BMW
2-valve Twins

1970 to 1993

473cc □ 498cc □ 599cc □ 649cc □ 745cc □ 797cc □ 898cc □ 979cc

Owners Workshop Manual

Haynes®

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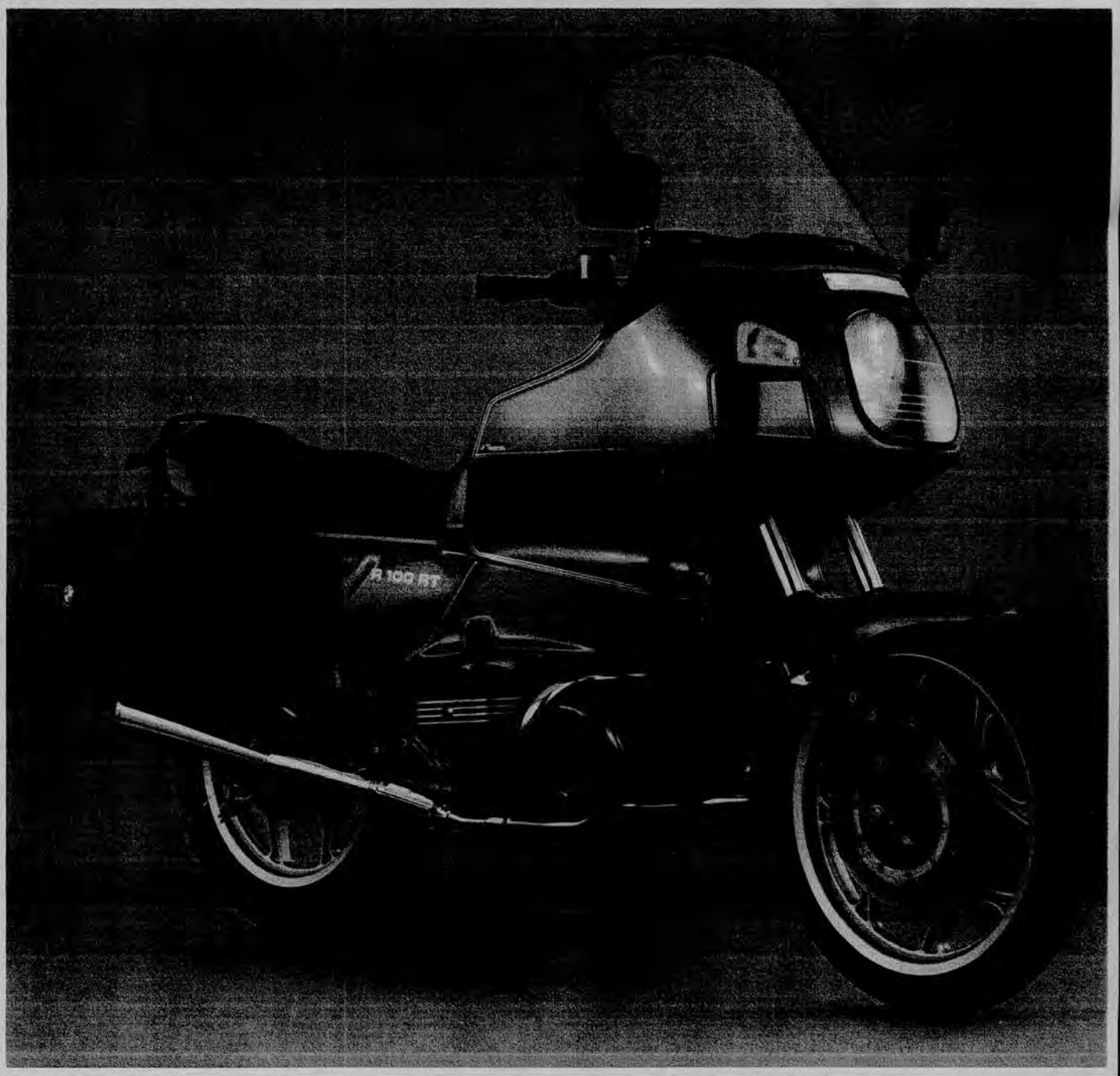

BMW Twins Owners Workshop Manual

by Jeremy Churchill

Models covered
R45. 473cc. UK only 1978 to 1985
R50. 498cc. UK 1970 to 1973, US 1969 to 1973
R60. 599cc. UK 1970 to 1978, US 1969 to 1978
R65, R65LS. 649cc. UK 1978 to 1988, US 1979 to 1987
R75. 745cc. UK 1970 to 1977, US 1969 to 1977
R80, R80/7, R80G/S*, R80GS, R80ST, R80RT. 797cc. UK 1977 on, US 1977 to 1987
R90/6, R90S. 898cc. UK and US 1973 to 1976
R100, R100/7, R100CS, R100GS*, R100R, R100RS, R100RT, R100S, R100SP, R100SRS, R100ST, R100T, R100TR. 979cc. UK and US 1976 to 1984, 1987 on
**Includes coverage of the Paris-Dakar versions*
Note: The 4-valve engine introduced in 1993 is not covered by this manual

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Our thanks are also due to Contact Developments of Reading who allowed us to reproduce Dell'orto carburettor illustrations.
The Avon Rubber Company supplied information on tyre care and fitting, and NGK Spark Plugs (UK) Ltd provided information on plug maintenance and electrode conditions.

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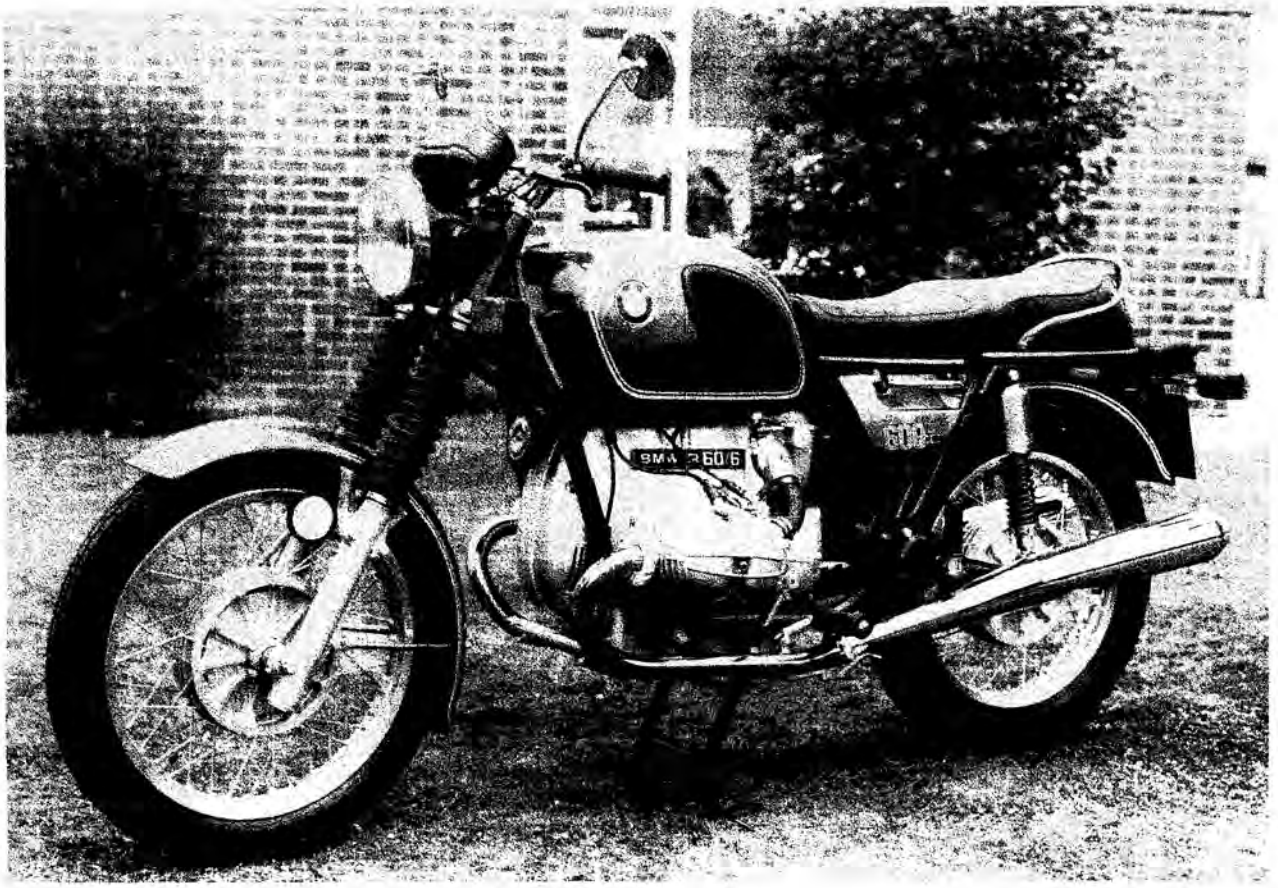
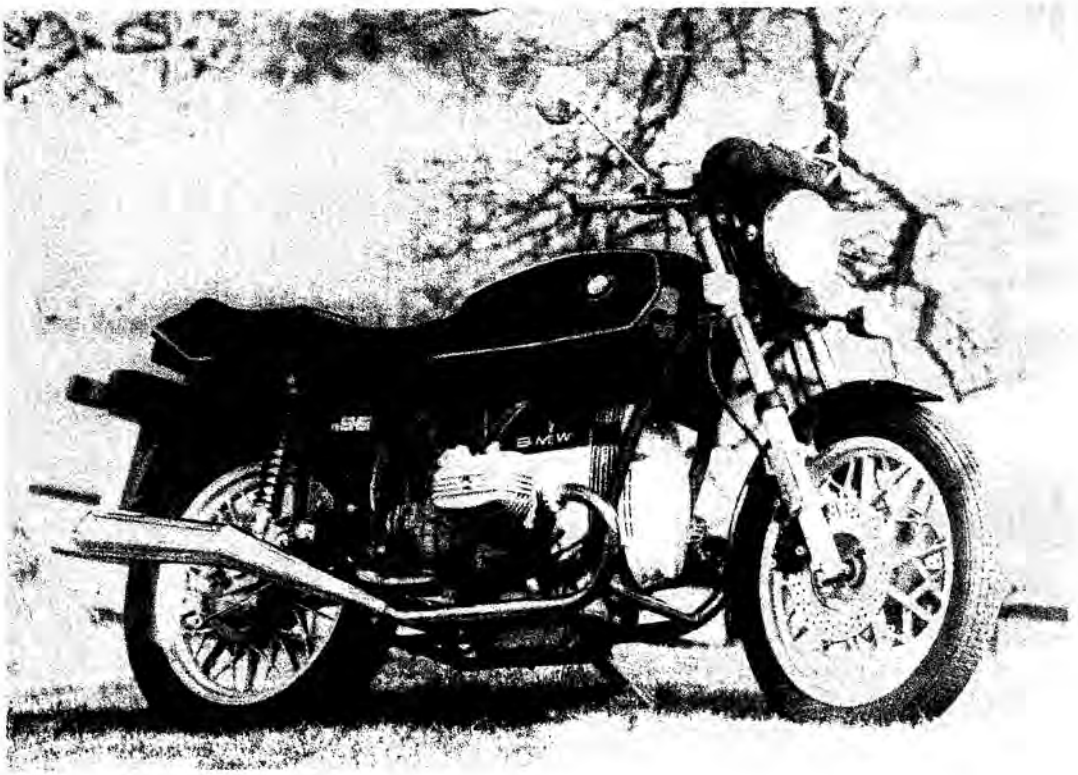


The R60/6 model



The R65 model

About this manual

The purpose of this manual is to present the owner with a concise and graphic guide which will enable him to tackle any operation from basic routine maintenance to a major overhaul. It has been assumed that any work would be undertaken without the luxury of a well-equipped workshop and a range of manufacturer's service tools.

To this end, the machine featured in the manual was stripped and rebuilt in our own workshop, by a team comprising a mechanic, a photographer and the author. The resulting photographic sequence depicts events as they took place, the hands shown being those of the author and the mechanic.

The use of specialised, and expensive, service tools was avoided unless their use was considered to be essential due to risk of breakage or injury. There is usually some way of improvising a method of removing a stubborn component, providing that a suitable degree of care is exercised.

The author learnt his motorcycle mechanics over a number of years, faced with the same difficulties and using similar facilities to those encountered by most owners. It is hoped that this practical experience can be passed on through the pages of this manual.

Where possible, a well-used example of the machine is chosen for the workshop project, as this highlights any areas which might be particularly prone to giving rise to problems. In this way, any such difficulties are encountered and resolved before the text is written, and the techniques used to deal with them can be incorporated in the relevant section. Armed with a working knowledge of the machine, the author undertakes a considerable amount of research in order that the maximum amount of data can be included in the manual.

A comprehensive section, preceding the main part of the manual, describes procedures for carrying out the routine maintenance of the machine at intervals of time and mileage. This section is included particularly for those owners who wish to ensure the efficient day-to-day running of their motorcycle, but who choose not to undertake overhaul or renovation work.

Each Chapter is divided into numbered sections. Within these sections are numbered paragraphs. Cross reference throughout the manual is quite straightforward and logical. When reference is made 'See Section 6.10' it means Section 6, paragraph 10 in the same Chapter. If another Chapter were intended, the reference would read, for example, 'See Chapter 2, Section 6.10'. All the photographs are captioned with a section/paragraph number to which they refer and are relevant to the Chapter text adjacent.

Figures (usually line illustrations) appear in a logical but numerical order, within a given Chapter. Fig. 1.1 therefore refers to the first figure in Chapter 1.

Left-hand and right-hand descriptions of the machines and their components refer to the left and right of a given machine when the rider is seated normally.

Motorcycle manufacturers continually make changes to specifications and recommendations, and these, when notified, are incorporated into our manuals at the earliest opportunity.

Introduction to the BMW twins

Although BMW's use of a shaft-drive motorcycle with a horizontally opposed twin-cylinder engine dates back to 1923, when the R32 model appeared, the machines described in this Manual were first introduced in 1969 to replace the high-quality R50/60/69S Earles Fork models which had been on sale since 1955, but were thought to be too unconventional in appearance to remain successful.

The major changes to the engine of the new machines were the substitution of a plain-bearing crankshaft for the previous ball-and-roller bearing component, the fitting of an electric starter and the use of a crankshaft-mounted alternator instead of the previous gear-driven dynamo. The camshaft, previously gear-driven above the crankshaft, was now mounted under the crank, driven by chain and used to drive the oil pump at its rear end; the repositioning of the camshaft had the effect of raising the cylinders for increased cornering clearance.

The most obvious changes were to the cycle parts, where a new frame gave a conventional appearance to the rear suspension, and where BMW reverted to the use of the telescopic fork; they had first used this type of front suspension in 1935 but had abandoned it in favour of Earles forks in 1955. The new suspension components were softly-sprung and gave a smooth, comfortable ride, which has become one of the marque's most popular features.

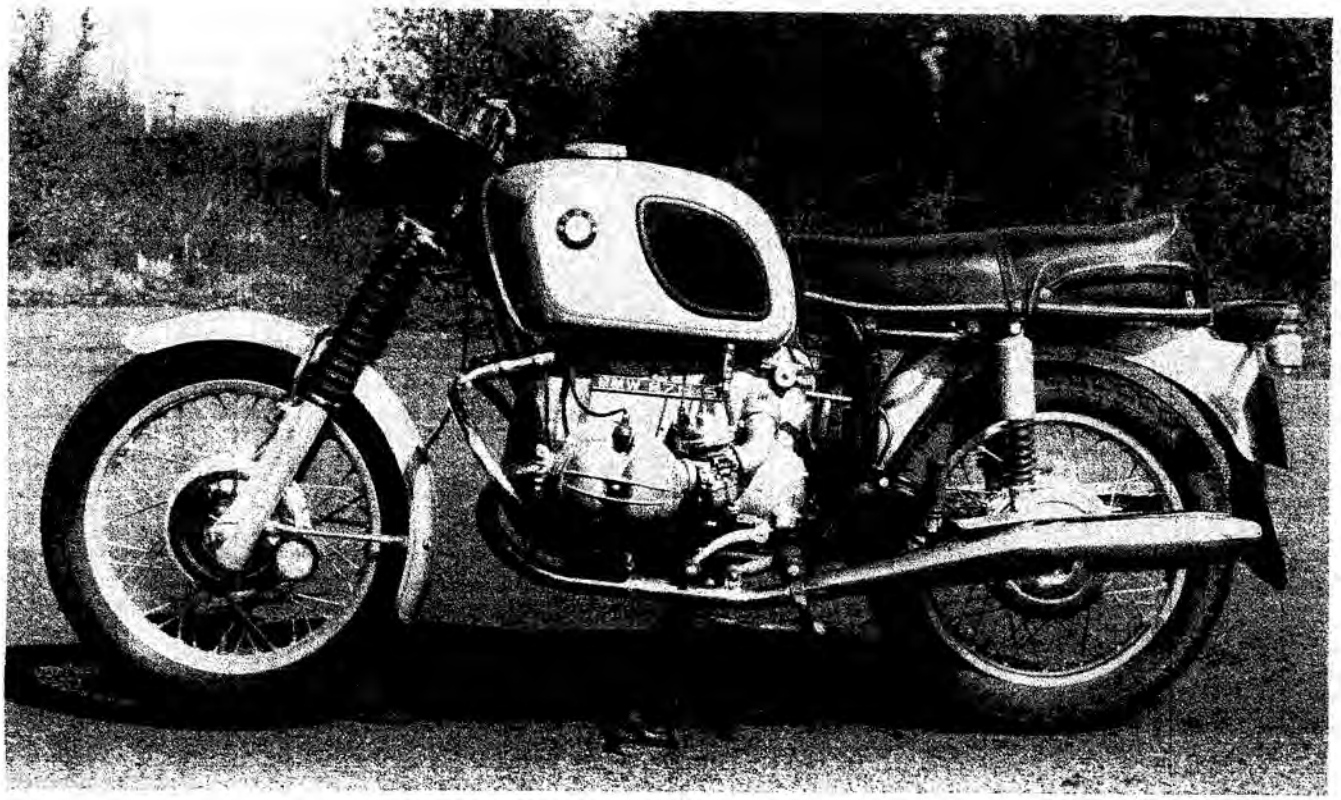
Although the machines described in this Manual have remained basically unchanged, especially by comparison with the products of the Japanese, most of their components have been modified in various degrees throughout their production life. The need to keep pace with the competition has resulted in larger-capacity engines with greatly increased power outputs and in the appearance of features such as five-speed gearboxes, disc brakes, cast alloy wheels and a much greater diversity of model types. Most of these changes can be seen by reference to the Specifications Section and/or introduction to each Chapter.

Note however that as BMW have made it a policy to offer a wide range of equipment as optional extras, with the components fitted as standard to the more expensive models being available for the basic versions, and to keep all components interchangeable where possible, many machines may be found to differ considerably from the specifications given; these refer at all times to the machines in their standard, original, form with likely variations noted where possible. For example, it is quite possible for a basic model of one year to have twin front discs and alloy wheels when it is listed as being equipped with a single disc and wire-spoked wheels, or for it to be fitted with modified components which are listed for later models.

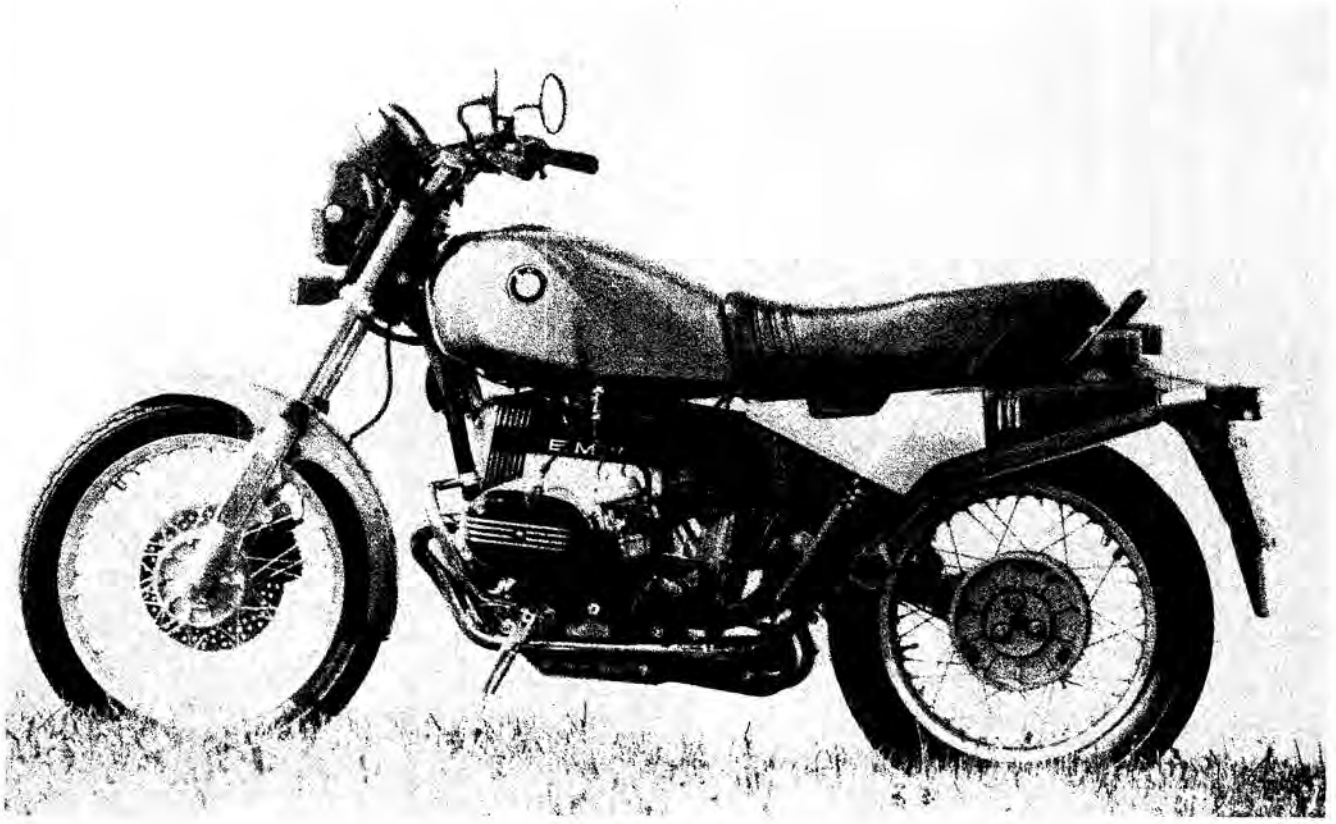
A complete list of the models covered is given below. For reference, to assist the owner in identifying his or her machine the approximate dates of import are also given; note that these may not necessarily coincide with the actual date of sale. Unless specifically mentioned in the text, the later 1000 cc model information will be as shown for the R100/7 model.

