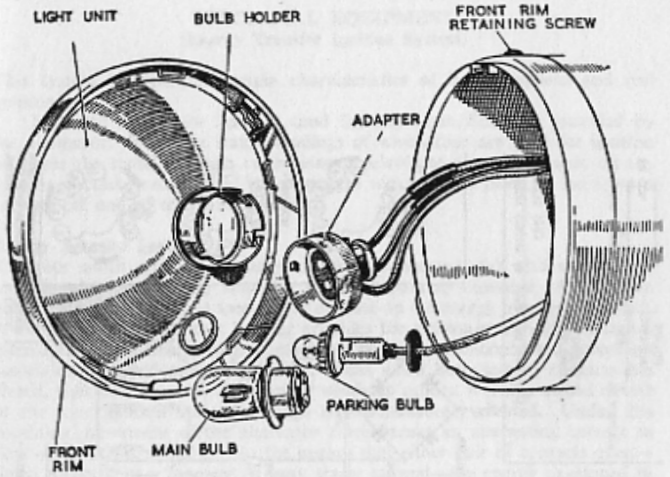


FIG. 31. *Headlight dismantled for bulb renewal.*

Parking Light.
Bulb No. 989, 12-volt, 6 watts. Disengage and withdraw the front rim and light unit assembly. The parking light bulbholder and bulb can then be withdrawn from the reflector in which it is a push-fit.

Headlight Beam Warning Light.
Bulb No. 281, 12-volt, 2 watts. Disengage and withdraw the front rim and light unit assembly. The bulb holder is a push-fit in its housing and to remove the bulb, depress and turn.

Stop-tail Light.
Bulb No. 380, 12-volt, 6/21 watts. Access to the bulb is gained by removing the two lens retaining screws. When fitting the replacement bulb, note that the securing pins are offset to ensure correct insertion into the bulb-holder.

Circuit Diagram.
A diagram of the electrical circuit appears on page 48. The rubber insulation of the wires is individually coloured, and these colours are indicated on the diagram.

Cable Harness.
As the lighting and ignition switch connections are of the plug-and-socket type, the cables are supported within the headlamp by a carrier clip to prevent accidental disengagement of the connections. Occasionally inspect the clip to make sure that the cables are properly retained.

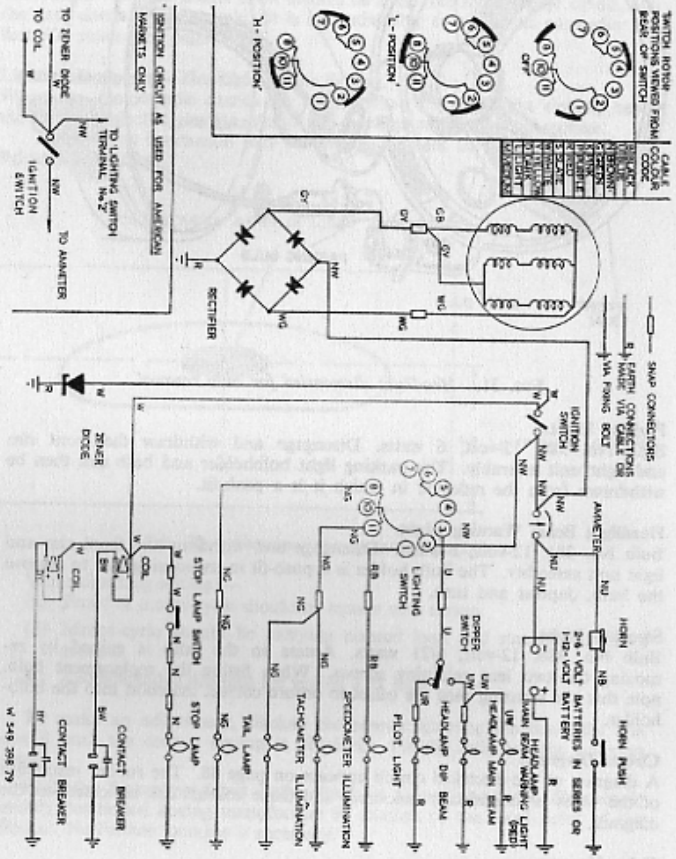


FIG. 32. *Wiring diagram.* (*Coil Ignition*)

ELECTRICAL EQUIPMENT
(Energy Transfer Ignition System)

This system incorporates certain characteristics of both magneto and coil ignition.