Model/capacity	UK	US
R45 473cc	Aug '78 to Oct '85	–
R50/5 498cc	May '70 to Sept '73	Sept '69 to Aug '73
R60/5 599cc	April '70 to Feb '74	Sept '69 to Aug '73
R60/6 599cc	Feb '74 to June '76	Sept '73 to Aug '76
R60/7 599cc	Sept '76 to Sept '78	Sept '76 to Dec '78
R65 649cc	Aug '78 to Oct '85	Jan '79 to Dec '84
R65LS 649cc	Dec '81 to Oct '85	Jan '82 to Dec '84
R75/5 745cc	April '70 to Feb '74	Sept '69 to Aug '73
R75/6 745cc	Feb '74 to June '76	Sept '73 to Aug '76
R75/7 745cc	Sept '76 to Sept '77	Sept '76 to Aug '77
R80/7 797cc	Oct '77 to Sept '80	Sept '77 to '80
R80G/S 797cc	Introduced Oct '80	Introduced Jan '81
R80ST 797cc	Sept '82 to '84	Jan '83 to Dec '84
R80RT 797cc	Introduced August '82	Introduced Jan '83
R80 797cc	Introduced Dec '84	Introduced Jan '85
R90/6 898cc	Dec '73 to June '76	Sept '73 to Aug '76
R90S 898cc	Dec '73 to June '76	Sept '73 to Aug '76
R100/7 979cc	Sept '76 to Feb '79	Sept '76 to Dec '78
R100T 979cc	Feb '79 to Sept '80	Jan '79 to Dec '80 includes '80 ST version
R100 979cc	Oct '80 to June '84	Jan '81 to '84 – includes TR (Touring) and SP (Sport) '82, '83 versions
R100S 979cc	Sept '76 to Sept '80	Sept '76 to Dec '80
R100CS 979cc	Oct '80 to June '84	Jan '81 to Dec '81, Jan '84 to late '84
R100RS 979cc	Sept '76 to June '84 – includes SRS version of '78	Sept '76 to '84
R100RT 979cc	Feb '79 to June '84	Jan '79 to '84

Details of the 1986 on models are given in Chapter 10.

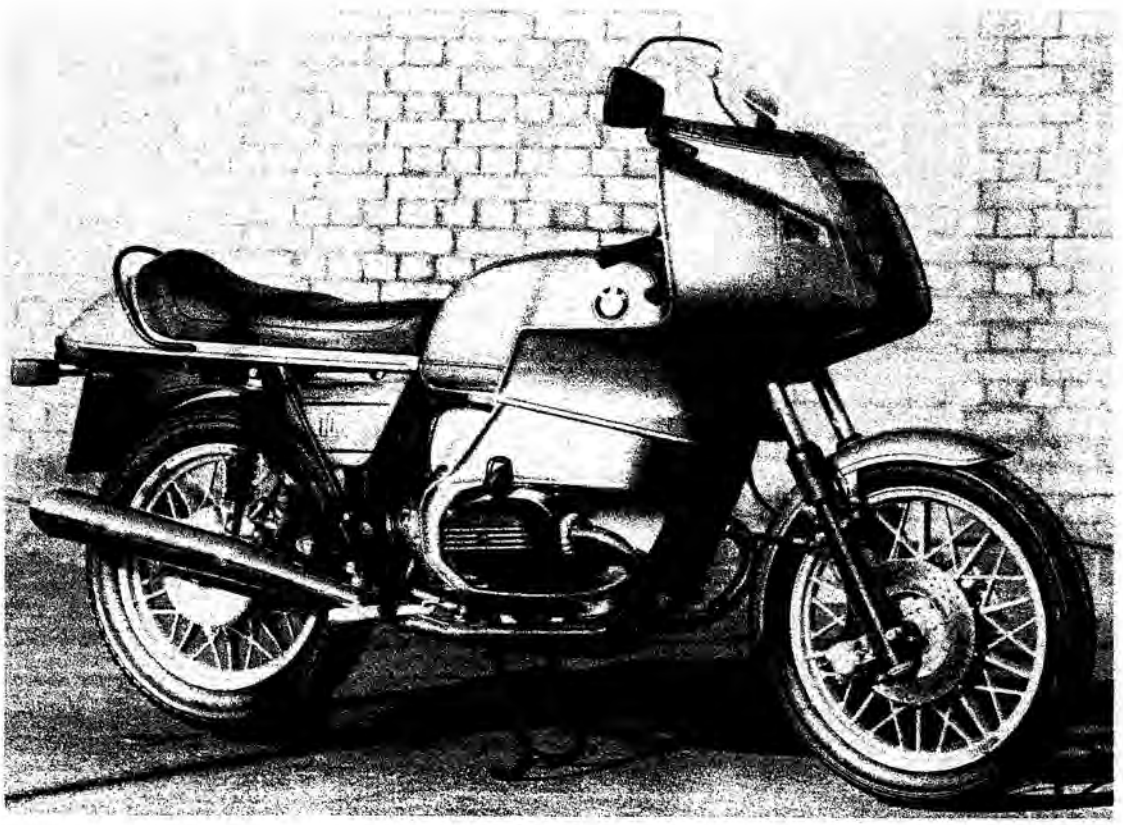


The R75/5 model



The R80ST model

The R100S model



The R100RS model

Model dimensions and weights

Overall width – of engine, except where otherwise specified:	
R45, R65, R65LS	688 mm (27.1 in)
/5, /6	740 mm (29.1 in)
/7	746 mm (29.4 in)
R80ST – engine bars	790 mm (31.1 in)
R80 – handlebar	800 mm (31.5 in)
R80G/S – handlebar	820 mm (32.3 in)
R80RT 1983-84 – fairing	930 mm (36.6 in)
R80RT 1985 on – fairing	960 mm (37.8 in)
Overall height:	
/5	1040 mm (40.9 in)
R45, R60/6, R60/7, R65, R75/6, R75/7, R80/7, R100/7, R100T, R100	1080 mm (42.5 in)
R65LS	1090 mm (42.9 in)
R80	1115 mm (43.9 in)
R80G/S, R80ST	1150 mm (45.3 in)
R90S, R100S, R100CS	1210 mm (47.6 in)
R100RS	1300 mm (51.2 in)
R80RT 1985 on	1478 mm (58.2 in)
R100RT, R80RT 1983 – 84	1465 mm (57.7 in)
Seat height – unladen:	
R45 and R65 up to 1980	770 mm (30.3 in)
R80, R80RT 1985 on	807 mm (31.8 in)
R45 1981 on, R60/6, R60/7, R65 1981 on, R65LS, R75/6, R75/7, R80/7, R100/7, R100T	810 mm (31.9 in)
R90S, all other 1000cc models, R80RT 1983 – 84	820 mm (32.3 in)
R80ST	845 mm (33.3 in)
/5	850 mm (33.5 in)
R80G/S	860 mm (33.9 in)
Overall length:	
/5	2100 mm (82.7 in)
R45 and R65 1981 on, R65LS	2110 mm (83.1 in)
R80, R80RT 1985 on	2175 mm (85.6 in)
/6, /7 up to 1978, R45 and R65 up to 1980, R80ST	2180 mm (85.8 in)
/7 1979 on	2210 mm (87.0 in)
R80RT 1983 – 84	2220 mm (87.4 in)
R80G/S	2230 mm (87.8 in)
Wheelbase – with rider weighing 165 lb (75 kg) seated:	
/5 up to mid-1973 (see Chapter 7)	1385 mm (54.5 in)
R45 and R65 up to 1980	1390 mm (54.7 in)
R45 and R65 1981 on, R65LS	1400 mm (55.1 in)
R80ST, R80, R80RT 1985 on	1440 mm (56.7 in)
/5 mid-1973 on, /6, /7, R80G/S, R80RT 1983 – 84	1465 mm (57.7 in)
Ground clearance – with rider weighing 165 lb (75 kg) seated:	
R45, R65, R65LS	105 mm (4.1 in)
/7 1981 on	115 mm (4.5 in)
R80, R80RT 1985 on	125 mm (4.9 in)
R80ST, R80RT 1983 – 84	130 mm (5.1 in)
/5, /6, /7 up to 1980	165 mm (6.5 in)
R80G/S	175 mm (6.9 in)
Kerb weight – machine with full fuel tank, tools etc:	
R80G/S – 1981 model without electric starter	410 lb (186 kg)
R80G/S with electric starter	423 lb (192 kg)
R80ST	436 lb (198 kg)
R45, R50/5, R65	452 lb (205 kg)
R65LS	456 lb (207 kg)
R60/5, R60/6, R75/5, R75/6, R80, R90/6	463 lb (210 kg)
R60/7, R75/7, R80/7, R90S, R100/7, R100T	474 lb (215 kg)
R100	481 lb (218 kg)
R100S, R100CS	485 lb (220 kg)
R80RT 1985 on	500 lb (227 kg)
R100RS	507 lb (230 kg)
R100RT 1979 – 80, R80RT 1983 – 84	516 lb (234 kg)
R100RT 1981 on	525 lb (238 kg)
Maximum permissible weight – total of machine, passenger(s) and luggage:	
/5, /6, /7 up to 1980, R45, R65, R65LS, R80G/S, R80ST	877 lb (398 kg)
/7 1981 on, R80, R80RT	970 lb (440 kg)

Ordering spare parts

When ordering replacement parts, it is essential to identify exactly the machine for which the parts are required. While in some cases it is sufficient to identify the machine by its title eg 'R75/7', the many modifications to most components mean that it is usually essential to identify the machine by its BMW **production** or model year eg '1977 R75/7'. The BMW production year starts in September of the previous calendar year, after the annual holiday, and continues until the following August. Therefore a 1977 R75/7 was **produced** at some time between September 1976 and August 1977; it may have been **sold** (to its first owner) at any time from September 1976 onwards. To avoid any further confusion, models are referred to **at all times** in this Manual by their BMW **production** or model year; to identify your own machine, record its full engine and frame numbers and take them to any BMW dealer who should have the necessary information to identify it exactly. Finally, in some cases modifications can be identified only by reference to the machine's engine or frame number; these should be noted and taken with you whenever replacement parts are required.

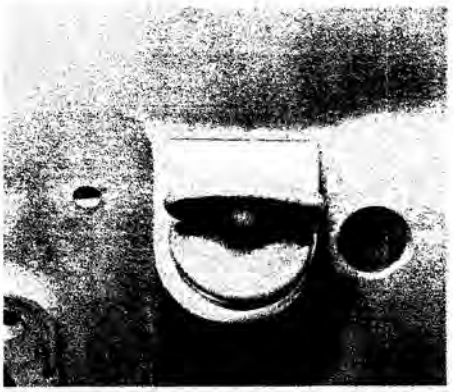
On all models up to 1983 the engine number is stamped on the crankcase left-hand side, immediately above the oil filler/dipstick boss. 1984 and later models have a rectangular, machined-flat surface on the crankcase left-hand side at the front, below the frame tube; the engine number is the upper of the two numbers stamped into this, the lower being a factory production code. This factory code should not be confused with the (usually 8-digit) engine number, it is to be found stamped into the crankcase, at the cylinder base on models up to 1979, underneath the oil filter cover on models from 1979 to 1983.

The frame number is stamped into the right-hand side of the steering head on all models up to 1982. On all 1983 and later models it is stamped into the right-hand lower frame tube, above the centre stand mounting. On all models the frame number is duplicated in the manufacturer's data plate, which is riveted to the steering head. A factory code which might puzzle some owners is as follows: all 500, 600, 750, 800, 900 and 1000 cc models, whether /5, /6 or /7, have the factory internal reference number '247', while R45, R65 and R65LS models have the number '248'.

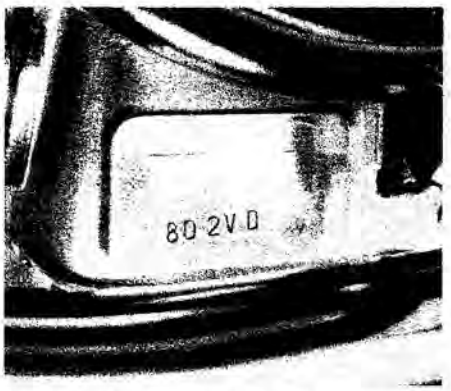
To be absolutely certain of receiving the correct part, not only is it essential to have the machine's identifying title and engine and frame numbers, but it is also useful to take the old part for comparison (where possible). Note that where a modified component has superseded the original, a careful check must be made that there are no related parts which have also been modified and must be used to enable the replacement to be correctly refitted; where such a situation is found, purchase all the necessary parts and fit them, even if this means replacing apparently unworn items.

Always purchase replacement parts from an authorised BMW dealer who will either have the parts in stock or can order them quickly from the importer, and always use genuine parts to ensure the machine's performance and reliability. Pattern parts are not widely available for BMWs, being generally restricted to items such as disc brake pads, oil and air filters and exhaust system components. Unless these are of recognised quality brands which will perform as well as or better than the original, they should be avoided.

Expendable items such as lubricants, spark plugs, some electrical components, bearings, bulbs and tyres can usually be obtained at lower prices from accessory shops, motor factors or from specialists advertising in the national motorcycle press.



Location of engine number – all models up to 1983



Location of engine number – all models 1984 on

Location of frame number – all models up to 1982

Location of frame number – all models 1983 on

Manufacturer's data plate also carries frame number – early version ...

... and later version

Safety first!

Professional motor mechanics are trained in safe working procedures. However enthusiastic you may be about getting on with the job in hand, do take the time to ensure that your safety is not put at risk. A moment's lack of attention can result in an accident, as can failure to observe certain elementary precautions.

There will always be new ways of having accidents, and the following points do not pretend to be a comprehensive list of all dangers; they are intended rather to make you aware of the risks and to encourage a safety-conscious approach to all work you carry out on your vehicle.

Essential DOs and DON'Ts

DON'T start the engine without first ascertaining that the transmission is in neutral.

DON'T suddenly remove the filler cap from a hot cooling system – cover it with a cloth and release the pressure gradually first, or you may get scalded by escaping coolant.

DON'T attempt to drain oil until you are sure it has cooled sufficiently to avoid scalding you.

DON'T grasp any part of the engine, exhaust or silencer without first ascertaining that it is sufficiently cool to avoid burning you.

DON'T allow brake fluid or antifreeze to contact the machine's paintwork or plastic components.

DON'T syphon toxic liquids such as fuel, brake fluid or antifreeze by mouth, or allow them to remain on your skin.

DON'T inhale dust – it may be injurious to health (see *Asbestos* heading).

DON'T allow any spilt oil or grease to remain on the floor – wipe it up straight away, before someone slips on it.

DON'T use ill-fitting spanners or other tools which may slip and cause injury.

DON'T attempt to lift a heavy component which may be beyond your capability – get assistance.

DON'T rush to finish a job, or take unverified short cuts.

DON'T allow children or animals in or around an unattended vehicle.

DON'T inflate a tyre to a pressure above the recommended maximum. Apart from overstressing the carcase and wheel rim, in extreme cases the tyre may blow off forcibly.

DO ensure that the machine is supported securely at all times. This is especially important when the machine is blocked up to aid wheel or fork removal.

DO take care when attempting to slacken a stubborn nut or bolt. It is generally better to pull on a spanner, rather than push, so that if slippage occurs you fall away from the machine rather than on to it.

DO wear eye protection when using power tools such as drill, sander, bench grinder etc.

DO use a barrier cream on your hands prior to undertaking dirty jobs – it will protect your skin from infection as well as making the dirt easier to remove afterwards; but make sure your hands aren't left slippery. Note that long-term contact with used engine oil can be a health hazard.

DO keep loose clothing (cuffs, tie etc) and long hair well out of the way of moving mechanical parts.

DO remove rings, wristwatch etc, before working on the vehicle – especially the electrical system.

DO keep your work area tidy – it is only too easy to fall over articles left lying around.

DO exercise caution when compressing springs for removal or installation. Ensure that the tension is applied and released in a controlled manner, using suitable tools which preclude the possibility of the spring escaping violently.

DO ensure that any lifting tackle used has a safe working load rating adequate for the job.

DO get someone to check periodically that all is well, when working alone on the vehicle.

DO carry out work in a logical sequence and check that everything is correctly assembled and tightened afterwards.

DO remember that your vehicle's safety affects that of yourself and others. If in doubt on any point, get specialist advice.

IF, in spite of following these precautions, you are unfortunate enough to injure yourself, seek medical attention as soon as possible.

Asbestos

Certain friction, insulating, sealing, and other products – such as brake linings, clutch linings, gaskets, etc – contain asbestos. *Extreme care must be taken to avoid inhalation of dust from such products since it is hazardous to health.* If in doubt, assume that they *do* contain asbestos.

Fire

Remember at all times that petrol (gasoline) is highly flammable. Never smoke, or have any kind of naked flame around, when working on the vehicle. But the risk does not end there – a spark caused by an electrical short-circuit, by two metal surfaces contacting each other, by careless use of tools, or even by static electricity built up in your body under certain conditions, can ignite petrol vapour, which in a confined space is highly explosive.

Always disconnect the battery earth (ground) terminal before working on any part of the fuel or electrical system, and never risk spilling fuel on to a hot engine or exhaust.

It is recommended that a fire extinguisher of a type suitable for fuel and electrical fires is kept handy in the garage or workplace at all times. Never try to extinguish a fuel or electrical fire with water.

Note: *Any reference to a 'torch' appearing in this manual should always be taken to mean a hand-held battery-operated electric lamp or flashlight. It does* ***not*** *mean a welding/gas torch or blowlamp.*

Fumes

Certain fumes are highly toxic and can quickly cause unconsciousness and even death if inhaled to any extent. Petrol (gasoline) vapour comes into this category, as do the vapours from certain solvents such as trichloroethylene. Any draining or pouring of such volatile fluids should be done in a well ventilated area.

When using cleaning fluids and solvents, read the instructions carefully. Never use materials from unmarked containers – they may give off poisonous vapours.

Never run the engine of a motor vehicle in an enclosed space such as a garage. Exhaust fumes contain carbon monoxide which is extremely poisonous; if you need to run the engine, always do so in the open air or at least have the rear of the vehicle outside the workplace.

The battery

Never cause a spark, or allow a naked light, near the vehicle's battery. It will normally be giving off a certain amount of hydrogen gas, which is highly explosive.

Always disconnect the battery earth (ground) terminal before working on the fuel or electrical systems.

If possible, loosen the filler plugs or cover when charging the battery from an external source. Do not charge at an excessive rate or the battery may burst.

Take care when topping up and when carrying the battery. The acid electrolyte, even when diluted, is very corrosive and should not be allowed to contact the eyes or skin.

If you ever need to prepare electrolyte yourself, always add the acid slowly to the water, and never the other way round. Protect against splashes by wearing rubber gloves and goggles.

Mains electricity and electrical equipment

When using an electric power tool, inspection light etc, always ensure that the appliance is correctly connected to its plug and that, where necessary, it is properly earthed (grounded). Do not use such appliances in damp conditions and, again, beware of creating a spark or applying excessive heat in the vicinity of fuel or fuel vapour. Also ensure that the appliances meet the relevant national safety standards.

Ignition HT voltage

A severe electric shock can result from touching certain parts of the ignition system, such as the HT leads, when the engine is running or being cranked, particularly if components are damp or the insulation is defective. Where an electronic ignition system is fitted, the HT voltage is much higher and could prove fatal.

Tools and working facilities

The first priority when undertaking maintenance or repair work of any sort on a motorcycle is to have a clean, dry, well-lit working area. Work carried out in peace and quiet in the well-ordered atmosphere of a good workshop will give more satisfaction and much better results than can usually be achieved in poor working conditions. A good workshop must have a clean flat workbench or a solidly constructed table of convenient working height. The workbench or table should be equipped with a vice which has a jaw opening of at least 4 in (100 mm). A set of jaw covers should be made from soft metal such as aluminium alloy or copper, or from wood. These covers will minimise the marking or damaging of soft or delicate components which may be clamped in the vice. Some clean, dry, storage space will be required for tools, lubricants and dismantled components. It will be necessary during a major overhaul to lay out engine/gearbox components for examination and to keep them where they will remain undisturbed for as long as is necessary. To this end it is recommended that a supply of metal or plastic containers of suitable size is collected. A supply of clean, lint-free, rags for cleaning purposes and some newspapers, other rags, or paper towels for mopping up spillages should also be kept. If working on a hard concrete floor note that both the floor and one's knees can be protected from oil spillages and wear by cutting open a large cardboard box and spreading it flat on the floor under the machine or workbench. This also helps to provide some warmth in winter and to prevent the loss of nuts, washers, and other tiny components which have a tendency to disappear when dropped on anything other than a perfectly clean, flat, surface.

Unfortunately, such working conditions are not always available to the home mechanic. When working in poor conditions it is essential to take extra time and care to ensure that the components being worked on are kept scrupulously clean and to ensure that no components or tools are lost or damaged.

A selection of good tools is a fundamental requirement for anyone contemplating the maintenance and repair of a motor vehicle. For the owner who does not possess any, their purchase will prove a considerable expense, offsetting some of the savings made by doing-it-yourself. However, provided that the tools purchased meet the relevant national safety standards and are of good quality, they will last for many years and prove an extremely worthwhile investment.

To help the average owner to decide which tools are needed to carry out the various tasks detailed in this manual, we have compiled three lists of tools under the following headings: *Maintenance and minor repair, Repair and overhaul* and *Specialized*. The newcomer to practical mechanics should start off with the simpler jobs around the vehicle. Then, as his confidence and experience grow, he can undertake more difficult tasks, buying extra tools as and when they are needed. In this way, a *Maintenance and minor repair* tool kit can be built-up into a *Repair and overhaul* tool kit over a considerable period of time without any major cash outlays. The experienced home mechanic will have a tool kit good enough for most repair and overhaul procedures and will add tools from the specialized category when he feels the expense is justified by the amount of use these tools will be put to.

It is obviously not possible to cover the subject of tools fully here. For those who wish to learn more about tools and their use there is a book entitled *Motorcycle Workshop Practice Manual* available from the publishers of this manual. It also provides an introduction to basic workshop practice which will be of interest to a home mechanic working on any type of motor vehicle.

As a general rule, it is better to buy the more expensive, good quality tools. Given reasonable use, such tools will last for a very long time, whereas the cheaper, poor quality, item will wear out faster and need to be renewed more often, thus nullifying the original saving. There is also the risk of a poor quality tool breaking while in use, causing personal injury or expensive damage to the component being worked on.

For practically all tools, a tool factor is the best source since he will have a very comprehensive range compared with the average garage or accessory shop. Having said that, accessory shops often offer excellent quality tools at discount prices, so it pays to shop around. There are plenty of tools around at reasonable prices, but always aim to purchase items which meet the relevant national safety standards. If in doubt, seek the advice of the shop proprietor or manager before making a purchase.

The basis of any toolkit is a set of spanners. While open-ended spanners with their slim jaws, are useful for working on awkwardly-positioned nuts, ring spanners have advantages in that they grip the nut far more positively. There is less risk of the spanner slipping off the nut and damaging it, for this reason alone ring spanners are to be preferred. Ideally, the home mechanic should acquire a set of each, but if expense rules this out a set of combination spanners (open-ended at one end and with a ring of the same size at the other) will provide a good compromise. Another item which is so useful it should be

considered an essential requirement for any home mechanic is a set of socket spanners. These are available in a variety of drive sizes. It is recommended that the ½-inch drive type is purchased to begin with as although bulkier and more expensive than the ⅜-inch type, the larger size is far more common and will accept a greater variety of torque wrenches, extension pieces and socket sizes. The socket set should comprise sockets of sizes between 8 and 24 mm, a reversible ratchet drive, an extension bar of about 10 inches in length, a spark plug socket with a rubber insert, and a universal joint. Other attachments can be added to the set at a later date.

Maintenance and minor repair tool kit

Set of spanners 8 – 24 mm
Set of sockets and attachments
Spark plug spanner with rubber insert – 10, 12, or 14 mm as appropriate
Adjustable spanner
C-spanner/pin spanner
Torque wrench (same size drive as sockets)
Set of screwdrivers (flat blade)
Set of screwdrivers (cross-head)
Set of Allen keys 4 – 10 mm
Impact screwdriver and bits
Ball pein hammer – 2 lb
Hacksaw (junior)
Self-locking pliers – Mole grips or vice grips
Pliers – combination
Pliers – needle nose
Wire brush (small)
Soft-bristled brush
Tyre pump
Tyre pressure gauge
Tyre tread depth gauge
Oil can
Fine emery cloth
Funnel (medium size)
Drip tray
Grease gun
Set of feeler gauges
Brake bleeding kit
Strobe timing light
Continuity tester (dry battery and bulb)
Soldering iron and solder
Wire stripper or craft knife
PVC insulating tape
Assortment of split pins, nuts, bolts, and washers

Repair and overhaul toolkit

The tools in this list are virtually essential for anyone undertaking major repairs to a motorcycle and are additional to the tools listed above. Concerning Torx driver bits, Torx screws are encountered on some of the more modern machines where their use is restricted to fastening certain components inside the engine/gearbox unit. It is therefore recommended that if Torx bits cannot be borrowed from a local dealer, they are purchased individually as the need arises. They are not in regular use in the motor trade and will therefore only be available in specialist tool shops.

Plastic or rubber soft-faced mallet
Torx driver bits
Pliers – electrician's side cutters
Circlip pliers – internal (straight or right-angled tips are available)
Circlip pliers – external
Cold chisel
Centre punch
Pin punch
Scriber
Scraper (made from soft metal such as aluminium or copper)
Soft metal drift
Steel rule/straight edge
Assortment of files
Electric drill and bits
Wire brush (large)
Soft wire brush (similar to those used for cleaning suede shoes)
Sheet of plate glass
Hacksaw (large)
Valve grinding tool
Valve grinding compound (coarse and fine)
Stud extractor set (E-Z out)

Specialized tools

This is not a list of the tools made by the machine's manufacturer to carry out a specific task on a limited range of models. Occasional references are made to such tools in the text of this manual and, in general, an alternative method of carrying out the task without the manufacturer's tool is given where possible. The tools mentioned in this list are those which are not used regularly and are expensive to buy in view of their infrequent use. Where this is the case it may be possible to hire or borrow the tools against a deposit from a local dealer or tool hire shop. An alternative is for a group of friends or a motorcycle club to join in the purchase.

Valve spring compressor
Piston ring compressor
Universal bearing puller
Cylinder bore honing attachment (for electric drill)
Micrometer set
Vernier calipers
Dial gauge set
Cylinder compression gauge
Vacuum gauge set
Multimeter
Dwell meter/tachometer

Care and maintenance of tools

Whatever the quality of the tools purchased, they will last much longer if cared for. This means in practice ensuring that a tool is used for its intended purpose; for example screwdrivers should not be used as a substitute for a centre punch, or as chisels. Always remove dirt or grease and any metal particles but remember that a light film of oil will prevent rusting if the tools are infrequently used. The common tools can be kept together in a large box or tray but the more delicate, and more expensive, items should be stored separately where they cannot be damaged. When a tool is damaged or worn out, be sure to renew it immediately. It is false economy to continue to use a worn spanner or screwdriver which may slip and cause expensive damage to the component being worked on.

Fastening systems

Fasteners, basically, are nuts, bolts and screws used to hold two or more parts together. There are a few things to keep in mind when working with fasteners. Almost all of them use a locking device of some type; either a lock washer, lock nut, locking tab or thread adhesive. All threaded fasteners should be clean, straight, have undamaged threads and undamaged corners on the hexagon head where the spanner fits. Develop the habit of replacing all damaged nuts and bolts with new ones.

Rusted nuts and bolts should be treated with a rust penetrating fluid to ease removal and prevent breakage. After applying the rust penetrant, let it 'work' for a few minutes before trying to loosen the nut or bolt. Badly rusted fasteners may have to be chiseled off or removed with a special nut breaker, available at tool shops.

Flat washers and lock washers, when removed from an assembly should always be replaced exactly as removed. Replace any damaged washers with new ones. Always use a flat washer between a lock washer and any soft metal surface (such as aluminium), thin sheet metal or plastic. Special lock nuts can only be used once or twice before they lose their locking ability and must be renewed.

If a bolt or stud breaks off in an assembly, it can be drilled out and removed with a special tool called an E-Z out. Most dealer service departments and motorcycle repair shops can perform this task, as well as others (such as the repair of threaded holes that have been stripped out).

Spanner size comparison

Jaw gap (in)	Spanner size
0.250	$\frac{1}{4}$ in AF
0.276	7 mm
0.313	$\frac{5}{16}$ in AF
0.315	8 mm
0.344	$\frac{11}{32}$ in AF; $\frac{1}{8}$ in Whitworth
0.354	9 mm
0.375	$\frac{3}{8}$ in AF
0.394	10 mm
0.433	11 mm
0.438	$\frac{7}{16}$ in AF
0.445	$\frac{3}{16}$ in Whitworth; $\frac{1}{4}$ in BSF
0.472	12 mm
0.500	$\frac{1}{2}$ in AF
0.512	13 mm
0.525	$\frac{1}{4}$ in Whitworth; $\frac{5}{16}$ in BSF
0.551	14 mm
0.563	$\frac{9}{16}$ in AF
0.591	15 mm
0.600	$\frac{5}{16}$ in Whitworth; $\frac{3}{8}$ in BSF
0.625	$\frac{5}{8}$ in AF
0.630	16 mm
0.669	17 mm
0.686	$\frac{11}{16}$ in AF
0.709	18 mm
0.710	$\frac{3}{8}$ in Whitworth; $\frac{7}{16}$ in BSF
0.748	19 mm
0.750	$\frac{3}{4}$ in AF
0.813	$\frac{13}{16}$ in AF
0.820	$\frac{7}{16}$ in Whitworth; $\frac{1}{2}$ in BSF
0.866	22 mm
0.875	$\frac{7}{8}$ in AF
0.920	$\frac{1}{2}$ in Whitworth; $\frac{9}{16}$ in BSF
0.938	$\frac{15}{16}$ in AF
0.945	24 mm
1.000	1 in AF
1.010	$\frac{9}{16}$ in Whitworth; $\frac{5}{8}$ in BSF
1.024	26 mm
1.063	$1\frac{1}{16}$ in AF; 27 mm
1.100	$\frac{5}{16}$ in Whitworth; $\frac{11}{16}$ in BSF
1.125	$1\frac{1}{8}$ in AF
1.181	30 mm
1.200	$\frac{11}{16}$ in Whitworth; $\frac{3}{4}$ in BSF
1.250	$1\frac{1}{4}$ in AF
1.260	32 mm
1.300	$\frac{3}{4}$ in Whitworth; $\frac{7}{8}$ in BSF
1.313	$1\frac{5}{16}$ in AF
1.390	$\frac{13}{16}$ in Whitworth; $\frac{15}{16}$ in BSF
1.417	36 mm
1.438	$1\frac{7}{16}$ in AF
1.480	$\frac{7}{8}$ in Whitworth; 1 in BSF
1.500	$1\frac{1}{2}$ in AF
1.575	40 mm; $\frac{15}{16}$ in Whitworth
1.614	41 mm
1.625	$1\frac{5}{8}$ in AF
1.670	1 in Whitworth; $1\frac{1}{8}$ in BSF
1.688	$1\frac{11}{16}$ in AF
1.811	46 mm
1.813	$1\frac{13}{16}$ in AF
1.860	$1\frac{1}{8}$ in Whitworth; $1\frac{1}{4}$ in BSF
1.875	$1\frac{7}{8}$ in AF
1.969	50 mm
2.000	2 in AF
2.050	$1\frac{1}{4}$ in Whitworth; $1\frac{3}{8}$ in BSF
2.165	55 mm
2.362	60 mm

Standard torque settings

Specific torque settings will be found at the end of the specifications section of each chapter. Where no figure is given, bolts should be secured according to the table below.

Fastener type (thread diameter)	**kgf m**	**lbf ft**
5mm bolt or nut	0.45 – 0.6	3.5 – 4.5
6 mm bolt or nut	0.8 – 1.2	6 – 9
8 mm bolt or nut	1.8 – 2.5	13 – 18
10 mm bolt or nut	3.0 – 4.0	22 – 29
12 mm bolt or nut	5.0 – 6.0	36 – 43
5 mm screw	0.35 – 0.5	2.5 – 3.6
6 mm screw	0.7 – 1.1	5 – 8
6 mm flange bolt	1.0 – 1.4	7 – 10
8 mm flange bolt	2.4 – 3.0	17 – 22
10 mm flange bolt	3.0 – 4.0	22 – 29

Choosing and fitting accessories

The range of accessories available to the modern motorcyclist is almost as varied and bewildering as the range of motorcycles. This Section is intended to help the owner in choosing the correct equipment for his needs and to avoid some of the mistakes made by many riders when adding accessories to their machines. It will be evident that the Section can only cover the subject in the most general terms and so it is recommended that the owner, having decided that he wants to fit, for example, a luggage rack or carrier, seeks the advice of several local dealers and the owners of similar machines. This will give a good idea of what makes of carrier are easily available, and at what price. Talking to other owners will give some insight into the drawbacks or good points of any one make. A walk round the motorcycles in car parks or outside a dealer will often reveal the same sort of information.

The first priority when choosing accessories is to assess exactly what one needs. It is, for example, pointless to buy a large heavy-duty carrier which is designed to take the weight of fully laden panniers and topbox when all you need is a place to strap on a set of waterproofs and a lunchbox when going to work. Many accessory manufacturers have ranges of equipment to cater for the individual needs of different riders and this point should be borne in mind when looking through a dealer's catalogues. Having decided exactly what is required and the use to which the accessories are going to be put, the owner will need a few hints on what to look for when making the final choice. To this end the Section is now sub-divided to cover the more popular accessories fitted. Note that it is in no way a customizing guide, but merely seeks to outline the practical considerations to be taken into account when adding aftermarket equipment to a motorcycle.

Fairings and windscreens

A fairing is possibly the single, most expensive, aftermarket item to be fitted to any motorcycle and, therefore, requires the most thought before purchase. Fairings can be divided into two main groups: front fork mounted handlebar fairings and windscreens, and frame mounted fairings.

The first group, the front fork mounted fairings, are becoming far more popular than was once the case, as they offer several advantages over the second group. Front fork mounted fairings generally are much easier and quicker to fit, involve less modification to the motorcycle, do not as a rule restrict the steering lock, permit a wider selection of handlebar styles to be used, and offer adequate protection for much less money than the frame mounted type. They are also lighter, can be swapped easily between different motorcycles, and are available in a much greater variety of styles. Their main disadvantages are that they do not offer as much weather protection as the frame mounted types, rarely offer any storage space, and, if poorly fitted or naturally incompatible, can have an adverse effect on the stability of the motorcycle.

The second group, the frame mounted fairings, are secured so rigidly to the main frame of the motorcycle that they can offer a substantial amount of protection to motorcycle and rider in the event of a crash. They offer almost complete protection from the weather and, if double-skinned in construction, can provide a great deal of useful storage space. The feeling of peace, quiet and complete relaxation encountered when riding behind a good full fairing has to be experienced to be believed. For this reason full fairings are considered essential by most touring motorcyclists and by many people who ride all year round. The main disadvantages of this type are that fitting can take a long time, often involving removal or modification of standard motorcycle components, they restrict the steering lock and they can add up to about 40 lb to the weight of the machine. They do not usually affect the stability of the machine to any great extent once the front tyre pressure and suspension have been adjusted to compensate for the extra weight, but can be affected by sidewinds.

The first thing to look for when purchasing a fairing is the quality of the fittings. A good fairing will have strong, substantial brackets constructed from heavy-gauge tubing; the brackets must be shaped to fit the frame or forks evenly so that the minimum of stress is imposed on the assembly when it is bolted down. The brackets should be properly painted or finished – a nylon coating being the favourite of the better manufacturers – the nuts and bolts provided should be of the same thread and size standard as is used on the motorcycle and be properly plated. Look also for shakeproof locking nuts or locking washers to ensure that everything remains securely tightened down. The fairing shell is generally made from one of two materials: fibreglass or ABS plastic. Both have their advantages and disadvantages, but the main consideration for the owner is that fibreglass is much easier to repair in the event of damage occurring to the fairing. Whichever material is used, check that it is properly finished inside as well as out, that the edges are protected by beading and that the fairing shell is insulated from vibration by the use of rubber grommets at all mounting points. Also be careful to check that the windscreen is retained by plastic bolts which will snap on impact so that the windscreen will break away and not cause personal injury in the event of an accident.

Having purchased your fairing or windscreen, read the manufacturer's fitting instructions very carefully and check that you have all the necessary brackets and fittings. Ensure that the mounting brackets are located correctly and bolted down securely. Note that some manufacturers use hose clamps to retain the mounting brackets; these should be discarded as they are convenient to use but not strong enough for the task. Stronger clamps should be substituted; car exhaust pipe clamps of suitable size would be a good alternative. Ensure that the front forks can turn through the full steering lock available without fouling the fairing. With many types of frame-mounted fairing the handlebars will have to be altered or a different type fitted and the steering lock will be restricted by stops provided with the fittings. Also check that the fairing does not foul the front wheel or mudguard, in any

steering position, under full fork compression. Re-route any cables, brake pipes or electrical wiring which may snag on the fairing and take great care to protect all electrical connections, using insulating tape. If the manufacturer's instructions are followed carefully at every stage no serious problems should be encountered. Remember that hydraulic pipes that have been disconnected must be carefully re-tightened and the hydraulic system purged of air bubbles by bleeding.

Two things will become immediately apparent when taking a motorcycle on the road for the first time with a fairing – the first is the tendency to underestimate the road speed because of the lack of wind pressure on the body. This must be very carefully watched until one has grown accustomed to riding behind the fairing. The second thing is the alarming increase in engine noise which is an unfortunate but inevitable by-product of fitting any type of fairing or windscreen, and is caused by normal engine noise being reflected, and in some cases amplified, by the flat surface of the fairing.

Luggage racks or carriers

Carriers are possibly the commonest item to be fitted to modern motorcycles. They vary enormously in size, carrying capacity, and durability. When selecting a carrier, always look for one which is made specifically for your machine and which is bolted on with as few separate brackets as possible. The universal-type carrier, with its mass of brackets and adaptor pieces, will generally prove too weak to be of any real use. A good carrier should bolt to the main frame, generally using the two suspension unit top mountings and a mudguard mounting bolt as attachment points, and have its luggage platform as low and as far forward as possible to minimise the effect of any load on the machine's stability. Look for good quality, heavy gauge tubing, good welding and good finish. Also ensure that the carrier does not prevent opening of the seat, sidepanels or tail compartment, as appropriate. When using a carrier, be very careful not to overload it. Excessive weight placed so high and so far to the rear of any motorcycle will have an adverse effect on the machine's steering and stability.

Luggage

Motorcycle luggage can be grouped under two headings: soft and hard. Both types are available in many sizes and styles and have advantages and disadvantages in use.

Soft luggage is now becoming very popular because of its lower cost and its versatility. Whether in the form of tankbags, panniers, or strap-on bags, soft luggage requires in general no brackets and no modification to the motorcycle. Equipment can be swapped easily from one motorcycle to another and can be fitted and removed in seconds. Awkwardly shaped loads can easily be carried. The disadvantages of soft luggage are that the contents cannot be secure against the casual thief, very little protection is afforded in the event of a crash, and waterproofing is generally poor. Also, in the case of panniers, carrying capacity is restricted to approximately 10 lb, although this amount will vary considerably depending on the manufacturer's recommendation. When purchasing soft luggage, look for good quality material, generally vinyl or nylon, with strong, well-stitched attachment points. It is always useful to have separate pockets, especially on tank bags, for items which will be needed on the journey. When purchasing a tank bag, look for one which has a separate, well-padded, base. This will protect the tank's paintwork and permit easy access to the filler cap at petrol stations.

Hard luggage is confined to two types: panniers, and top boxes or tail trunks. Most hard luggage manufacturers produce matching sets of these items, the basis of which is generally that manufacturer's own heavy-duty luggage rack. Variations on this theme occur in the form of separate frames for the better quality panniers, fixed or quickly-detachable luggage, and in size and carrying capacity. Hard luggage offers a reasonable degree of security against theft and good protection against weather and accident damage. Carrying capacity is greater than that of soft luggage, around 15 – 20 lb in the case of panniers, although top boxes should never be loaded as much as their apparent capacity might imply. A top box should only be used for lightweight items, because one that is heavily laden can have a serious effect on the stability of the machine. When purchasing hard luggage look for the same good points as mentioned under fairings and windscreens, ie good quality mounting brackets and fittings, and well-finished fibreglass or ABS plastic cases. Again as with fairings, always purchase luggage made specifically for your motorcycle, using as few separate brackets as possible, to ensure that everything remains securely bolted in place. When fitting hard luggage, be careful to check that the rear suspension and brake operation will not be impaired in any way and remember that many pannier kits require re-siting of the indicators. Remember also that a non-standard exhaust system may make fitting extremely difficult.

Handlebars

The occupation of fitting alternative types of handlebar is extremely popular with modern motorcyclists, whose motives may vary from the purely practical, wishing to improve the comfort of their machines, to the purely aesthetic, where form is more important than function. Whatever the reason, there are several considerations to be borne in mind when changing the handlebars of your machine. If fitting lower bars, check carefully that the switches and cables do not foul the petrol tank on full lock and that the surplus length of cable, brake pipe, and electrical wiring are smoothly and tidily disposed of. Avoid tight kinks in cable or brake pipes which will produce stiff controls or the premature and disastrous failure of an overstressed component. If necessary, remove the petrol tank and re-route the cable from the engine/gearbox unit upwards, ensuring smooth gentle curves are produced. In extreme cases, it will be necessary to purchase a shorter brake pipe to overcome this problem. In the case of higher handlebars than standard it will almost certainly be necessary to purchase extended cables and brake pipes. Fortunately, many standard motorcycles have a custom version which will be equipped with higher handlebars and, therefore, factory-built extended components will be available from your local dealer. It is not usually necessary to extend electrical wiring, as switch clusters may be used on several different motorcycles, some being custom versions. This point should be borne in mind however when fitting extremely high or wide handlebars.

When fitting different types of handlebar, ensure that the mounting clamps are correctly tightened to the manufacturer's specifications and that cables and wiring, as previously mentioned, have smooth easy runs and do not snag on any part of the motorcycle throughout the full steering lock. Ensure that the fluid level in the front brake master cylinder remains level to avoid any chance of air entering the hydraulic system. Also check that the cables are adjusted correctly and that all handlebar controls operate correctly and can be easily reached when riding.

Crashbars

Crashbars, also known as engine protector bars, engine guards, or case savers, are extremely useful items of equipment which can contribute protection to the machine's structure if a crash occurs. They do not, as has been inferred in the US, prevent the rider from crashing, or necessarily prevent rider injury should a crash occur.

It is recommended that only the smaller, neater, engine protector type of crashbar is considered. This type will offer protection while restricting, as little as is possible, access to the engine and the machine's ground clearance. The crashbars should be designed for use specifically on your machine, and should be constructed of heavy-gauge tubing with strong, integral mounting brackets. Where possible, they should bolt to a strong lug on the frame, usually at the engine mounting bolts.

The alternative type of crashbar is the larger cage type. This type is not recommended in spite of their appearance which promises some protection to the rider as well as to the machine. The larger amount of leverage imposed by the size of this type of crashbar increases the risk of severe frame damage in the event of an accident. This type also decreases the machine's ground clearance and restricts access to the engine. The amount of protection afforded the rider is open to some doubt as the design is based on the premise that the rider will stay in the normally seated position during an accident, and the crash bar structure will not itself fail. Neither result can in any way be guaranteed.

As a general rule, always purchase the best, ie usually the most expensive, set of crashbars you an afford. The investment will be repaid by minimising the amount of damage incurred, should the machine be involved in an accident. Finally, avoid the universal type of crashbar. This should be regarded only as a last resort to be used if no alternative exists. With its usual multitude of separate brackets and spacers, the universal crashbar is far too weak in design and construction to be of any practical value.

Exhaust systems

The fitting of aftermarket exhaust systems is another extremely popular pastime amongst motorcyclists. The usual motive is to gain more performance from the engine but other considerations are to gain more ground clearance, to lose weight from the motorcycle, to obtain a more distinctive exhaust note or to find a cheaper alternative to the manufacturer's original equipment exhaust system. Original equipment exhaust systems often cost more and may well have a relatively short life. It should be noted that it is rare for an aftermarket exhaust system alone to give a noticeable increase in the engine's power output. Modern motorcycles are designed to give the highest power output possible allowing for factors such as quietness, fuel economy, spread of power, and long-term reliability. If there were a magic formula which allowed the exhaust system to produce more power without affecting these other considerations you can be sure that the manufacturers, with their large research and development facilities, would have found it and made use of it. Performance increases of a worthwhile and noticeable nature only come from well-tried and properly matched modifications to the entire engine, from the air filter, through the carburettors, port timing or camshaft and valve design, combustion chamber shape, compression ratio, and the exhaust system. Such modifications are well outside the scope of this manual but interested owners might refer to specialist books produced by the publisher of this manual which go into the whole subject in great detail.

Whatever your motive for wishing to fit an alternative exhaust system, be sure to seek expert advice before doing so. Changes to the carburettor jetting will almost certainly be required for which you must consult the exhaust system manufacturer. If he cannot supply adequately specific information it is reasonable to assume that insufficient development work has been carried out, and that particular make should be avoided. Other factors to be borne in mind are whether the exhaust system allows the use of both centre and side stands, whether it allows sufficient access to permit oil and filter changing and whether modifications are necessary to the standard exhaust system. Many two-stroke expansion chamber systems require the use of the standard exhaust pipe; this is all very well if the standard exhaust pipe and silencer are separate units but can cause problems if the two, as with so many modern two-strokes, are a one-piece unit. While the exhaust pipe can be removed easily by means of a hacksaw it is not so easy to refit the original silencer should you at any time wish to return the machine to standard trim. The same applies to several four-stroke systems.

On the subject of the finish of aftermarket exhausts, avoid black-painted systems unless you enjoy painting. As any trail-bike owner will tell you, rust has a great affinity for black exhausts and re-painting or rust removal becomes a task which must be carried out with monotonous regularity. A bright chrome finish is, as a general rule, a far better proposition as it is much easier to keep clean and to prevent rusting. Although the general finish of aftermarket exhaust systems is not always up to the standard of the original equipment the lower cost of such systems does at least reflect this fact.

When fitting an alternative system always purchase a full set of new exhaust gaskets, to prevent leaks. Fit the exhaust first to the cylinder head or barrel, as appropriate, tightening the retaining nuts or bolts by hand only and then line up the exhaust rear mountings. If the new system is a one-piece unit and the rear mountings do not line up exactly, spacers must be fabricated to take up the difference. Do not force the system into place as the stress thus imposed will rapidly cause cracks and splits to appear. Once all the mountings are loosely fixed, tighten the retaining nuts or bolts securely, being careful not to overtighten them. Where the motorcycle manufacturer's torque settings are available, these should be used. Do not forget to carry out any carburation changes recommended by the exhaust system's manufacturer.

Electrical equipment

The vast range of electrical equipment available to motorcyclists is so large and so diverse that only the most general outline can be given here. Electrical accessories vary from electronic ignition kits fitted to replace contact breaker points, to additional lighting at the front and rear, more powerful horns, various instruments and gauges, clocks, anti-theft systems, heated clothing, CB radios, radio-cassette players, and intercom systems, to name but a few of the more popular items of equipment.

As will be evident, it would require a separate manual to cover this subject alone and this section is therefore restricted to outlining a few basic rules which must be borne in mind when fitting electrical equipment. The first consideration is whether your machine's electrical system has enough reserve capacity to cope with the added demand of the accessories you wish to fit. The motorcycle's manufacturer or importer should be able to furnish this sort of information and may also be able to offer advice on uprating the electrical system. Failing this, a good dealer or the accessory manufacturer may be able to help. In some cases, more powerful generator components may be available, perhaps from another motorcycle in the manufacturer's range. The second consideration is the legal requirements in force in your area. The local police may be prepared to help with this point. In the UK for example, there are strict regulations governing the position and use of auxiliary riding lamps and fog lamps.

When fitting electrical equipment always disconnect the battery first to prevent the risk of a short-circuit, and be careful to ensure that all connections are properly made and that they are waterproof. Remember that many electrical accessories are designed primarily for use in cars and that they cannot easily withstand the exposure to vibration and to the weather. Delicate components must be rubber-mounted to insulate them from vibration, and sealed carefully to prevent the entry of rainwater and dirt. Be careful to follow exactly the accessory manufacturer's instructions in conjunction with the wiring diagram at the back of this manual.