Electrical energy for ignition (and lighting when fitted) is provided by the alternator. It has six stator windings of which four are used for ignition purposes the remaining two coils being available to serve the needs of any lighting circuits—exclusive of the stop light which, when fitted, is fed from a tapping off one of the ignition coils.

Energy Transfer Ignition.

The four stator ignition windings are series-connected: (*a*) with each other, and (*b*) with the primary windings of two separately-mounted 3ET ignition coils (these being designed specially to operate on the energy transfer principle). A twin-lever model contact breaker provides the necessary low-tension circuit interrupting mechanism, each contact set being parallel-connected across an associated 3ET coil primary winding. Thus when both sets of contacts are closed, short-circuiting of the primary windings occurs, whilst a closed circuit of the four ignition stator windings is simultaneously created. Under this condition, movement of the alternator rotor causes an alternating current to flow in the stator windings. At the instant that either pair of contacts open—timed to occur at a moment of peak stator current—the energy developed in the stator windings is discharged as a pulse through the primary winding of the 3ET coil associated with the opened contacts. The effect of this energy pulse in the primary winding is to induce a high voltage in the ignition coil secondary winding, this high-tension current being discharged in the usual way across the appropriate plug gap. Contact closure is completed (allowing re-generation of the stator winding current) before the second contacts are opened to provide high-tension current in a similar fashion to plug number two.

Timing.

Accurate ignition timing is an important requirement in the operation of the energy transfer system. The contact breaker is arranged to open only at the moment of peak value in the alternating current cycle in order that maximum electromagnetic energy is transferred from the alternator to the ignition coil and a good spark obtained at the plug (see page 50).

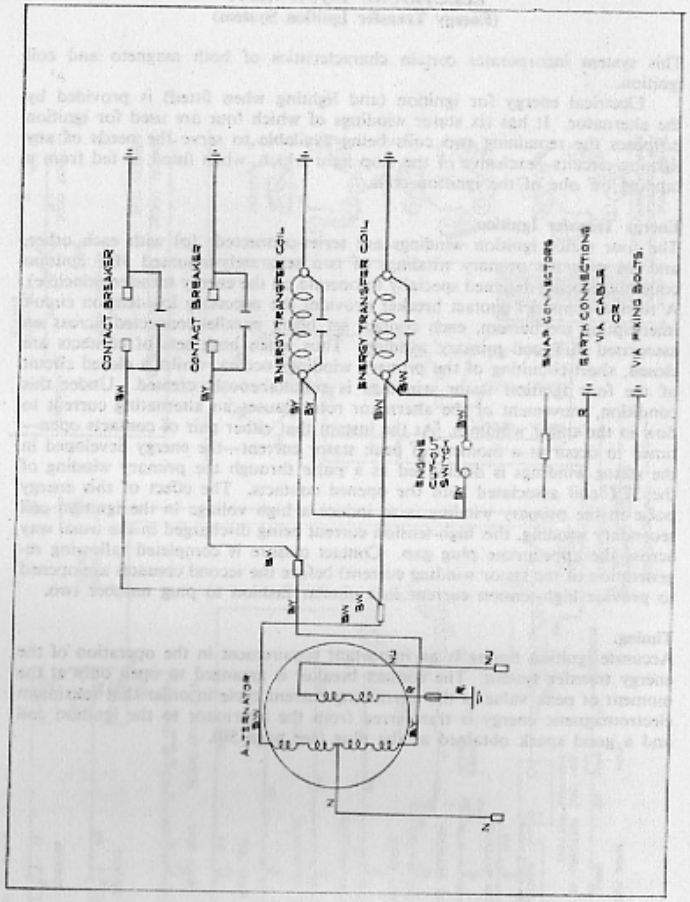


FIG. 33. *Wiring diagram. (Energy transfer ignition).*