Accessories – general

Accessories fitted to your motorcycle will rapidly deteriorate if not cared for. Regular washing and polishing will maintain the finish and will provide an opportunity to check that all mounting bolts and nuts are securely fastened. Any signs of chafing or wear should be watched for, and the cause cured as soon as possible before serious damage occurs.

As a general rule, do not expect the re-sale value of your motorcycle to increase by an amount proportional to the amount of money and effort put into fitting accessories. It is usually the case that an absolutely standard motorcycle will sell more easily at a better price than one that has been modified. If you are in the habit of exchanging your machine for another at frequent intervals, this factor should be borne in mind to avoid loss of money.

Fault diagnosis

Contents

1 Introduction

This Section provides an easy reference-guide to the more common ailments that are likely to afflict your machine. Obviously, the opportunities are almost limitless for faults to occur as a result of obscure failures, and to try and cover all eventualities would require a book. Indeed, a number have been written on the subject.

Successful fault diagnosis is not a mysterious 'black art' but the application of a bit of knowledge combined with a systematic and logical approach to the problem. Approach any fault diagnosis by first accurately identifying the symptom and then checking through the list of possible causes, starting with the simplest or most obvious and progressing in stages to the most complex. Take nothing for granted, but above all apply liberal quantities of common sense.

The main symptom of a fault is given in the text as a major heading below which are listed, as Section headings, the various systems or areas which may contain the fault. Details of each possible cause for a fault and the remedial action to be taken are given, in brief, in the paragraphs below each Section heading. Further information should be sought in the relevant Chapter.

Starter motor problems

2 Starter motor not rotating

Engine stop switch off.

Fuse blown. Check the main fuse located behind the battery side cover.

Battery voltage low. Switching on the headlamp and operating the horn will give a good indication of the charge level. If necessary recharge the battery from an external source.

Neutral gear not selected. Where a neutral indicator switch is fitted.

Faulty neutral indicator switch or clutch interlock switch (where fitted). Check the switch wiring and switches for correct operation.

Ignition switch defective. Check switch for continuity and connections for security.

Engine stop switch defective. Check switch for continuity in 'Run' position. Fault will be caused by broken, wet or corroded switch contacts. Clean or renew as necessary.

Starter button switch faulty. Check continuity of switch. Faults as for engine stop switch.

Starter relay (solenoid) faulty. If the switch is functioning correctly a pronounced click should be heard when the starter button is depressed. This presupposes that current is flowing to the solenoid when the button is depressed.

Wiring open or shorted. Check first that the battery terminal connections are tight and corrosion free. Follow this by checking that all wiring connections are dry, tight and corrosion free. Check also for frayed or broken wiring. Occasionally a wire may become trapped between two moving components, particularly in the vicinity of the steering head, leading to breakage of the internal core but leaving the softer but more resilient outer cover intact. This can cause mysterious intermittent or total power loss.

Starter motor defective. A badly worn starter motor may cause high current drain from a battery without the motor rotating. If current is found to be reaching the motor, after checking the starter button and starter relay, suspect a damaged motor. The motor should be removed for inspection.

3 Starter motor rotates but engine does not turn over

Damaged starter motor drive train. Inspect and renew component where necessary. Failure in this area is unlikely.

4 Starter motor and clutch function but engine will not turn over

Engine seized. Seizure of the engine is always a result of damage to internal components due to lubrication failure, or component breakage resulting from abuse, neglect or old age. A seizing or partially seized component may go un-noticed until the engine has cooled down and an attempt is made to restart the engine. Suspect first seizure of the valves, valve gear and the pistons. Instantaneous seizure whilst the engine is running indicates component breakage. In either case major dismantling and inspection will be required.

Engine does not start when turned over

5 No fuel flow to carburettor

No fuel or insufficient fuel in tank.

Fuel tap lever position incorrectly selected.

Tank filler cap air vent obstructed. Usually caused by dirt or water. Clean the vent orifice.

Fuel tap or filter blocked. Blockage may be due to accumulation of rust or paint flakes from the tank's inner surface or of foreign matter from contaminated fuel. Remove the tap and clean it and the filter. Look also for water droplets in the fuel.

Fuel line blocked. Blockage of the fuel line is more likely to result from a kink in the line rather than the accumulation of debris.

6 Fuel not reaching cylinder

Float chamber not filling. Caused by float needle or floats sticking in up position. This may occur after the machine has been left standing for an extended length of time allowing the fuel to evaporate. When this occurs a gummy residue is often left which hardens to a varnish-like substance. This condition may be worsened by corrosion and crystaline deposits produced prior to the total evaporation of contaminated fuel. Sticking of the float needle may also be caused by wear. In any case removal of the float chamber will be necessary for inspection and cleaning.

Blockage in starting circuit, slow running circuit or jets. Blockage of these items may be attributable to debris from the fuel tank by-passing the filter system or to gumming up as described in paragraph 1. Water droplets in the fuel will also block jets and passages. The carburettor should be dismantled for cleaning.

Fuel level too low. The fuel level in the float chamber is controlled by float height. The fuel level may increase with wear or damage but will never reduce, thus a low fuel level is an inherent rather than developing condition. Check the fuel level and make any necessary adjustment.

7 Engine flooding

Float valve needle worn or stuck open. A piece of rust or other debris can prevent correct seating of the needle against the valve seat thereby permitting an uncontrolled flow of fuel. Similarly, a worn needle or needle seat will prevent valve closure. Dismantle the carburettor float bowl for cleaning and, if necessary, renewal of the worn components.

Fuel level too high. The fuel level is controlled by the float height which may increase due to wear of the float needle, pivot pin or operating tang. Check the float height, and make any necessary adjustment. A leaking float will cause an increase in fuel level, and thus should be renewed.

Accelerator pump. On those models so equipped, repeated operation of the throttle prior to starting will cause flooding due to too much raw fuel being injected into the venturi.

Cold starting mechanism. Check the choke (starter mechanism) for correct operation. If the mechanism jams in the 'On' position subsequent starting of a hot engine will be difficult.

Blocked air filter. A badly restricted air filter will cause flooding. Check the filter and clean or renew as required.

8 No spark at plug

Ignition switch not on.

Engine stop switch off.

Fuse blown. Check fuse for ignition circuit. See wiring diagram.

Battery voltage low. The current draw required by a starter motor is

sufficiently high that an under-charged battery may not have enough spare capacity to provide power for the ignition circuit during starting. Use of the kickstart (where fitted) is recommended until the battery has been recharged either by the machine's generator or from an external charger.

Starter motor inefficient. A starter motor with worn brushes and a worn or dirty commutator will draw excessive amounts of current causing power starvation in the ignition system. See the preceding paragraph. Starter motor overhaul will be required.

Spark plug failure. Clean the spark plug thoroughly and reset the electrode gap. Refer to the spark plug section and the colour condition guide in Routine Maintenance. If the spark plug shorts internally or has sustained visible damage to the electrodes, core or ceramic insulator it should be renewed. On rare occasions a plug that appears to spark vigorously will fail to do so when refitted to the engine and subjected to the compression pressure in the cylinder.

Spark plug cap or high tension (HT) lead faulty. Check condition and security. Replace if deterioration is evident.

Spark plug cap loose. Check that the spark plug cap fits securely over the plug and, where fitted, the screwed terminal on the plug end is secure.

Shorting due to moisture. Certain parts of the ignition system are susceptible to shorting when the machine is ridden or parked in wet weather. Check particularly the area from the spark plug cap back to the ignition coil. A water dispersant spray may be used to dry out waterlogged components. Recurrence of the problem can be prevented by using an ignition sealant spray after drying out and cleaning.

Ignition or stop switch shorted. May be caused by water, corrosion or wear. Water dispersant and contact cleaning sprays may be used. If this fails to overcome the problem dismantling and visual inspection of the switches will be required.

Shorting or open circuit in wiring. Failure in any wire connecting any of the ignition components will cause ignition malfunction. Check also that all connections are clean, dry and tight.

Ignition coil failure. Check the coil, referring to Chapter 5.

Capacitor (condenser) failure. The capacitor may be checked most easily by direct substitution with a replacement item. Blackened contact breaker points indicate capacitor malfunction but this may not always occur.

Contact breaker points pitted, burned or closed up. Check the contact breaker points, referring to Routine Maintenance. Check also that the low tension leads at the contact breaker are secure and not shorting out.

Electronic ignition system fault. Refer to Chapter 5.

9 Weak spark at plug

Feeble sparking at the plug may be caused by any of the faults mentioned in the preceding Section other than those items in paragraphs 1 and 2. Check first the contact breaker assembly and the spark plug, these being the most likely culprits.

10 Compression low

Spark plug loose. This will be self-evident on inspection, and may be accompanied by a hissing noise when the engine is turned over. Remove the plug and check that the threads in the cylinder head are not damaged. Check also that the plug sealing washer is in good condition.

Cylinder head gasket leaking. This condition is often accompanied by a high pitched squeak from around the cylinder head and oil loss, and may be caused by insufficiently tightened cylinder head fasteners, a warped cylinder head or mechanical failure of the gasket material. Re-torqueing the fasteners to the correct specification may seal the leak in some instances but if damage has occurred this course of action will provide, at best, only a temporary cure.

Valve not seating correctly. The failure of a valve to seat may be caused by insufficient valve clearance, pitting of the valve seat or face, carbon deposits on the valve seat or seizure of the valve stem or valve gear components. Valve spring breakage will also prevent correct valve closure. The valve clearances should be checked first and then, if these are found to be in order, further dismantling will be required to inspect the relevant components for failure.

Cylinder, piston and ring wear. Compression pressure will be lost if any of these components are badly worn. Wear in one component is invariably accompanied by wear in another. A top end overhaul will be required.

Piston rings sticking or broken. Sticking of the piston rings may be caused by seizure due to lack of lubrication or heating as a result of poor carburation or incorrect fuel type. Gumming of the rings may result from lack of use, or carbon deposits in the ring grooves. Broken rings result from over-revving, overheating or general wear. In either case a top-end overhaul will be required.

Engine stalls after starting

11 General causes

Improper cold start mechanism operation. Check that the operating controls function smoothly and, where applicable, are correctly adjusted. A cold engine may not require application of an enriched mixture to start initially but may baulk without choke once firing. Likewise a hot engine may start with an enriched mixture but will stop almost immediately if the choke is inadvertently in operation.

Ignition malfunction. See Section 9, 'Weak spark at plug'.

Carburettor incorrectly adjusted. Maladjustment of the mixture strength or idle speed may cause the engine to stop immediately after starting. See Chapter 4.

Fuel contamination. Check for filter blockage by debris or water which reduces, but does not completely stop, fuel flow or blockage of the slow speed circuit in the carburettor by the same agents. If water is present it can often be seen as droplets in the bottom of the float bowl. Clean the filter and, where water is in evidence, drain and flush the fuel tank and float bowl.

Intake air leak. Check for security of the carburettor mounting and hose connections, and for cracks or splits in the hoses. Check also that the carburettor top is secure and that the vacuum gauge adaptor plug (where fitted) is tight.

Air filter blocked or omitted. A blocked filter will cause an over-rich mixture; the omission of a filter will cause an excessively weak mixture. Both conditions will have a detrimental affect on carburation. Clean or renew the filter as necessary.

Fuel filler cap air vent blocked. Usually caused by dirt or water. Clean the vent orifice.

Poor running at idle and low speed

12 Weak spark at plug or erratic firing

Battery voltage low. In certain conditions low battery charge, especially when coupled with a badly sulphated battery, may result in misfiring. If the battery is in good general condition it should be recharged; an old battery suffering from sulphated plates should be renewed.

Spark plug fouled, faulty or incorrectly adjusted. See Section 8 or refer to Routine Maintenance.

Spark plug cap or high tension lead shorting. Check the condition of both these items ensuring that they are in good condition and dry and that the cap is fitted correctly.

Spark plug type incorrect. Fit plug of correct type and heat range as given in Specifications. In certain conditions a plug of hotter or colder type may be required for normal running.

Contact breaker points pitted, burned or closed-up. Check the contact breaker assembly, referring to Routine Maintenance.

Igniting timing incorrect. Check the ignition timing statically and dynamically, ensuring that the advance is functioning correctly.

Faulty ignition coil. Partial failure of the coil internal insulation will diminish the performance of the coil. No repair is possible, a new component must be fitted.

Faulty capacitor (condenser). A failure of capacitor will cause blackening of the contact breaker point faces and will allow excessive sparking at the points. A faulty capacitor may best be checked by substitution of a serviceable replacement item.

13 Fuel/air mixture incorrect

Intake air leak. See Section 11.

Mixture strength incorrect. Adjust slow running mixture strength using pilot adjustment screw

Carburettor synchronisation.

Pilot jet or slow running circuit blocked. The carburettor should be removed and dismantled for thorough cleaning. Blow through all jets and air passages with compressed air to clear obstructions.

Air cleaner clogged or omitted. Clean or fit air cleaner element as necessary. Check also that the element and air filter cover are correctly seated.

Cold start mechanism in operation. Check that the choke has not been left on inadvertently and the operation is correct. Where applicable check the operating cable free play.

Fuel level too high or too low. Check the float height and adjust as necessary. See Section 7.

Fuel tank air vent obstructed. Obstruction usually caused by dirt or water. Clean vent orifice.

Valve clearance incorrect. Check, and if necessary, adjust, the clearances.

14 Compression low

See Section 10.

Acceleration poor

15 General causes

All items as for previous Section.

Accelerator pump defective. Where so equipped, check that the accelerator pump injects raw fuel into the carburettor venturi, when the throttle is open fully. If this does not occur check the condition of the pump components and that the feed passage to the pump is not obstructed.

Timing not advancing. This is caused by a sticking or damaged automatic timing unit (ATU). Cleaning and lubrication of the ATU will usually overcome sticking, failing this, and in any event if damage is evident, renewal of the ATU will be required.

Sticking throttle vacuum piston. CD carburettors only.

Brakes binding. Usually caused by maladajustment or partial seizure of the operating mechanism due to poor maintenance. Check brake adjustment (where applicable). A bent wheel spindle or warped brake disc can produce similar symptoms.

Poor running or lack of power at high speeds

16 Weak spark at plug or erratic firing

All items as for Section 12.

HT lead insulation failure. Insulation failure of the HT lead and spark plug cap due to old age or damage can cause shorting when the engine is driven hard. This condition may be less noticeable, or not noticeable at all at lower engine speeds.

17 Fuel/air mixture incorrect

All items as for Section 13, with the exception of items 2 and 4.

Main jet blocked. Debris from contaminated fuel, or from the fuel tank, and water in the fuel can block the main jet. Clean the fuel filter, the float bowl area, and if water is present, flush and refill the fuel tank.

Main jet is the wrong size. The standard carburettor jetting is for sea level atmospheric pressure. For high altitudes, usually above 5000 ft, a smaller main jet will be required.

Jet needle and needle jet worn. These can be renewed individually but should be renewed as a pair. Renewal of both items requires partial dismantling of the carburettor.

Air bleed holes blocked. Dismantle carburettor and use compressed air to blow out all air passages.

Reduced fuel flow. A reduction in the maximum fuel flow from the fuel tank to the carburettor will cause fuel starvation, proportionate to the engine speed. Check for blockages through debris or a kinked fuel line.

Vacuum diaphragm split. Renew.

18 Compression low

See Section 10

Knocking or pinking

19 General causes

Carbon build-up in combustion chamber. After high mileages have been covered large accumulation of carbon may occur. This may glow red hot and cause premature ignition of the fuel/air mixture, in advance of normal firing by the spark plug. Cylinder head removal will be required to allow inspection and cleaning.

Fuel incorrect. A low grade fuel, or one of poor quality may result in compression induced detonation of the fuel resulting in knocking and pinking noises. Use only the specified grade of fuel. Refer to Chapter 4. Old fuel can cause similar problems. A too highly leaded fuel will reduce detonation but will accelerate deposit formation in the combustion chamber and may lead to early pre-ignition as described in item 1.

Spark plug heat range incorrect. Uncontrolled pre-ignition can result from the use of a spark plug the heat range of which is too hot.

Weak mixture. Overheating of the engine due to a weak mixture can result in pre-ignition occurring where it would not occur when engine temperature was within normal limits. Maladjustment, blocked jets or passages and air leaks can cause this condition.

Some models are prone to pinking (see Chapter 5 for a typical example). In severe cases, compression plates may be fitted to provide a cure.

Overheating

20 Firing incorrect

Spark plug fouled, defective or maladjusted. See Section 6.

Spark plug type incorrect. Refer to the Specifications and ensure that the correct plug type is fitted.

Incorrect ignition timing. Timing that is far too much advanced or far too much retarded will cause overheating. Check the ignition timing is correct and that the advance mechanism is functioning.

21 Fuel/air mixture incorrect

Slow speed mixture strength incorrect. Adjust pilot air screw.

Main jet wrong size. The carburettor is jetted for sea level atmospheric conditions. For high altitudes, usually above 5000 ft, a smaller main jet will be required.

Air filter badly fitted or omitted. Check that the filter element is in place and that it and the air filter box cover are sealing correctly. Any leaks will cause a weak mixture

Induction air leaks. Check the security of the carburettor mountings and hose connections, and for cracks and splits in the hoses. Check also that the carburettor top is secure and that the vacuum gauge adaptor plug (where fitted) is tight.

Fuel level too low. See Section 6.

Fuel tank filler cap air vent obstructed. Clear blockage.

22 Lubrication inadequate

Engine oil too low. Not only does the oil serve as a lubricant by preventing friction between moving components, but it also acts as a coolant. Check the oil level and replenish.

Engine oil overworked. The lubricating properties of oil are lost slowly during use as a result of changes resulting from heat and also contamination. Always change the oil at the recommended interval.

Engine oil of incorrect viscosity or poor quality. Always use the recommended viscosity and type of oil.

Oil filter and filter by-pass valve blocked. Renew filter and clean the by-pass valve.

23 Miscellaneous causes

Engine fins clogged. A build-up of mud in the cylinder head and cylinder barrel cooling fins will decrease the cooling capabilities of the fins. Clean the fins as required.

Clutch operating problems

24 Clutch slip

No clutch lever play. Adjust clutch lever end play according to the procedure in Routine Maintenance.

Clutch plate worn or warped. Overhaul clutch assembly, replacing plate if necessary (Chapter 2).

Pressure or cover plates worn or warped. Overhaul clutch assembly, replacing plates out of specification (Chapter 2).

Clutch spring broken or worn. An old or heat-damaged (from slipping clutch) spring should be renewed (Chapter 2).

Clutch release not adjusted properly. See Routine Maintenance.

Clutch inner cable snagging. Caused by a frayed cable or kinked outer cable. Replace the cable with a new one. Repair of a frayed cable is not advised.

Clutch release mechanism defective. Worn or damaged parts in the clutch release mechanism could include the pushrod, thrust bearing or thrust piston. Replace parts as necessary (Chapter 2).

Oil leaking on to clutch plate. Dismantle clutch (Chapter 2) renew clutch plate, wash off all traces of oil and trace source of leak. If the leak is from the engine refer to Chapter 1, if from the gearbox, refer to Chapter 3.

25 Clutch drag

Clutch lever play excessive. Adjust lever at bars or at cable end if necessary (refer to Routine Maintenance).

Clutch plates warped or damaged. This will cause a drag on the clutch, causing the machine to creep. Overhaul clutch assembly (Chapter 2).

Clutch release mechanism defective. Worn or damaged release mechanism parts can stick and fail to provide leverage. Overhaul clutch release mechanism (Chapter 2).

Gear selection problems

26 Gear lever does not return

Weak or broken return spring. Renew the spring.

27 Gear selection difficult or impossible

Clutch not disengaging fully. See Section 25.

Wear at external linkage (where fitted) causing excessive free play. Renew worn items.

Gearchange arms, pawls or pins worn or damaged. Wear or breakage of any of these items may cause difficulty in selecting one or more gears. Overhaul the selector mechanism.

Gearchange arm spring broken. Renew spring.

Gearchange drum stopper cam damage. Failure, rather than wear, of these items may jam the cam plates thereby preventing gearchanging. The damaged items must be renewed.

Selector forks bent or seized. This can be as a result of lack of lubrication. Though rare, bending of a shaft can result from a missed gearchange or false selection at high speed.

Selector fork end and pin wear. Pronounced wear of these items and the grooves in the cam plates can lead to imprecise selection and, eventually, no selection. Renewal of the worn components will be required.

Structural failure. Failure of any one component of the selector rod and change mechanism will result in improper or fouled gear selection.

28 Jumping out of gear

Indexing lever assembly worn or damaged. Wear of the lever and the cam with which it locates and breakage of the detent spring can cause imprecise gear selection resulting in jumping out of gear. Renew the damaged components.

Gear pinion dogs worn or damaged. Rounding off the dog edges and the mating recesses in adjacent pinion can lead to jumping out of gear when under load. The gears should be inspected and renewed. Attempting to reprofile the dogs is not recommended.

Selector forks, cam plates and pinion grooves worn. Extreme wear of these interconnected items can occur after high mileages especially when lubrication has been neglected. The worn components must be renewed.

Gear pinions, bushes and shafts worn. Renew the worn components.

Gear pinion tooth broken. Chipped teeth are unlikely to cause jumping out of gear once the gear has been selected fully; a tooth which is completely broken off, however, may cause problems in this respect and in any event will cause transmission noise.

29 Overselection

Pawl spring weak or broken. Renew the spring.

Indexing lever worn or broken. Renew the damaged items.

Stopper arm spring worn or broken. Renew the spring.

Gearchange arm stop pads worn. Repairs can be made by welding and reprofiling with a file.

Selector limiter claw components (where fitted) worn or damaged. Renew the damaged items.

Abnormal engine noise

30 Knocking or pinking

See Section 19.

31 Piston slap or rattling from cylinder

Cylinder bore/piston clearance excessive. Resulting from wear, partial seizure or improper boring during overhaul. This condition can often be heard as a high, rapid tapping noise when the engine is under little or no load, particularly when power is just beginning to be applied. Reboring to the next correct oversize should be carried out (where possible) and a new oversize piston fitted or the cylinders and pistons should be renewed (all models 1981 on).

Connecting rod bent. This can be caused by over-revving, trying to start a very badly flooded engine (resulting in a hydraulic lock in the cylinder) or by earlier mechanical failure such as a dropped valve. Attempts at straightening a bent connecting rod from a high performance engine are not recommended. Careful inspection of the crankshaft should be made before renewing the damaged connecting rod.

Gudgeon pin, piston boss bore or small-end bearing wear or seizure. Excess clearance or partial seizure between normal moving parts of these items can cause continuous or intermittent tapping noises. Rapid wear or seizure is caused by lubrication starvation resulting from an insufficient engine oil level or oilway blockage.

Piston rings worn, broken or sticking. Renew the rings after careful inspection of the piston and bore.

32 Valve noise or tapping from the cylinder head

Valve clearance incorrect. Adjust the clearances with the engine cold.

Valve spring broken or weak. Renew the spring set.

Excessive rocker arm endfloat. Refer to Chapter 1.

Rocker arm or spindle wear. Rapid wear of a rocker arm, and the resulting need for frequent valve clearance adjustment, indicates breakthrough or failure of the surface hardening on the rocker arm tips. Similar wear in the cam lobes can be expected. Renew the worn components after checking for lubrication failure.

33 Other noises

Big-end bearing wear. A pronounced knock from within the crankcase which worstens rapidly is indicative of big-end bearing failure as a result of extreme normal wear or lubrication failure. Remedial action in the form of a bottom end overhaul should be taken; continuing to run the engine will lead to further damage including the possibility of connecting rod breakage.

Main bearing failure. Extreme normal wear or failure of the main bearings is characteristically accompanied by a rumble from the crankcase and vibration felt through the frame and footrests. Refer to Chapter 1; crankshaft repair is a task for a BMW dealer only.

Crankshaft excessively out of true. A bent crank may result from over-revving or damage from an upper cylinder component or gearbox failure. Renew the crankshaft.

Engine mounting loose. Tighten all the engine mounting nuts and bolts.

Cylinder head gasket leaking. The noise most often associated with a leaking head gasket is a high pitched squeaking, although any other noise consistent with gas being forced out under pressure from a small orifice can also be emitted. Gasket leakage is often accompanied by oil seepage from around the mating joint or from the cylinder head holding down bolts and nuts. Leakage results from insufficient or uneven tightening of the cylinder head fasteners, or from random mechanical failure. Retightening to the correct torque figure will, at best, only provide a temporary cure. The gasket should be renewed at the earliest opportunity.

Exhaust system leakage. Popping or crackling in the exhaust system, particularly when it occurs with the engine on the overrun, indicates a poor joint either at the cylinder port or at the exhaust pipe/silencer connection. Failure of the gasket or looseness of the clamp should be looked for.

Abnormal transmission noise

34 Clutch noise

Clutch plate centre splines worn. Renew the clutch plate and examine closely the gearbox input shaft.

35 Transmission noise

Bearing or bushes worn or damaged. Renew the affected components.

Gear pinions worn or chipped. Renew the gear pinions.

Metal chips jams in gear teeth.This can occur when pieces of metal from any failed component are picked up by a meshing pinion. The condition will lead to rapid bearing wear or early gear failure.

Oil level too low. Top up immediately to prevent damage to gearbox.

Gearchange mechanism worn or damaged. Wear or failure of certain items in the selection and change components can induce mis-selection of gears (see Section 27) where incipient engagement of more than one gear set is promoted. Remedial action, by the overhaul of the gearbox, should be taken without delay.

36 White/blue smoke (caused by oil burning)

Piston rings worn or broken. Breakage or wear of any ring, but particularly the oil control ring, will allow engine oil past the piston into the combustion chamber. Overhaul the cylinder barrel and piston.

Cylinder cracked, worn or scored. These conditions may be caused by overheating, lack of lubrication, component failure or advanced normal wear. The cylinder barrel should be renewed (with the piston) or rebored and the next oversize piston fitted.

Valve guides damaged or worn. This can occur as a result of valve guide failure or old age. The emission of smoke is likely to occur when the throttle is closed rapidly after acceleration, for instance, when changing gear. Renew the valve guides.

Engine oil level too high. This increases the crankcase pressure and allows oil to be forced pass the piston rings. Often accompanied by seepage of oil at joints and oil seals.

Abnormal crankcase pressure. This may be caused by blocked breather passages or hoses causing back-pressure at high engine revolutions.

37 Black smoke (caused by over-rich mixture)

Air filter element clogged. Clean or renew the element.

Main jet loose or too large. Remove the float chamber to check for tightness of the jet. If the machine is used at high altitudes rejetting will be required to compensate for the lower atmospheric pressure.

Cold start mechanism jammed on. Check that the mechanism works smoothly and correctly and that, where fitted, the operating cable is lubricated and not snagged.

Fuel level too high. The fuel level is controlled by the float height which can increase as a result of wear or damage. Remove the float bowl and check the float height. Check also that floats have not punctured; a punctured float will loose buoyancy and allow an increased fuel level.

Float valve needle stuck open. Caused by dirt or a worn valve. Clean the float chamber or renew the needle and, if necessary, the valve seat.

Oil pressure indicator lamp goes on

38 Engine lubrication system failure

Engine oil defective. Oil pump shaft or locating pin sheared off from ingesting debris or seizing from lack of lubrication (low oil level) (Chapter 1).

Engine oil screen clogged. Change oil and filter and service pickup screen (Routine Maintenance and Chapter 4).

Engine oil level too low. Inspect for leak or other problem causing low oil level and add recommended lubricant. Refer to Routine Maintenance.

Engine oil viscosity too low. Very old, thin oil, or an improper weight of oil used in engine. Change to correct lubricant. Refer to Routine Maintenance.

Camshaft or journals worn. High wear causing drop in oil pressure. Replace cam and/or bearings. Abnormal wear could be caused by oil starvation at high rpm from low oil level or improper oil weight or type (Chapter 1).

Crankshaft and/or bearings worn. Same problems as paragraph 5. Overhaul lower end. Refer to Chapter 1, crankshaft repair is a task for a BMW dealer only.

Relief valve stuck open. This causes the oil to be dumped back into the sump. Repair or replace (Chapter 4).

39 Electrical system failure

Oil pressure switch defective. Check switch according to the procedures in Chapter 9. Replace if defective.

Oil pressure indicator lamp wiring system defective. Check for pinched, shorted, disconnected or damaged wiring (Chapter 9).

Poor handling or roadholding

40 Directional instability

Steering head bearing adjustment too tight. This will cause rolling or weaving at low speeds. Re-adjust the bearings.

Steering head bearing worn or damaged. Correct adjustment of the bearing will prove impossible to achieve if wear or damage has occurred. Inconsistent handling will occur including rolling or weaving at low speed and poor directional control at indeterminate higher speeds. The steering head bearing should be dismantled for inspection and renewed if required. Lubrication should also be carried out.

Bearing races pitted or dented. Impact damage caused, perhaps, by an accident or riding over a pot-hole can cause indentation of the bearing, usually in one position. This should be noted as notchiness when the handlebars are turned. Renew and lubricate the bearings.

Steering stem bent. This will occur only if the machine is subjected to a high impact such as hitting a curb or a pot-hole. The lower yoke/stem should be renewed; do not attempt to straighten the stem.

Front or rear tyre pressures too low.

Front or rear tyre worn. General instability, high speed wobbles and skipping over white lines indicates that tyre renewal may be required. Tyre induced problems, in some machine/tyre combinations, can occur even when the tyre in question is by no means fully worn.

Swinging arm bearings worn. Difficulties in holding line, particularly when cornering or when changing power settings indicates wear in the swinging arm bearings. The swinging arm should be removed from the machine and the bearings renewed.

Swinging arm flexing. The symptoms given in the preceding paragraph will also occur if the swinging arm fork flexes badly. This can be caused by structural weakness as a result of corrosion, fatigue or impact damage, or because the rear wheel spindle is slack.

Wheel bearings worn. Renew the worn bearings.

Loose wheel spokes. The spokes should be tightened evenly to maintain tension and trueness of the rim.

Tyres unsuitable for machine. Not all available tyres will suit the characteristics of the frame and suspension, indeed, some tyres or tyre combinations may cause a transformation in the handling characteristics. Check with importer or BMW dealer for currently-approved makes of tyre. If handling problems occur immediately after changing to a new tyre type or make, revert to the original tyres to see whether an improvement can be noted. In some instances a change to what are, in fact, suitable tyres may give rise to handling deficiences. In this case a thorough check should be made of all frame and suspension items which affect stability.

41 Steering bias to left or right

Wheels out of alignment. This can be caused by impact damage to the frame, swinging arm, wheel spindles or front forks. Although occasionally a result of material failure or corrosion it is usually as a result of a crash.

Front forks twisted in the steering yokes. A light impact, for instance with a pot-hole or low curb, can twist the fork legs in the steering yokes without causing structural damage to the fork legs or the yokes themselves. Re-alignment can be made by loosening the yoke pinch bolts, wheel spindle and mudguard bolts. Re-align the wheel with the handlebars and tighten the bolts working upwards from the wheel spindle. This action should be carried out only when there is no chance that structural damage has occurred.

42 Handlebar vibrates or oscillates

Tyres worn or out of balance. Either condition, particularly in the front tyre, will promote shaking of the fork assembly and thus the handlebars. A sudden onset of shaking can result if a balance weight is displaced during use.

Tyres badly positioned on the wheel rims. A *moulded* line on each wall of a tyre is provided to allow visual verification that the tyre is correctly positioned on the rim. A check can be made by rotating the tyre; any misalignment will be immediately obvious.

Wheels rims warped or damaged. Inspect the wheels for runout as described in Routine Maintenance.

Swinging arm bearings worn. Renew the bearings.

Wheel bearings worn. Renew the bearings.

Steering head bearings incorrectly adjusted. Vibration is more likely to result from bearings which are too loose rather than too tight. Re-adjust the bearings.

Loosen fork component fasteners. Loose nuts and bolts holding the fork legs, wheel spindle, mudguards or steering stem can promote shaking at the handlebars. Fasteners on running gear such as the forks and suspension should be check tightened occasionally to prevent dangerous looseness of components occurring.

Engine mounting bolts loose. Tighten all fasteners.

43 Poor front fork performance

Damping fluid level incorrect. If the fluid level is too low poor suspension control will occur resulting in a general impairment of roadholding and early loss of tyre adhesion when cornering and braking. Too much oil is unlikely to change the fork characteristics unless severe overfilling occurs when the fork action will become stiffer and oil seal failure may occur.

Damping oil viscosity incorrect. The damping action of the fork is directly related to the viscosity of the damping oil. The lighter the oil used, the less will be the damping action imparted. For general use, use only one of the recommended types of oil, changing to a slightly higher or heavier oil only when a change in damping characteristic is required. Overworked oil, or oil contaminated with water which has found its way past the seals, should be renewed to restore the correct damping performance and to prevent bottoming of the forks.

Damping components worn or corroded. Advanced normal wear of the fork internals is unlikely to ocur until a very high mileage has been covered. Continual use of the machine with damaged oil seals which allows the ingress of water, or neglect, will lead to rapid corrosion and wear. Dismantle the forks for inspection and overhaul. See Chapter 6.

Weak fork springs. Progressive fatigue of the fork springs, resulting in a reduced spring free length, will occur after extensive use. This condition will promote excessive fork dive under braking, and in its advanced form will reduce the at-rest extended length of the forks and thus the fork geometry. Renewal of the springs as a pair is the only satisfactory course of action. Heavier duty springs or preload spacers are available for some models.

Bent stanchions or corroded stanchions. Both conditions will prevent correct telescoping of the fork legs, and in an advanced state can cause sticking of the fork in one position. In a mild form corrosion will cause stiction of the fork thereby increasing the time the suspension takes to react to an uneven road surface. Bent fork stanchions should be attended to immediately because they indicate that impact damage has occurred, and there is a danger that the forks will fail with disastrous consequences.

44 Front fork judder when braking (see also Section 56)

Wear between the fork stanchions and the fork legs. Renewal of the affected components is required.

Slack steering head bearings. Re-adjust the bearings.

Warped brake disc or drum. If irregular braking action occurs fork judder can be induced in what are normally serviceable forks. Renew the damaged brake components.

45 Poor rear suspension performances

Rear suspension unit damper worn out or leaking. The damping performance of most rear suspension units falls off with age. This is a gradual process, and thus may not be immediately obvious. Indications of poor damping include hopping of the rear end when cornering or braking, and a general loss of positive stability. See Chapter 7.

Weak rear springs. If the suspension unit springs fatigue they will promote excessive pitching of the machine and reduce the ground clearance when cornering. Although replacement springs are available separately from the rear suspension damper unit it is probable that if spring fatigue has occurred the damper units will also require renewal.

Swinging arm flexing or bearings worn. See Sections 40 and 41.

Bent suspension unit damper rod. This is likely to occur only if the machine is dropped or if seizure of the piston occurs. If either happens the suspension units should be renewed, as a pair (where applicable).

Abnormal frame and suspension noise

46 Front end noise

Oil level low or too thin. This can cause a 'spurting' sound and is usually accompanied by irregular fork action (Chapter 6).

Spring weak or broken. Makes a clicking or scraping sound. Fork oil will have a lot of metal particles in it (Chapter 6).

Steering head bearings loose or damaged. Clicks when braking. Check, adjust or replace (Chapter 6).

Fork clamps loose. Make sure all fork clamp pinch bolts are tight (Chapter 6).

Fork stanchion bent. Good possibility if machine has been dropped. Repair or replace tube (Chapter 6).

Excessive play in damper assembly. See Chapter 6.

47 Rear suspension noise

Fluid level too low. Leakage of a suspension unit, usually evident by oil on the outer surfaces, can cause a spurting noise. The suspension units should be renewed, as a pair (where applicable).

Defective rear suspension unit with internal damage. Renew the suspension units, as a pair (where applicable).

Brake problems

48 Brakes are spongy or ineffective – disc brakes

Air in brake circuit. This is only likely to happen in service due to neglect in checking the fluid level or because a leak has developed. The problem should be identified and the brake system bled of air.

Pad worn. Check the pad wear against the wear lines provided or measure the friction material thickness and renew the pads if necessary.

Contaminated pads. Cleaning pads which have been contaminated with oil, grease or brake fluid is unlikely to prove successful; the pads should be renewed.

Pads glazed. This is usually caused by overheating. The surface of the pads may be roughened using glass-paper or a fine file.

Brake fluid deterioration. A brake which on initial operation is firm but rapidly becomes spongy in use may be failing due to water contamination of the fluid. The fluid should be drained and then the system refilled and bled.

Master cylinder seal failure. Wear or damage of master cylinder internal parts will prevent pressurisation of the brake fluid. Overhaul the master cylinder unit.

Caliper seal failure. This will almost certainly be obvious by loss of fluid, a lowering of fluid in the master cylinder reservoir and contamination of the brake pads and caliper. Overhaul the caliper assembly.

Brake lever or pedal improperly adjusted. Adjust the clearance between the lever end and master cylinder plunger to take up lost motion, as recommended in Routine maintenance (/6, /7 up to 1980 only).

Caliper pivot seized (/6, /7 up to 1980 only).

49 Brakes drag – disc brakes

Disc warped. The disc must be renewed.

Caliper pivot, piston or pads corroded. The brake caliper assembly is vulnerable to corrosion due to water and dirt, and unless cleaned at regular intervals and lubricated in the recommended manner, will become sticky in operation.

Piston seal deteriorated. The seal is designed to return the piston in the caliper to the retracted position when the brake is released. Wear or old age can affect this function. The caliper should be overhauled if this occurs.

Brake pad damaged. Pad material separating from the backing plate due to wear or faulty manufacture. Renew the pads. Faulty installation of a pad also will cause dragging.

Wheel spindle bent. The spindle may be straightened if no structural damage has occurred.

Brake lever or pedal not returning. Check that the lever or pedal works smoothly throughout its operating range and does not snag on any adjacent cycle parts. Lubricate the pivot if necessary.

50 Brake lever or pedal pulsates in operation – disc brakes

Disc warped or irregularly worn. The disc must be renewed.

Wheel spindle bent. The spindle may be straightened provided no structural damage has occurred.

51 Disc brake noise

Brake squeal. Squealing can be caused by dust on the pads, usually in combination with glazed pads, or other contamination from oil, grease, brake fluid or corrosion. Persistent squealing which cannot be traced to any of the normal causes can often be cured by applying a thin layer of high temperature silicone grease to the rear of the pads. Make absolutely certain that no grease is allowed to contaminate the braking surface of the pads.

Glazed pads. This is usually caused by high temperatures or contamination. The pad surfaces may be roughened using glass-paper or a fine file. If this approach does not effect a cure the pads should be renewed.

Disc warped. This can cause a chattering, clicking or intermittent squeal and is usually accompanied by a pulsating brake lever or pedal or uneven braking. The disc must be renewed.

Brake pads fitted incorrectly or undersize. Longitudinal play in the pads due to omission of the locating springs (where fitted) or because pads of the wrong size have been fitted will cause a single tapping noise every time the brake is operated. Inspect the pads for correct installation and security.

52 Brakes are spongy or ineffective – drum brakes

Brake cable deterioration. Damage to the outer cable by stretching or being trapped will give a spongy feel to the brake lever. The cable should be renewed. A cable which has become corroded due to old age or neglect of lubrication will partially seize making operation very heavy. Lubrication at this stage may overcome the problem but the fitting of a new cable is recommended.

Worn brake linings. Determine lining wear using the external brake wear indicator on the brake backplate, or by removing the wheel and withdrawing the brake backplate. Renew the shoe/lining units as a pair if the linings are worn below the recommended limit.

Worn brake camshaft. Wear between the camshaft and the bearing surface will reduce brake feel and reduce operating efficiency. Renewal of one or both items will be required to rectify the fault.

Worn brake cam and shoe ends. Renew the worn components.

Linings contaminated with dust or grease. Any accumulations of

dust should be cleaned from the brake assembly and drum using a petrol dampened cloth. Do not blow or brush off the dust because it is asbestos based and thus harmful if inhaled. Light contamination from grease can be removed from the surface of the brake linings using a solvent; attempts at removing heavier contamination are less likely to be successful because some of the lubricant will have been absorbed by the lining material which will severely reduce the braking performance.

53 Brake drag – drum brakes

Incorrect adjustment. Re-adjust the brake operating mechanism.

Drum warped or oval. This can result from overheating, impact or uneven tension of the wheel spokes. The condition is difficult to correct, although if slight ovality only occurs, skimming the surface of the brake drum can provide a cure. This is work for a specialist engineer. Renewal of the complete wheel hub is normally the only satisfactory solution.

Weak brake shoe return springs. This will prevent the brake lining/shoe units from pulling away from the drum surface once the brake is released. The springs should be renewed.

Brake camshaft, lever pivot or cable poorly lubricated. Failure to attend to regular lubrication of these areas will increase operating resistance which, when compounded, may cause tardy operation and poor release movement.

54 Brake lever or pedal pulsates in operation – drum brakes

Drums warped or oval. This can result from overheating, impact or uneven spoke tension. This condition is difficult to correct, although if slight ovality only occurs skimming the surface of the drum can provide a cure. This is work for a specialist engineer. Renewal of the hub is normally the only satisfactory solution.

55 Drum brake noise

Drum warped or oval. This can cause intermittent rubbing of the brake linings against the drum. See the preceding Section.

Brake linings glazed. This condition, usually accompanied by heavy lining dust contamination, often induces brake squeal. The surface of the linings may be roughened using glass-paper or a fine file.

56 Brake induced fork judder

Worn front fork stanchions and legs, or worn or badly adjusted steering head bearings. These conditions, combined with uneven or pulsating braking as described in Sections 50 and 54 will induce more or less judder when the brakes are applied, dependent on the degree of wear and poor brake operation. Attention should be given to both areas of malfunction. See the relevant Sections.

Electrical problems

57 Battery dead or weak

Battery faulty. Battery life should not be expected to exceed 3 to 4 years, particularly where a starter motor is used regularly. Gradual sulphation of the plates and sediment deposits will reduce the battery performance. Plate and insulator damage can often occur as a result of vibration. Complete power failure, or intermittent failure, may be due to a broken battery terminal. Lack of electrolyte will prevent the battery maintaining charge.

Battery leads making poor contact. Remove the battery leads and clean them and the terminals, removing all traces of corrosion and tarnish. Reconnect the leads and apply a coating of petroleum jelly to the terminals.

Load excessive. If additional items such as spot lamps, are fitted, which increase the total electrical load above the maximum alternator output, the battery will fail to maintain full charge. Reduce the electrical load to suit the electrical capacity.

Regulator/diode board failure.

Alternator generating coils open-circuit or shorted.

Charging circuit shorting or open circuit. This may be caused by frayed or broken wiring, dirty connectors or a faulty ignition switch. The system should be tested in a logical manner. See Section 60.

58 Battery overcharged

Diode board/regulator faulty. Overcharging is indicated if the battery becomes hot or it is noticed that the electrolyte level falls repeatedly between checks. In extreme cases the battery will boil causing corrosive gases and electrolyte to be emitted through the vent pipes.

Battery wrongly matched to the electrical circuit. Ensure that the specified battery is fitted to the machine.

59 Total electrical failure

Fuse blown. Check the main fuse. If a fault has occurred, it must be rectified before a new fuse is fitted.

Battery faulty. See Section 57.

Earth failure. Check that the main earth strap from the battery is securely affixed to the gearbox and is making a good contact.

Ignition switch or power circuit failure. Check for current flow through the battery positive lead (red) to the ignition switch. Check the ignition switch for continuity.

60 Circuit failure

Cable failure. Refer to the machine's wiring diagram and check the circuit for continuity. Open circuits are a result of loose or corroded connections, either at terminals or in-line connectors, or because of broken wires. Occasionally, the core of a wire will break without there being any apparent damage to the outer plastic cover.

Switch failure. All switches may be checked for continuity in each switch position, after referring to the switch position boxes incorporated in the wiring diagram for the machine. Switch failure may be a result of mechanical breakage, corrosion or water.

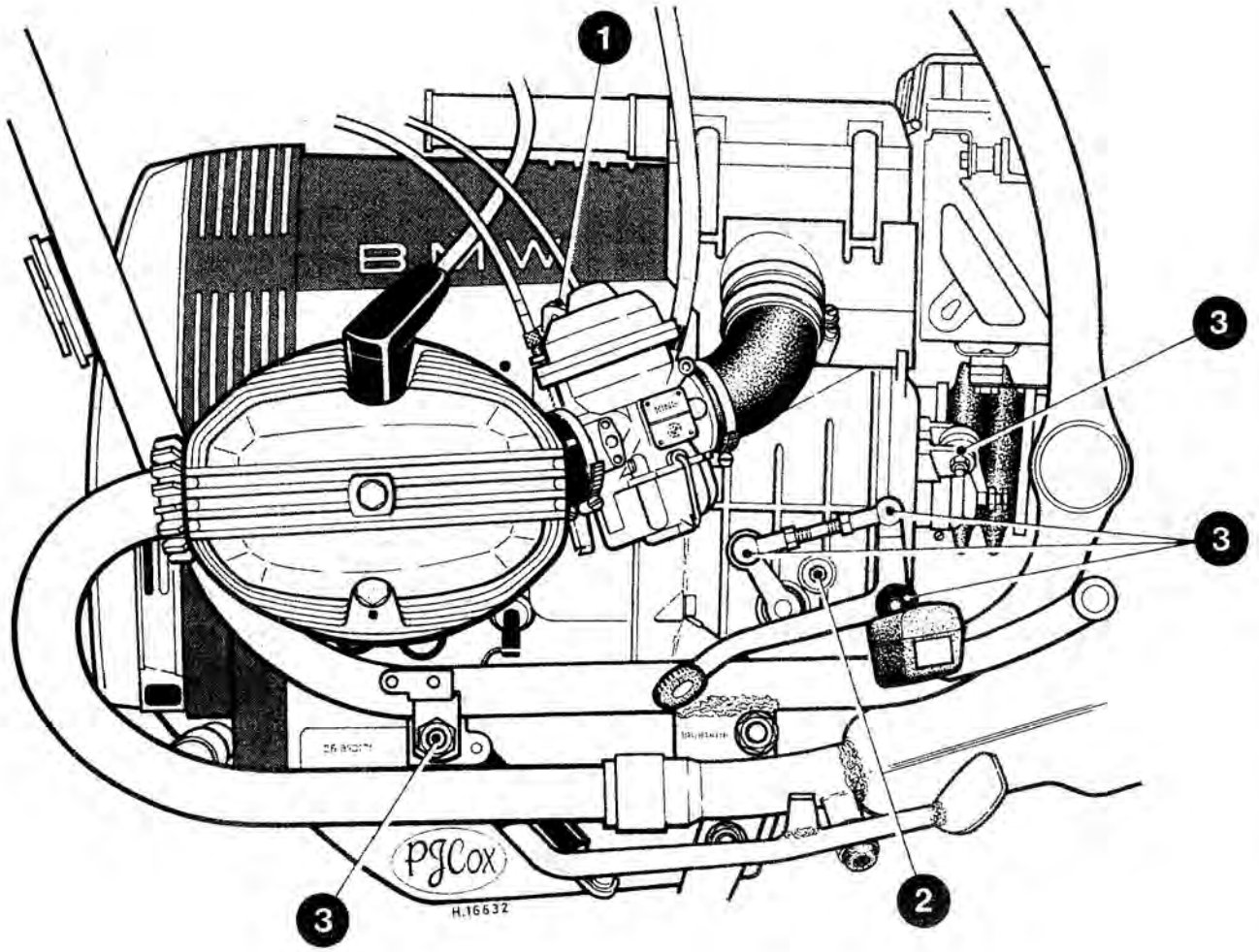
Fuse blown. Refer to the wiring diagram to check whether or not a circuit fuse is fitted. Replace the fuse, if blown, only after the fault has been identified and rectified.

61 Bulbs blowing repeatedly

Vibration failure. This is often an inherent fault related to the natural vibration characteristics of the engine and frame and is, thus, difficult to resolve. Modifications of the lamp mounting, to change the damping characteristics may help.

Intermittent earth. Repeated failure of one bulb, particularly where the bulb is fed directly from the generator, indicates that a poor earth exists somewhere in the circuit. Check that a good contact is available at each earthing point in the circuit.

Reduced voltage. Where a quartz-halogen bulb is fitted the voltage to the bulb should be maintained or early failure of the bulb will occur. Do not overload the system with additional electrical equipment in excess of the system's power capacity and ensure that all circuit connections are maintained clean and tight.



1

Engine

Capacity:	
/5, /6, /7 up to 1980 without oil cooler, R80G/S, R45, R65 up to 1980	2.25 litres (3.96 Imp pt/2.38 US qt)
/5, /6, /7 up to 1980 with oil cooler, /7 1981 on without oil cooler, R80, R80ST, R45, R65 1981 on	2.50 litres (4.40 Imp pt/2.64 US qt)
/7 1981 on with oil cooler	2.75 litres (4.84 Imp pt/2.91 US qt)
Recommended lubricant	Good quality HD oil suitable for 4-stroke spark ignition engines. API classification SE, SF or SG (see chart in Routine maintenance for viscosities)

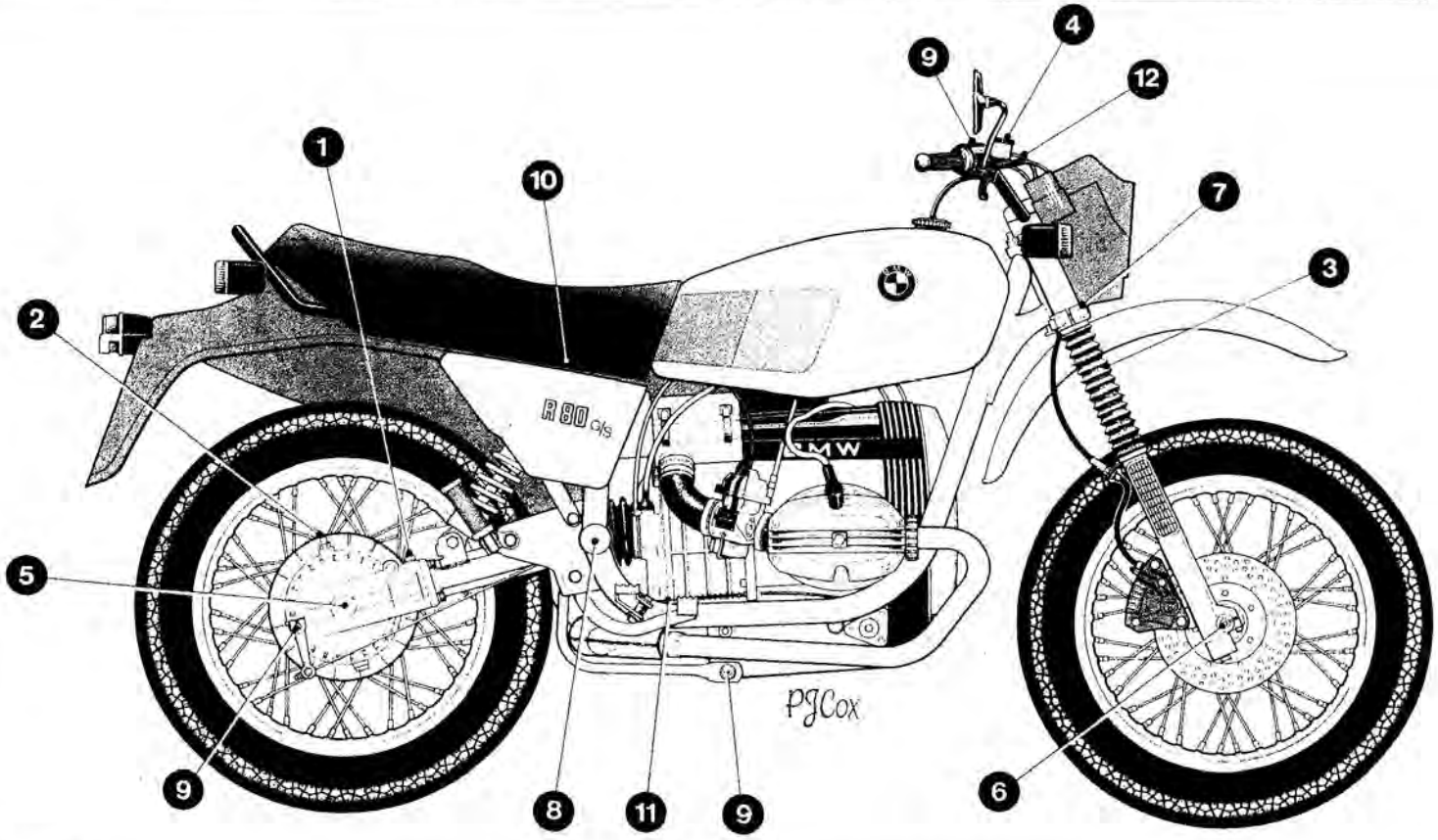
2

Gearbox

Capacity	800cc (1.41 Imp pt/0.85 US qt)
Recommended lubricant	Good quality hypoid gear oil API class GL-5 or to specification MIL-L-2105 B or C, viscosity SAE 90 above 5°C (41°F) SAE 80 below 5°C (41°F), alternatively SAE 80W90

3

All greasing points	High melting-point lithium fibre-based grease, eg Shell Retinax A



❶ **Driveshaft**		
Capacity:		
/5 up to mid 1973	100cc (0.18 Imp pt/0.11 US qt)	
All other models	150cc (0.26 Imp pt/0.16 US qt)	
Recommended lubricant	Good quality hypoid gear oil API class GL-5 or to specification MIL-L-2105 B or C, viscosity SAE 90 above 5°C (41°F) SAE 80 below 5°C (41°F), alternatively SAE 80W90	
❷ **Rear bevel drive**		
Capacity:		
All models up to 1980	250cc (0.44 Imp pt/0.26 US qt)	
All models 1981 on	350cc (0.61 Imp pt/0.37 US qt)	
Recommended lubricant	As driveshaft type	
❸ **Front forks**	Recommended brands and types only – see Chapter 6	
❹ **Brake fluid**	DOT 4 (ATE SL)	
❺ **Rear wheel/final drive splines**	Molykote BR2 or liquid Moly LM47L	
❻ **Wheel bearings**	High melting-point lithium fibre-based grease, eg Shell Retinax A	
❼ **Steering head bearings**	As wheel bearing type	
❽ **Swinging arm bearings**	As wheel bearing type	
❾ **All greasing points**	As wheel bearing type	
❿ **Battery terminals**	Petroleum jelly or acid-free grease	
⓫ **Control cable nipples and all other pivots**	Engine oil or light machine oil	
⓬ **Cables – non nylon lined**	As above	
ATU pivots – up to 1978 models only	Bosch grease Ft 1v4	
ATU shaft – up to 1978 models only	Bosch grease Ft 1v22 or Ft 1v26	
Front brake master cylinder pushrod and caliper pivot pin – /6, /7 up to 1980	Molykote BR2 or liquid Moly LM47L	

Routine maintenance

Refer to Chapter 10 for information relating to the 1986 on models

Periodic routine maintenance is a continuous process which should commence immediately the machine is used. The object is to maintain all adjustments and to diagnose and rectify minor defects before they develop into more extensive, and often more expensive, problems.

It follows that if the machine is maintained properly, it will both run and perform with maximum efficiency, and be less prone to unexpected breakdowns. Regular inspection of the machine will show up any parts which are wearing, and with a little experience, it is possible to obtain the maximum life from any one component, renewing it when it becomes so worn that it is liable to fail.

Regular cleaning can be considered as important as mechanical maintenance. This will ensure that all the cycle parts are inspected regularly and are kept free from accumulations of road dirt and grime.

All intervals are intended as a guide only; as a machine gets older it develops individual faults which require more frequent attention and if used under particularly arduous conditions it is advisable to reduce the period between each check.

For ease of reference, most service operations are described in detail under the relevant heading. However, if further general information is required, this can be found under the pertinent Section heading and Chapter in the main text.

Although no special tools are required for routine maintenance, a good selection of general workshop tools is essential. Included in the tools must be a range of metric ring or combination spanners and a selection of good quality Allen keys; all necessary tools being included in the machine's toolkit.

Service intervals – mileage:

BMW maintenance is grouped into two parts, a minor and a major service which must be carried out at the following intervals:

/5 models:
Minor service every 8000 miles (12 000 km) starting with the first 4000 miles (6000 km)
Major service every 8000 miles (12 000 km) starting with the first 8000 miles (12 000 km)
All other models:
Minor service every 10 000 miles (15 000 km) starting with the first 5000 miles (7500 km)
Major service every 10 000 miles (15 000 km) starting with the first 10 000 miles (15 000 km)

Therefore minor and major services should be carried out alternately at every 4000 miles (6000 km) for /5 models, every 5000 miles (7500 km) for all other models.

Service intervals – time:

If the machine is not used regularly, or does not cover a high mileage, BMW recommend two major services be carried out each year to preserve the machine's performance and reliability. Therefore, the minor service should be carried out every three months, the major service every six months.

Additional recommendations:

Engine oil – in normal use the engine oil should be changed every six months at the latest. If the machine is used in temperatures below 0°C (32°F), or for short, local journeys only, the oil should be changed every 2000 miles (3000 km) or three months at the latest.

Gearbox oil – must be changed at least once annually.

Driveshaft oil – must be changed at least once annually.

Rear bevel drive oil – must be changed at least once annually.

Front fork oil – must be changed at least once annually.

Hydraulic brake fluid – must be changed annually.

Wheel and steering head bearings – if conditions are very severe the bearings must be cleaned and packed with new grease every 16 000 miles (24 000 km) for /5 models, every 20 000 miles (30 000 km) for all other models. Refer to the relevant Sections of Chapters 8 and 6.

Battery – should be checked at least every month.

Air filter – should be cleaned and renewed at more frequent intervals if the machine is used in very dusty or severe conditions.

Cleaning the machine

Keeping the motorcycle clean should be considered as an important part of the routine maintenance, to be carried out whenever the need arises. A machine cleaned regularly will not only succumb less speedily to the inevitable corrosion of external surfaces, and hence maintain its market value, but will be far more approachable when the time comes for maintenance or service work. Furthermore, loose or failing components are more readily spotted when not partially obscured by a mantle of road grime and oil.

Surface dirt should be removed using a sponge and warm, soapy water; the latter being applied copiously to remove the particles of grit which might otherwise cause damage to the paintwork and polished surfaces.

Oil and grease are removed most easily by the application of a cleaning solvent such as 'Gunk' or 'Jizer'. The solvent should be applied when the parts are still dry and worked in with a stiff brush. Large quantities of water should be used when rinsing off, taking care that water does not enter the carburettors, air cleaners or electrics.

Application of a wax polish to the cycle parts and a good chrome cleaner to the chrome parts will give a good finish. Always wipe the machine down if used in the wet.

Daily (pre-ride check)

It is recommended that the following items are checked whenever the machine is about to be used. This is important to prevent the risk of unexpected failure of any component while riding the machine and with experience, can be reduced to a simple checklist which will only take a few moments to complete. For those owners who are not inclined to check all items with such frequency, it is suggested that the best course is to carry out the checks in the form of a service which can be undertaken each week or before any long journey. It is essential that all items are checked and serviced with reasonable frequency.

1 Check the tyres

Check the tyre pressures with a gauge that is known to be accurate. It is worthwhile purchasing a pocket gauge for this purpose because the gauges on garage forecourt airlines are notoriously inaccurate. The pressures, which should be checked with the tyres cold, are given in the Specifications Section of Chapter 8. Note that they are recommended by BMW **only** for the tyres fitted as standard to their machines and should be checked by reference to the tyre pressure warning label on the machine in case different types of tyre were fitted at the factory. If the machine is fitted subsequently with another make and/or type of tyre, the owner must check with the tyre manufacturer to find out if different pressures are necessary. In most cases the BMW importer will be able to help with advice on recommended tyres and pressures. Finally, ensure at all times that the pressures are suited to the load the machine is carrying and the speed at which it will be travelling.

At the same time as the tyre pressures are checked, examine the tyres themselves. Check them for damage, especially splitting of the sidewalls. Remove any small stones or other road debris caught between the treads. When checking the tyres for damage, they should be examined for tread depth in view of both the legal and safety aspects. It is vital to keep the tread depth within the UK legal limits of 1 mm of depth over three-quarters of the tread breadth around the entire circumference with no bald patches. Many riders, however, consider nearer 2 mm to be the limit for secure roadholding, traction, and braking, especially in adverse weather conditions, and it should be noted that BMW recommend minimum tread depths of 2.0 mm (0.08 in) for speeds below 80 mph (130 km/h), or 3 mm (0.12 in) for speeds above 80 mph (130 km/h), measured at the centre of the tread.

If new tyres are to be fitted, they must be of the correct size and speed or load rating, as listed in the Specifications Section of Chapter 8. However, since BMW motorcycles have proved especially sensitive to particular makes and types of tyre as well as to tyre pressures, great care must be taken when choosing new tyres. First check with the importer or a good local BMW dealer what types of currently-available tyre are approved for use on your particular model; do not forget to check the recommended tyre pressures, if different. **Do not** use any other tyre than those that are approved; if a particular make and/or type is not approved the factory, which conducts exhaustive tests, will have a very good reason for this. Once you have made your choice from the available selection, always fit front and rear tyres from the same manufacturer; never mix different tyre brands. Also, fit new inner tubes and rim tapes (where fitted) with every new tyre and use only tubes and rim tapes of the same make as the new tyre. Finally note the new pressures (if different) at all loads and speeds and keep this with the machine.

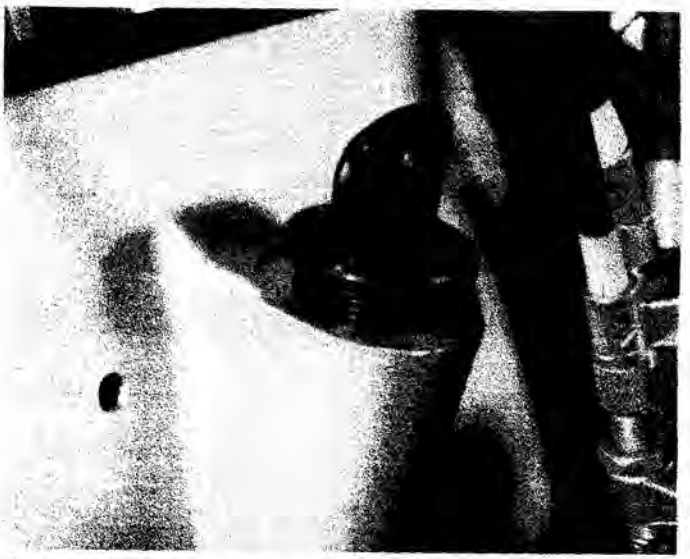
2 Check the engine oil level

Position the machine upright on its centre stand, on level ground.

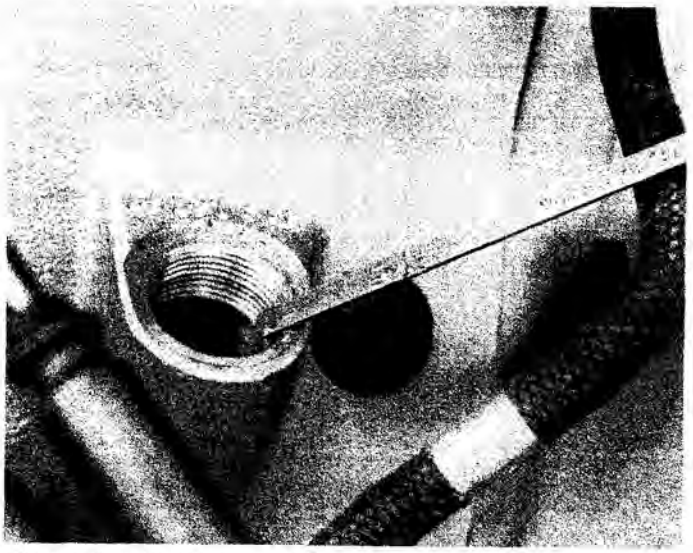
The engine must have been stopped for some time (at least 5 minutes) so that the level settles before it can be checked accurately. Unscrew the filler plug/dipstick from its boss in the crankcase left-hand side, wipe it clean and refit it so that the plug rests on the crankcase; **do not** screw it in. Withdraw the dipstick and note the level of oil on it, which should be between the 'Max' and 'Min' lines with the machine supported upright on its centre stand.

Never allow the engine to run with the level below the 'Min' line, and do not overfill it so that the level is above the 'Max' line.

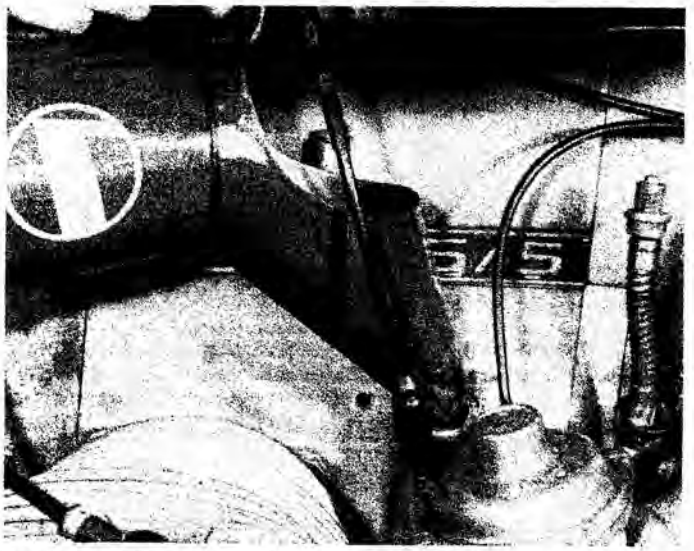
Use only a good quality, heavy duty oil suitable for 4-stroke spark ignition engines. Refer to the accompanying thermometer chart to decide what viscosity of oil is necessary at the prevailing outside temperatures. BMW recommend that a medium range multigrade, eg 10W30 is preferable to a wide range multigrade, such as 10W50, and that multigrades are preferable to monogrades.



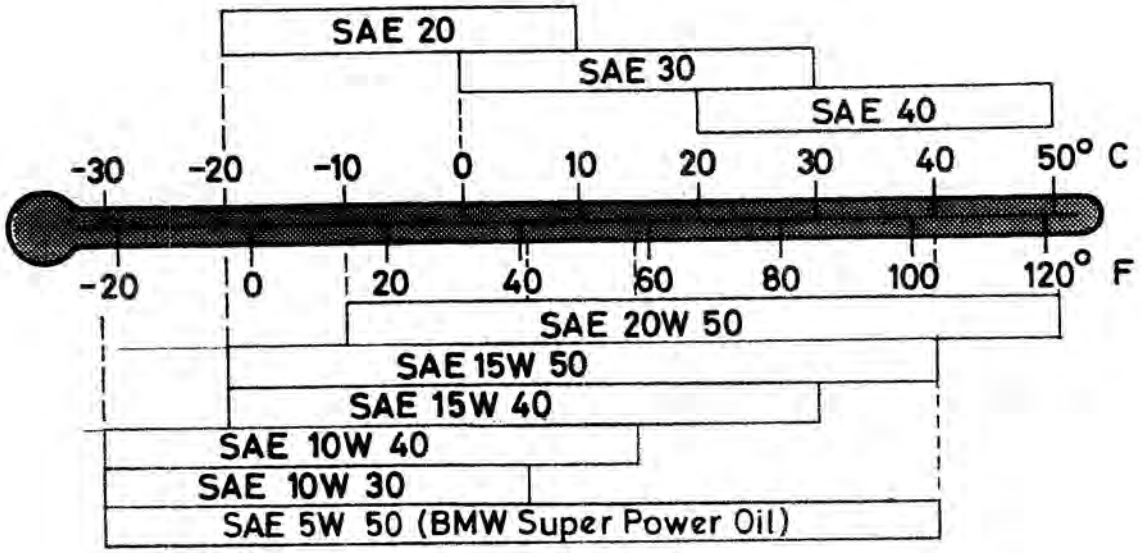
Filler plug/dipstick must rest on crankcase as shown for accurate level to be recorded – do not screw it in



Oil level must be between 'Max' and 'Min' level lines



Use only good quality oil of specified type when topping up



Oil viscosity selection chart

A small funnel is useful when topping up, especially if it can be carried on the machine. To fill the engine from 'Min' to 'Max' marks on the dipstick requires approximately 1.0 litre (1.76 Imp pint/1.06 US qt) on all models up to 1980, 0.85 litre (1.5 Imp pint/0.9 US qt) on all models from 1981 on. Renew the sealing washer if it is damaged or flattened and refit the dipstick, tightening it securely.

3 Check the fuel level

Checking the petrol level may seem obvious, but it is all too easy to forget. Ensure that you have enough petrol to complete your journey, or at least to get you to the nearest petrol station.

4 Legal check

Check that all lights, turn signals, horn and speedometer are working correctly to make sure that the machine complies with all legal requirements in this respect. Check also that the headlamp is correctly aimed. The vertical aim must be aligned so that with the machine standing on its wheels on level ground with the rider (and pillion passenger, if one is regularly carried) seated normally, the main beam centre (as shown on a wall 25 feet away) must be at the same height from the ground as the centre of the headlamp itself. This is adjusted by slackening the headlamp mounting bolts and tilting the headlamp to the correct angle. On machines with RS or RT fairings, ensure that the fairing headlamp glass is completely clean and dry so that there can be no reduction of the headlamp's light output. Detach the glass and clean it regularly with a suitable detergent to avoid this.

5 Check the brakes

Check that the front and rear brakes work effectively and without binding. Ensure that the rod linkages and the cables, are lubricated and properly adjusted. Check the fluid level in the master cylinder reservoir, where appropriate, and ensure that there are no fluid leaks. Should topping-up be required, use only the recommended hydraulic fluid.

6 Check the controls

Check the throttle and clutch cables and levers and the gear lever to ensure that they are adjusted correctly, functioning correctly, and that they are securely fastened. If a bolt is going to work loose, or a cable snap, it is better that it is discovered at this stage with the machine at a standstill, rather than when it is being ridden.

7 Rear suspension settings

Except for machines with Nivomat rear suspension units, ensure that the spring preload adjusters are at the correct setting for the machine's intended load. On models with two rear suspension units, ensure at all times that both are at the same setting.

8 Check the tightness of all nuts and bolts

Using the specified torque settings (where given), check that all fasteners are tightened securely, particularly the wheel spindle nuts and clamp bolts, the rear wheel fasteners (Monolever models) and the stand, footrest, suspension unit and rear subframe mounting bolts or nuts.

Minor service

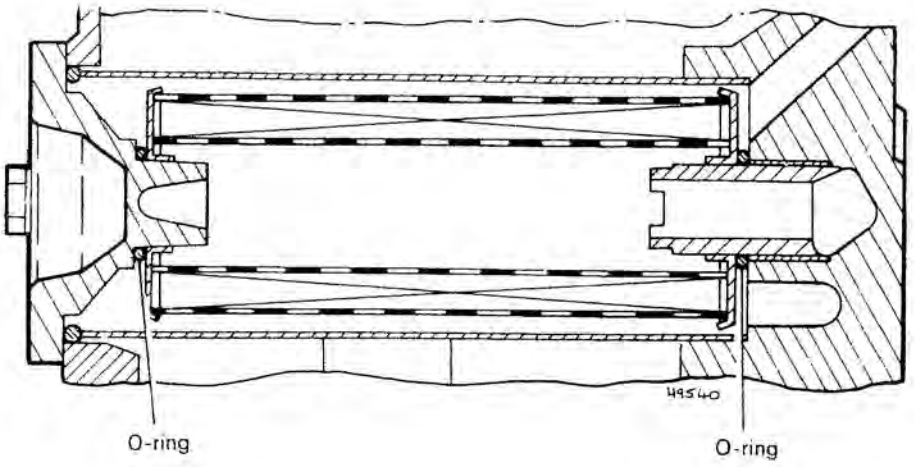
1 Change the engine oil and filter

Oil changes will be much quicker if the machine is first ridden far enough to warm up the engine to normal operating temperature: this will thin the oil and ensure that any particles of dirt or debris will be retained in suspension in the oil and flushed out with it.

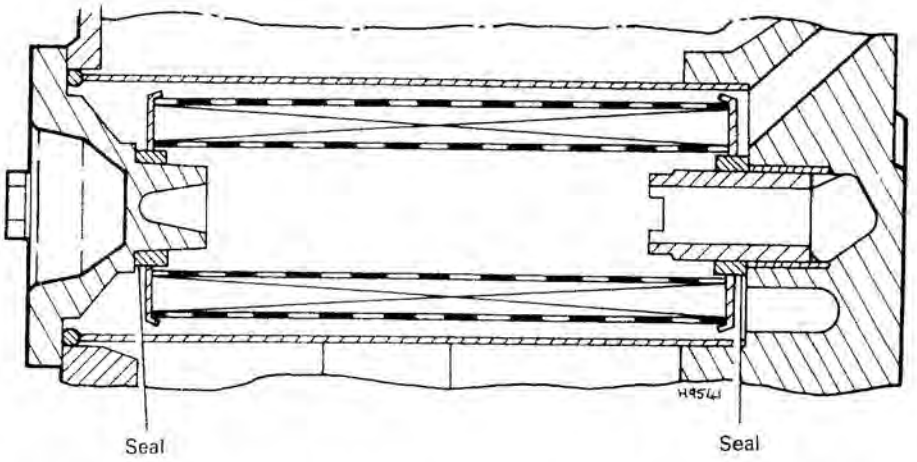
Place the machine on its centre stand on level ground, place a container of at least 3 litres (approx 5 Imp pints, 3 US qts) beneath the crankcase. Unscrew the dipstick.

On standard models fitted with BMW crashbars, remove the right-hand crashbar rear mounting, slacken the two front mountings and manoeuvre the bar forwards clear of the filter. Be careful not to burn your hands on the hot exhaust pipe. If an oil cooler is fitted, it is extremely awkward to remove and refit the filter with the exhaust in place; it is advisable to remove the exhaust pipes (taking great care to avoid injury) before draining the oil. Refer to Chapter 4.

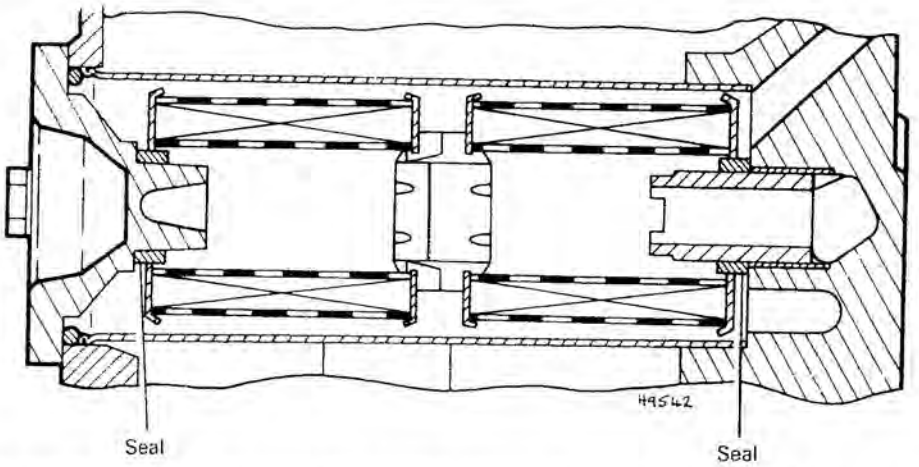
On machines fitted with RS or RT fairings only, there should be sufficient room to remove and refit the oil filter with the fairing in place, especially if the hinged type of element is to be used. If BMW crashbars are also fitted, the fairing right-hand lower section should be removed (see Chapter 6) and the crashbar should be moved forwards out of the way, as described above. If an oil cooler is also fitted the exhaust pipes should be removed first, as described in Chapter 4, to make work easier. Take great care to avoid injury when handling the hot exhaust pipes.



Short rigid element with two separate O-rings. Fitted to all /5, /6, /7 (except those below), R45 and R65 models. Note /7 model and later filter cover shown

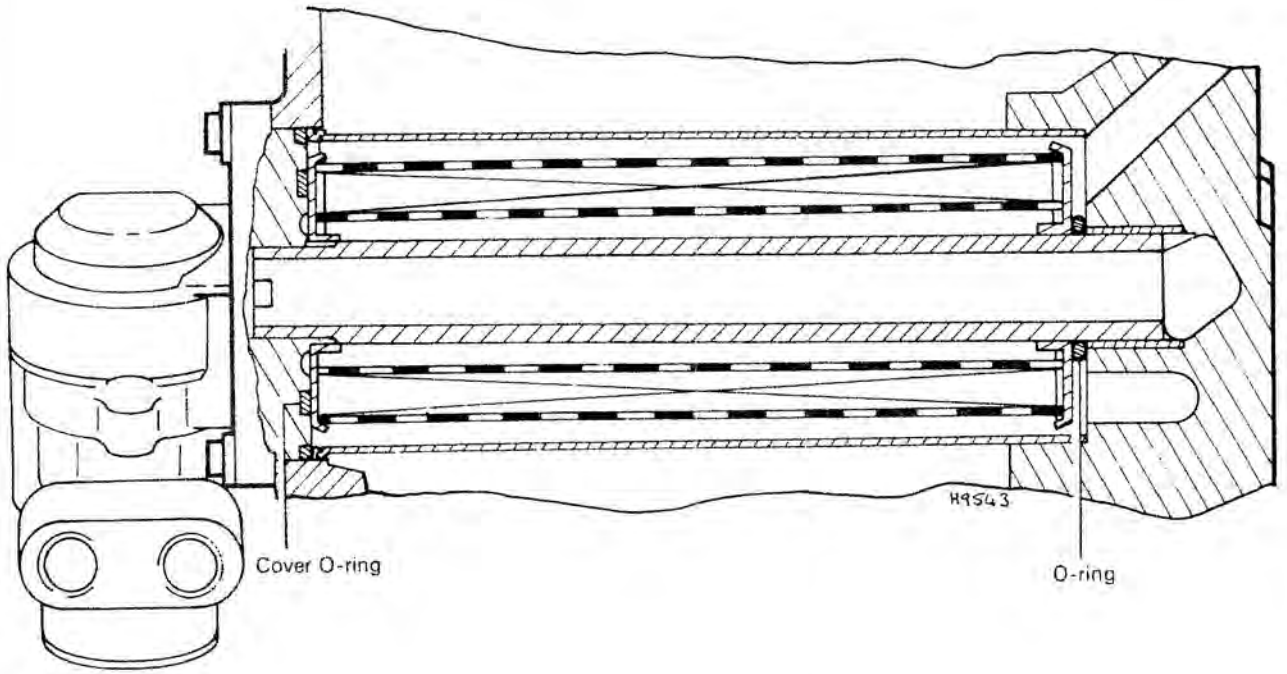


Short rigid element with two square-section seals glued in place, separate O-rings must not be used. Fitted to R80G/S and R80ST but can also be fitted to all /5, /6, /7 (except those below), R45 and R65 models

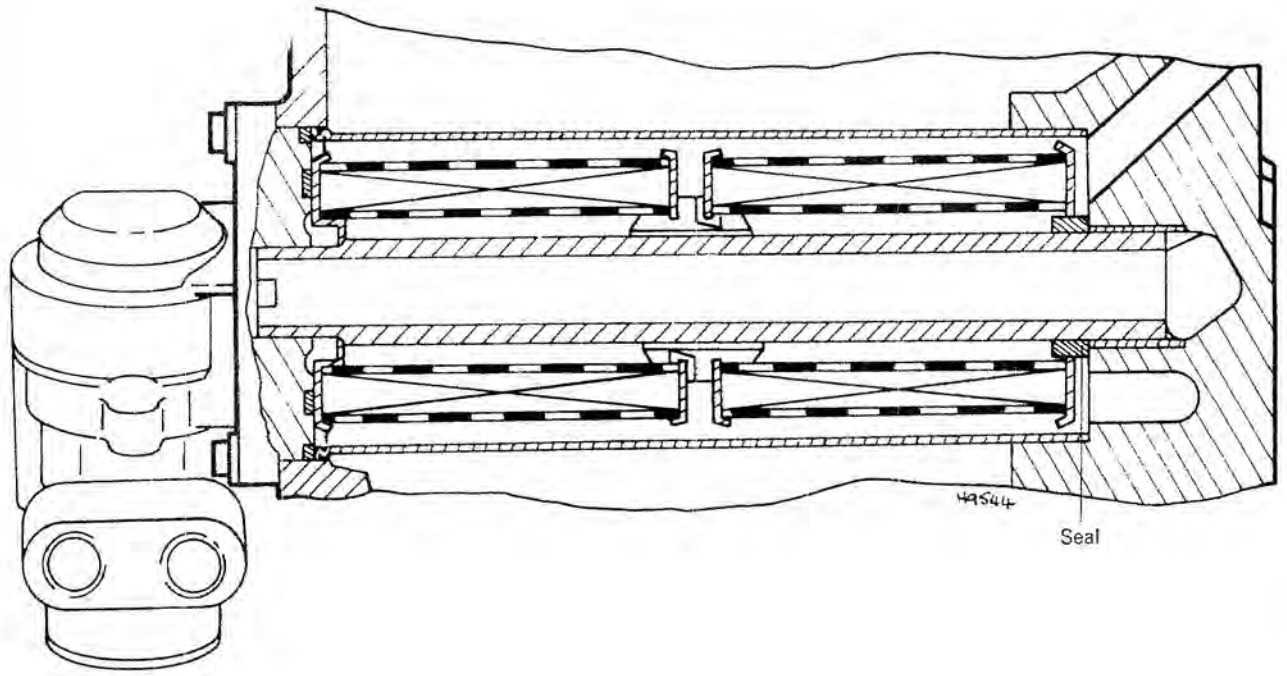


Short hinged element with two square-section seals glued in place, separate O-rings must not be used. Fitted to R100RS and R100RT machines without an oil cooler, R80 and R80RT, but can also be fitted to any standard machine fitted with an RS or RT fairing and no oil cooler

Oil filter types (continued overleaf)

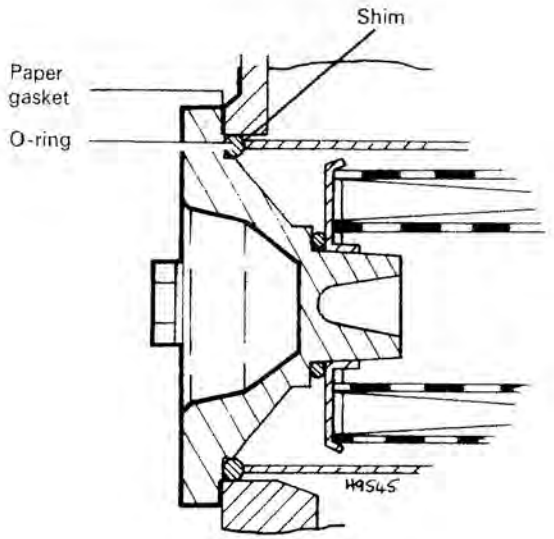


Long rigid element with one separate O-ring (note arrangement of filter cover O-rings). Fitted to R100RS and R100RT models with an oil cooler or any standard machine with an oil cooler

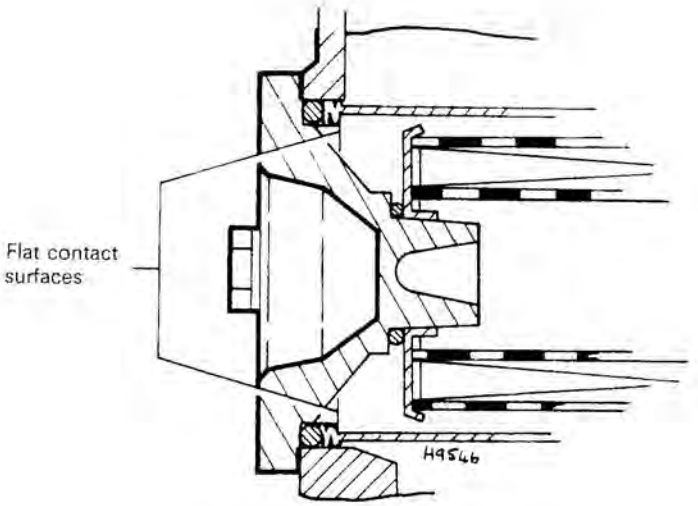


Long hinged element with one square-section seal glued in place, separate small O-ring must not be used. This element can be used instead of rigid type on machines with an RS or RT fairing and an oil cooler

Oil filter types (continued)



Oil filter cover seals – all models up to 1982 (except /5, /6)

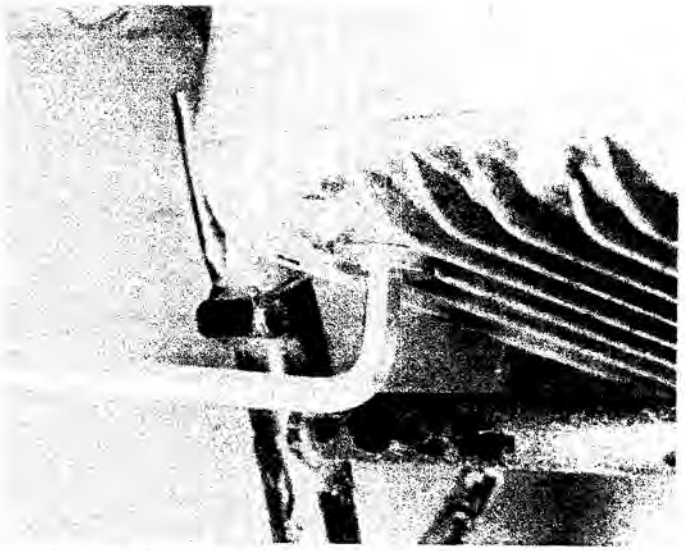


Oil filter cover seals – all models 1982 on

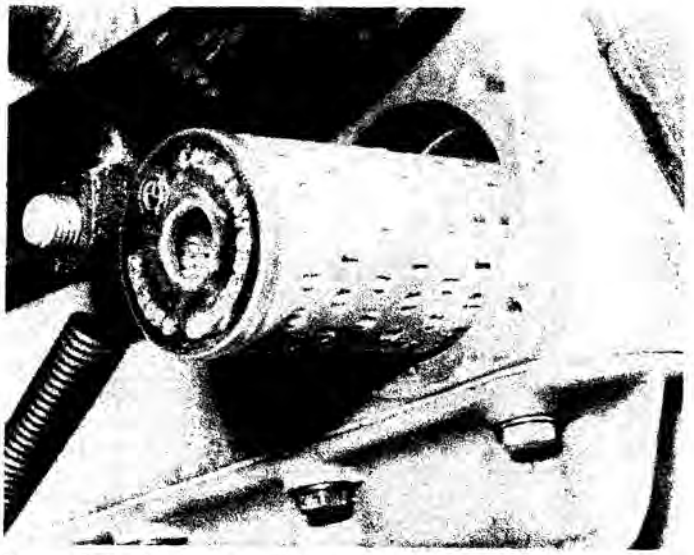
On machines without an oil cooler, unscrew the sump drain plug and allow the oil to drain into the container. Being careful to avoid burning your hands on the hot exhaust pipe or cylinder barrel, remove the oil filter from its chamber in the bottom right-hand front corner of the crankcase. Unscrew the three bolts or screws which retain the triangular filter cover and withdraw it. **Note**: make a careful note of the exact location, type and number of gaskets, O-rings and metal washers found as the filter components are removed. On /5 and /6 models only, remove the outer cover and gasket, unscrew the single retaining bolt that is now exposed and withdraw the inner cover. Use a bent piece of wire to hook out the filter element, noting the small O-ring at each end. On all other models the filter element is exposed as soon as the triangular cover has been removed; the accompanying illustrations will show the varying seal arrangements.

Allow the oil to drain fully from the sump and filter chamber, then wipe out the chamber with a clean, lint-free rag, and clean the sealing surfaces. Insert the new filter element. If the element with separate O-rings is to be used, ensure that the O-rings are positioned correctly on the chamber centre tube and on the filter cover boss; if an element with square-section seals is to be used, ensure that no O-rings (from previous filter types) are left in the chamber, and that the seals engage correctly on the chamber centre tube and filter cover boss. Renew all seals and gaskets (where applicable) as the filter cover is refitted; these will be supplied with a genuine BMW oil filter. Tighten securely the filter cover bolts, renew the sump drain plug sealing washer if it is flattened or damaged and refit the sump drain plug. Thoroughly clean its threads and the sump orifice and tighten the plug securely. Use the specified torque setting if possible (later models only). Fill the crankcase with the correct amount of oil, start the engine and allow it to warm up to normal operating temperature. Stop the engine and check the oil level (see pre-ride check). Top up if necessary.

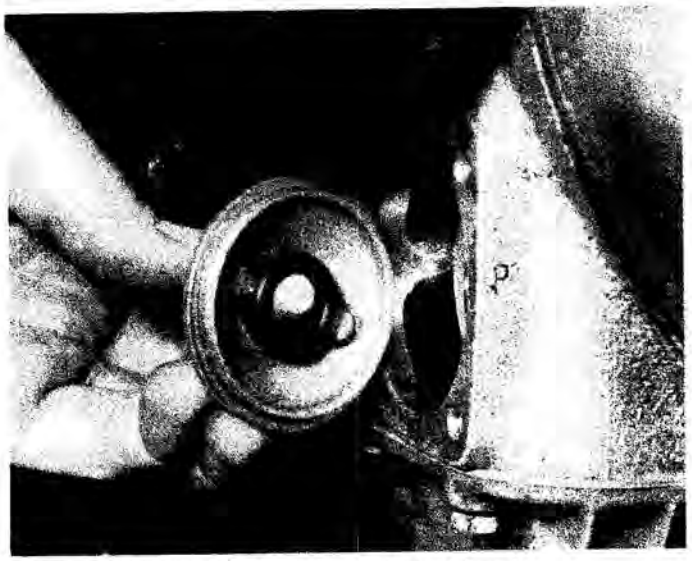
The task of changing the engine oil and filter is slightly different



Unscrew the sump drain plug



Ensure that only seals appropriate to type of filter used are refitted



Note inner filter cover fitted to /5 and /6 models only

Ensure that all gaskets and O-rings (where fitted) are renewed before refitting filter cover

when an oil cooler is fitted. One item that is essential is the oil cooler bleed bolt, which is inserted into the base of the oil cooler adaptor in place of the standard bolt and opens the thermostatic valve by physically lifting the valve operating plunger, thus allowing the old oil to drain from the cooler and new oil to enter it on refilling. An oil cooler bleed bolt should be supplied in the toolkit of any machine fitted with an oil cooler as standard equipment and is included in the kit if the oil cooler was fitted as an optional extra. It has a longer hexagon head than a normal bolt, and a smoothly rounded tip to prevent damaging the thermostatic valve. Check very carefully that the threaded portion is exactly 23 mm (0.906 in) long; this is necessary as while too short a bolt would raise the valve plunger insuffficiently to allow free drainage of the oil, too long a bolt would damage the valve itself. It appears that some undesirably long bolts have been issued. If a bolt is found that is too long, the surplus can be removed with a hacksaw or on a grinding wheel, but it is essential that the tip is left with a smooth rounded finish. The alternative is to purchase a new bleed bolt.

Remove the single bolt that protrudes from the base of the oil cooler adaptor. Remove its sealing washer and place this over the bleed bolt. Check the length of the bleed bolt, as described above, and screw it fully into the adaptor. The oil cooler is now ready to be drained with the rest of the lubrication system; accordingly remove the dipstick and sump drain plug, then allow the oil to drain into the container. While the oil is draining, remove both spark plugs, and on 1981 and later models only, refit each into its spark plug cap and lay each on its respective cylinder head so that the metal body is touching the cylinder head finning.

When draining is complete, check the condition of the drain plug sealing washer, renewing it if necessary, then refit and tighten securely the drain plug to the specified torque setting (where given). Remove the three bolts securing the cooler adaptor to the crankcase and withdraw the adaptor taking care to catch any remaining oil from the cooler and/or filter chamber. **Note:** make a careful note of the exact location, type and number O-rings, gaskets and metal washers found as the filter is removed. Use a piece of bent wire to hook out the filter element and the separate O-ring behind it (where fitted). Wipe out the filter chamber with a clean lint-free rag and clean the sealing surfaces. Insert the new filter element. If the earlier type with a separate O-ring is to be fitted, ensure that the new O-ring is located correctly on the chamber centre tube; if the later type with a square section seal is used, ensure that the seal engages correctly on the centre tube.

Renew the adaptor sealing O-rings (and gasket, if fitted) and tighten securely the adaptor mounting bolts, then pour the specified amount of oil into the crankcase. Switch on the ignition and turn the engine over on the starter motor until the oil pressure warning lamp goes out, being careful on 1981 and later models, that the spark plugs remain in contact with the cylinder head at all times to avoid damage to the ignition system. When the oil pressure warning lamp goes out, release the starter button and switch off the ignition, because the lamp shows that fresh oil has been pumped through the cooler and filled it. Unscrew the bleed bolt and refit the original M6 x 10 mm long bolt, renewing its sealing washer if necessary, then refit both spark plugs and connect the spark plug caps to each. Check the oil level, adding oil if necessary as described above.

On all models, the oil pump pick-up filter gauze in the sump will have been cleaned at the first 600 mile (1000 km) service and does not require regular cleaning (as a part of routine maintenance) after this. It should be cleaned, however, and the sump thoroughly washed whenever the sump is removed. Refer to Chapter 4.

2 *Clean the cylinder and sump cooling fins*

In addition to the normal cleaning, check carefully that the cooling fins of the cylinder heads and barrels and of the sump are clean. Remove the fairing lower sections (machines with RS or RT fairings) or the sump bashplate (R80G/S) to ensure that all dirt and oil are removed which might reduce the fins' cooling ability. On machines with an oil cooler, check that the matrix is clean and unblocked; use a garden hose to flush the matrix through from behind to remove any dirt or debris.

Referring to Chapter 4, Section 12, and Chapter 10, Section 8, dismantle the exhaust pipe joint at each cylinder head, and clean the nut and head stub threads of all corrosion. Apply Copaslip to the threads on reassembly.

3 *Lubricate the controls and stand pivots*

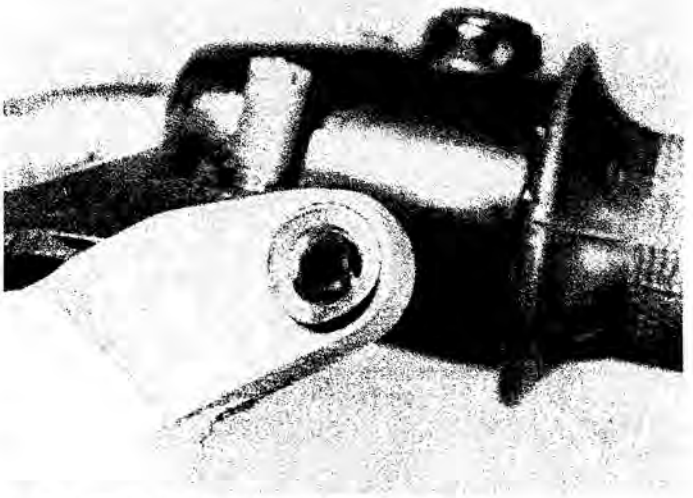
To grease the handlebar lever pivots, the control cables must be slackened and the pivot pins removed. Unhook the clutch cable from the actuating arm underneath the gearbox. Slacken the front brake cable (where fitted) at the drum or the master cylinder.

Remove the locknut on the lever pivot and unscrew the pin. Note the spring shim washer between the lever and the pivot housing. Disconnect the cables by pushing the inner cable into the lever until the slotted trunnion can be pulled out of the lever.

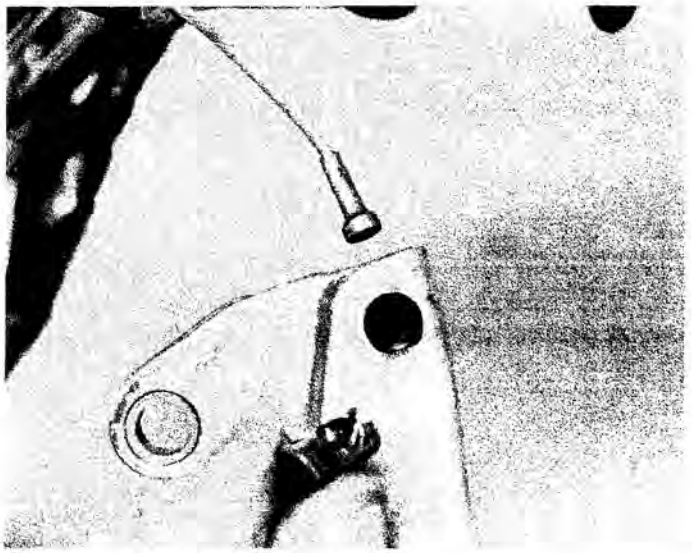
The straight-pull twistgrip should be dismantled for greasing or replacing cables. Push back the cable rubber cover. Unscrew the slotted screw in the twistgrip gear cover and remove the cover. Pull the twistgrip drum from the handlebar and unhook the cables from the block.

Grease the handlebar end, twistgrip drum gear, pinion shaft and chain. Replace the lower cable nipple in the block. With the slot in the twistgrip drum aligned with the slot in the housing, the marks on the drum gear and the pinion must be in line. This ensures that there will be

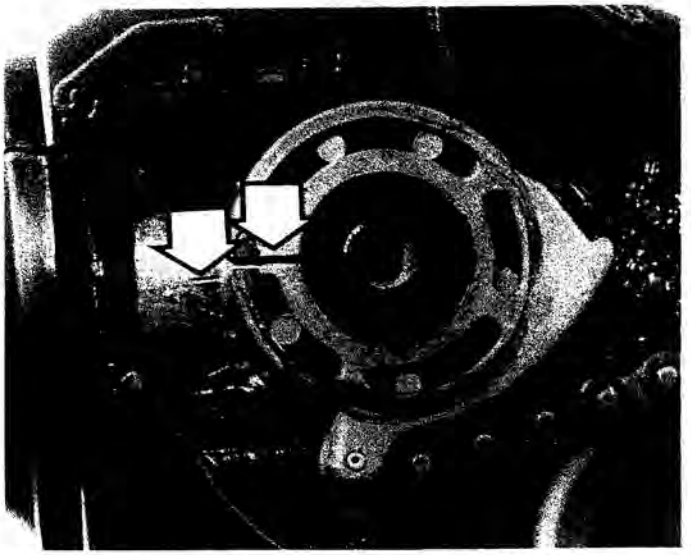
Remove handlebar lever pivot screw ...



... and withdraw lever, noting shim (where fitted)



Disengage cable inner from slotted trunnion



Align twistgrip gear marks when refitting throttle cables

full throttle movement. Replace the upper cable nipple, pull back the outer cables and replace the gear cover.

Control cables on early models will require regular oiling, which is best achieved by disconnecting them and removing them from the machine. Check the outer cables for signs of damage, then examine the exposed portions of the inner cables. Any signs of kinking or fraying will indicate that renewal is required. To obtain maximum life and reliability from the cables they should be thoroughly lubricated using light machine oil. To do the job properly and quickly use one of the hydraulic cable oilers available from most motorcycle shops. Assemble the cable oiler as described by the manufacturer's instructions. Operate the oiler until oil emerges from the lower end, indicating that the cable is lubricated throughout its length. This process will expel any dirt or moisture and will prevent its subsequent ingress.

If a cable oiler is not available hang the cable upright and make up a small funnel arrangement using plasticine or by taping a plastic bag around the upper end. Fill the funnel with oil and leave it overnight to drain through.

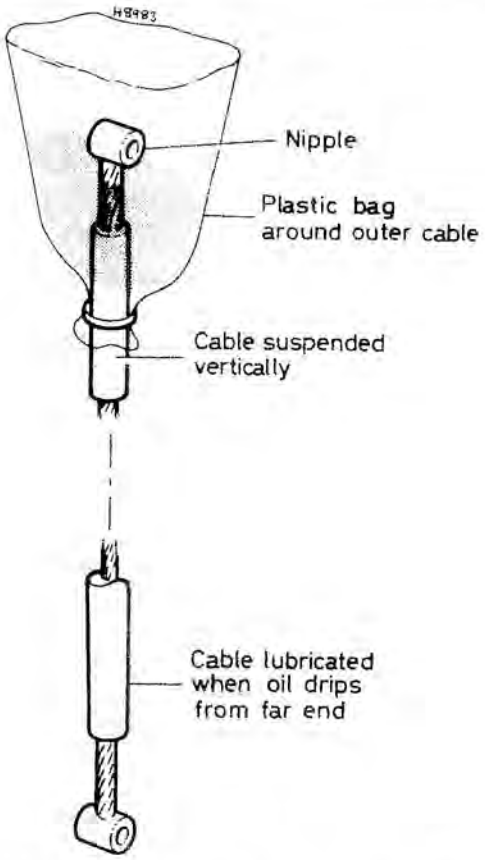
Note that the control cables on later models (approximately from 1978 on) are lined with nylon or a similar material which **must not** be lubricated. If the cables become stiff through old age, wear, or damage, they must be renewed, although in some cases the application of one of the modern 'dry' lubricants may help.

Finish off control lubrication by applying a few drops of engine oil or light machine oil to all nipples and control pivots, and all adjuster threads.

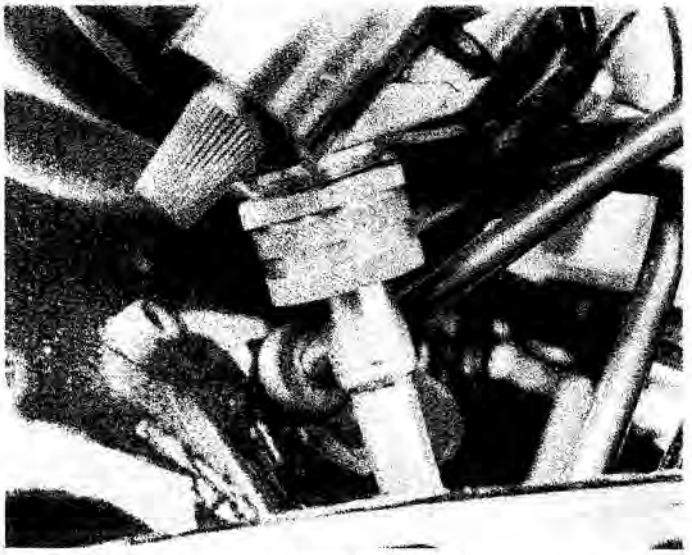
Using a water dispersant lubricant such as WD40 or CRC5-56, spray a small amount of lubricant into all locks and electrical components.

The instrument drive cable inner wire cannot be removed from the outer casing so lubrication is not possible; the cables should be renewed if damaged, sticking or worn. To cure a squeaking cable, however, engine oil could be poured through it using the funnel arrangement described above. Ensure that all surplus oil has drained off before refitting the cable or it may work up into the instrument as the cable rotates and ruin it.

The side stand pivot is usually fitted with a grease nipple and should be lubricated with a grease gun until fresh grease can be seen. The centre stand (and side stands with no grease nipple) should be removed so that the pivots can be cleaned and greased. Check the return springs are in good condition and that their anchorages are secure. Grease all pivot components on reassembly and tighten all fasteners securely (to the specified torque settings, where given). If excessive wear is noted between the side stand and its bracket, note that a modification is available for 1981 to 1984 models which involves inserting headed bushes in the pivot.



Oiling a control cable - early models only



Instrument drive cables are retained by knurled rings at their upper ends

4 *Check the battery*

The battery is sited underneath the seat, to the rear of the engine/gearbox unit. Raise or remove the seat and remove the tool tray to reach it. Check that the mountings are secure.

To check the battery in place, the machine must be positioned so that the battery is absolutely level. Where a black-cased battery is fitted, remove the cell filler plugs and check that the electrolyte level is 5 mm (0.2 in) above the plates. Where a battery with a translucent casing is fitted, through which the electrolyte level can be seen, the level must be between the level marks on all cells. Use only distilled water to top up to the correct height or upper level mark and refit the filler plugs.

On all models, whenever the battery is disconnected, remember to disconnect the negative (-) terminal first, to prevent the possibility of short circuits. Check that the terminals are clean and apply a thin smear of petroleum jelly (or acid-free grease) to each to prevent corrosion. On refitting, check that the vent hose is not blocked and that it is correctly routed with no kinks, also that it hangs well below any other component, particularly the exhaust system. Remember always to connect the negative (-) terminal last when refitting the battery.

Always check that the terminals are tight and that the covers are correctly refitted, also that the fuse connections are clean and tight, that the fuses are of the correct rating and in good condition, and that a spare is available on the machine should the need arise.

At regular intervals remove the battery and check that there is no pale grey sediment deposited at the bottom of the casing. This is caused by sulphation of the plates as a result of re-charging at too high a rate or as a result of the battery being left discharged for long periods. A good battery should have little or no sediment visible and its plates should be straight and pale grey or brown in colour. If sediment deposits are deep enough to reach the bottom of the plates, or if the plates are buckled and have whitish deposits on them, the battery is faulty and must be renewed. Remember that a poor battery will give rise to a large number of minor electrical faults.

If the machine is not in regular use, disconnect the battery and give it a refresher charge every month to six weeks, as described in Chapter 9.

5 *Check the gearbox oil level*

With the machine supported upright on its centre stand on level ground, remove the gearbox oil filler plug. On /5 models the level should be at the lowest thread of the filler plug orifice; on all other models it should be at the bottom edge of the orifice. Remove any surplus oil (/5) or allow it to trickle out (all others). If topping up is necessary use only good quality oil of the specified type. Renew the sealing washer if it is damaged or worn and refit the filler plug, tightening it to a torque setting of 28 - 31 Nm (21 - 23 lbf ft). Wash off any spilt oil.

6 *Check the driveshaft oil level*

With the machine supported upright on its centre stand on level ground and with the rear wheel touching the ground, remove the filler plug from the top of the **front end** of the rear bevel drive housing (see accompanying photograph). Insert a suitable rod **vertically** into the filler orifice until it touches the top of the drive shaft rear coupling. The level of oil on the rod should be 2 mm (0.08 in). If topping up is necessary, add only good quality oil of the specified type. Renew the sealing washer if it is damaged or worn and refit the filler plug. Tighten it to a torque setting of 14 Nm (10 lbf ft) on all models up to 1980, securely finger tight on all later models.

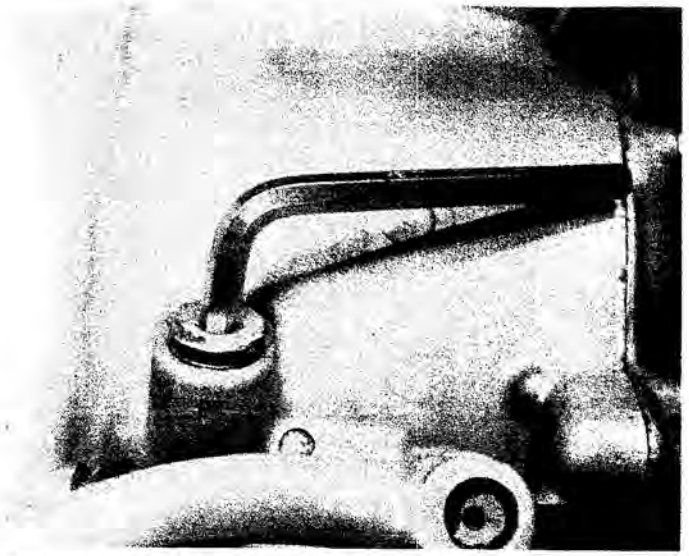
Note: *all models from 1979 on (ie those with a shock absorber in the driveshaft) - it may prove easier to check the oil level accurately by draining the swinging arm and refilling it with the exact amount of oil, carefully measured. This is described under the Major Service heading.*

7 *Check the rear bevel drive oil level*

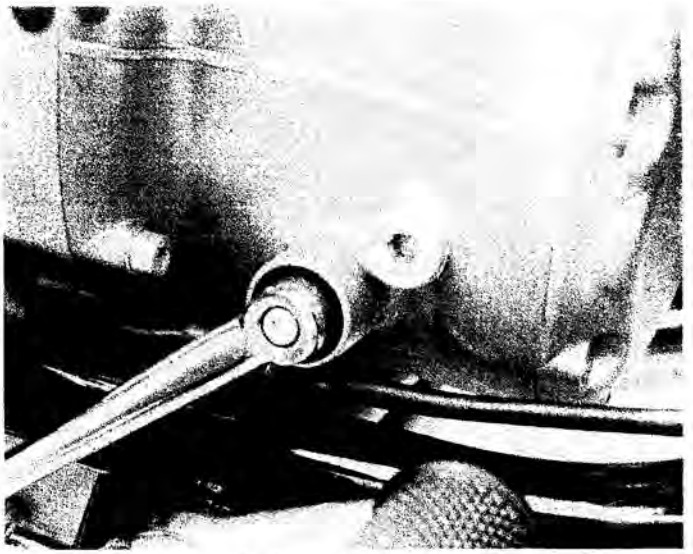
The oil level must be checked with the machine supported upright on its centre stand on level ground and with the rear wheel touching the ground.

All models up to 1980 Unscrew the filler/level plug from the rear of the housing. The oil level should be at the lowest thread of the filler plug orifice. Remove any surplus oil using a syringe or similar, to prevent oil being blown on to the rear tyre via the breather. If topping up is necessary, use only good quality oil of the specified type. Renew the sealing washer if it is damaged or worn and refit the filler plug, tightening it to a torque setting of 28 - 31 Nm (21 - 23 lbf ft). Wash off any spilt oil from the housing and swinging arm.

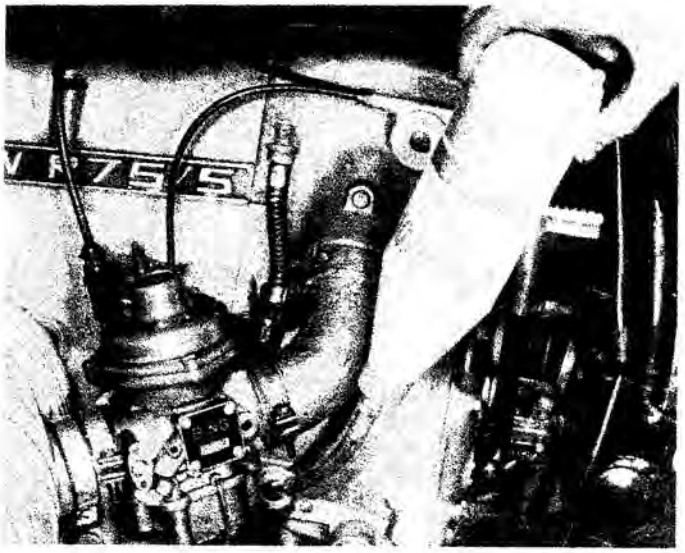
All models 1981 on Remove the level plug from the rear of the housing. If the level is correct, oil should trickle slowly out. If the level is too high allow the surplus to drain off, until the flow is reduced to a



Remove gearbox filler plug to check oil level – /5 models ...

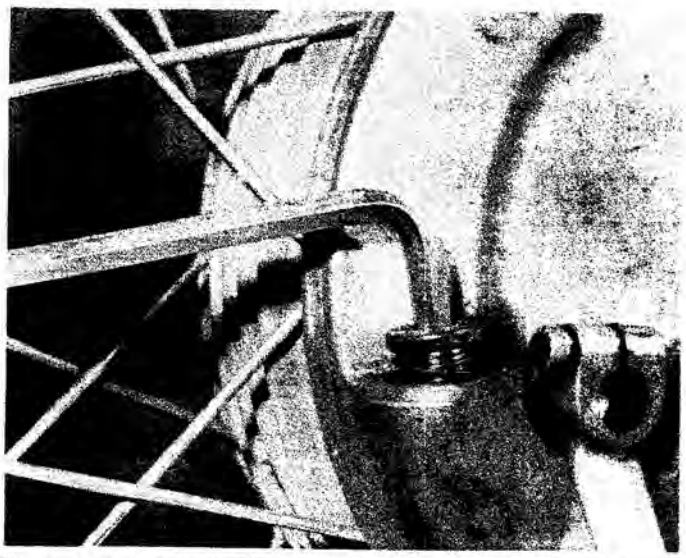


... gearbox filler plug – all other models



Use only good quality oil of specified type when topping up

Checking the driveshaft oil level



Remove bevel drive filler/level plug to check oil level – all models up to 1980

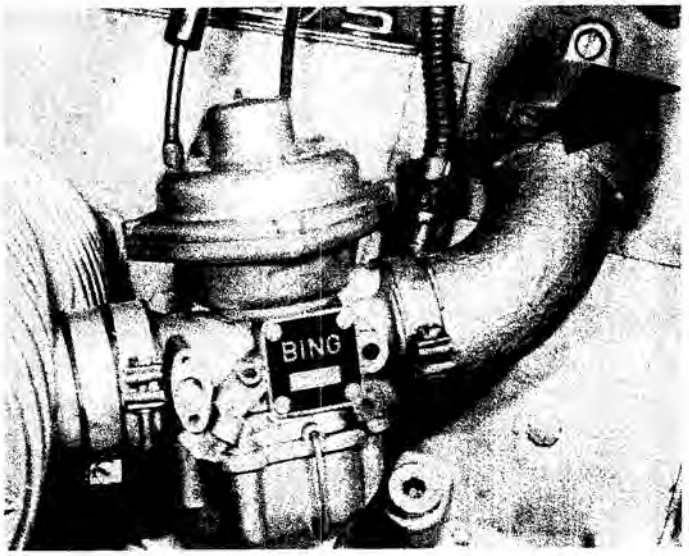
slow trickle, to prevent oil being blown onto the rear tyre via the breather. If topping up is necessary, remove the breather/filler plug from the top of the housing and add only good quality oil of the specified type. When the level is correct renew their sealing washers if damaged or flattened and refit the plugs. Tighten the level plug to a torque setting of 10 Nm (7.5 lbf ft); the breather/filler plug should be tightened securely, using the torque setting, where specified. Wash off any spilt oil from the housing and swinging arm.

8 Clean the air filter

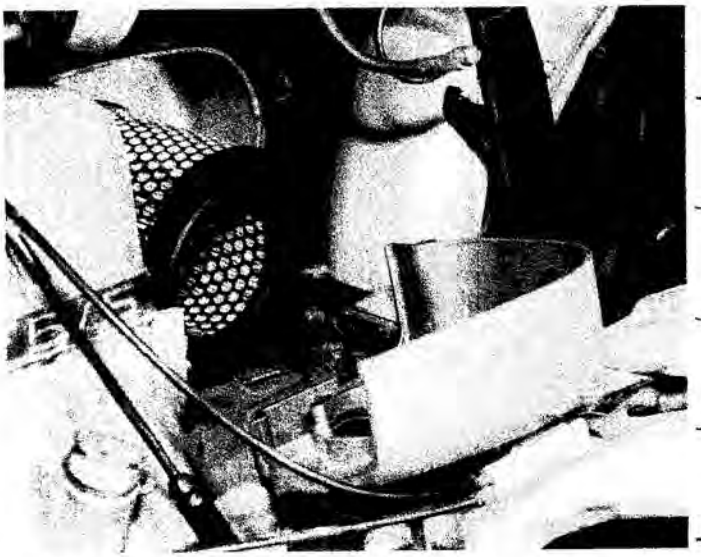
The air filter element should be removed for cleaning at regular intervals or performance will be reduced and fuel consumption increased.

/5, /6, /7 up to 1978

Slacken the left-hand air filter/carburettor hose clamps and the carburettor/cylinder head clamp(s) and withdraw the air hose. Unscrew the filter cover retaining screw and pull out the filter left-hand cover, holding the kickstart pedal out of the way. There is no need to disconnect the choke lever. Tap the filter lightly to remove loose particles of dirt and blow through from the inside with compressed air to clean the filter. If it is split or badly clogged it should be renewed.



Early models – removal retaining screw (arrowed) and carburettor hose ...



... then withdraw cover to release air filter element

On refitting, ensure that the element engages correctly on the three pins inside each filter cover, check that the left-hand cover is located correctly under the two metal retaining strips bolted to the gearbox top. Using two fingers inserted into the outlet aperture, guide the retaining screw into place and tighten it securely. Refit the carburettor hose and tighten the clamps securely.

/7, R45 and R65 1979-80 (UK), /7 and R65 1979 (US)

Although the filter is the same as for the models described above, due to modifications made to the crankcase breather from 1979 models onwards, the task of removal and refitting is more complicated.

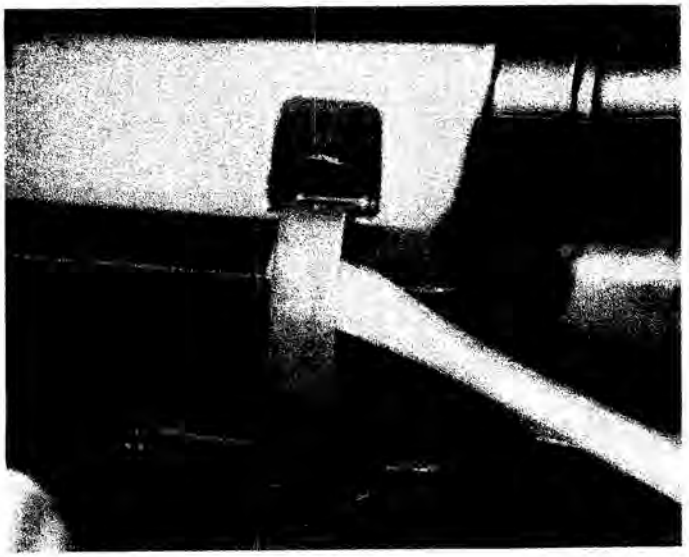
Remove the fuel tank as described in Chapter 4 to expose the crankcase top surface. Remove the two Allen screws and withdraw the starter motor cover. A black rubber breather hose will be seen projecting into the left-hand half of the air filter cover; pull this clear. Proceed as described above to remove and clean the filter element.

On refitting, reverse the dismantling order but push the breather hose into place as far as possible before pushing the filter cover left-hand half into place. Refit the carburettor hose, starter motor cover and fuel tank.

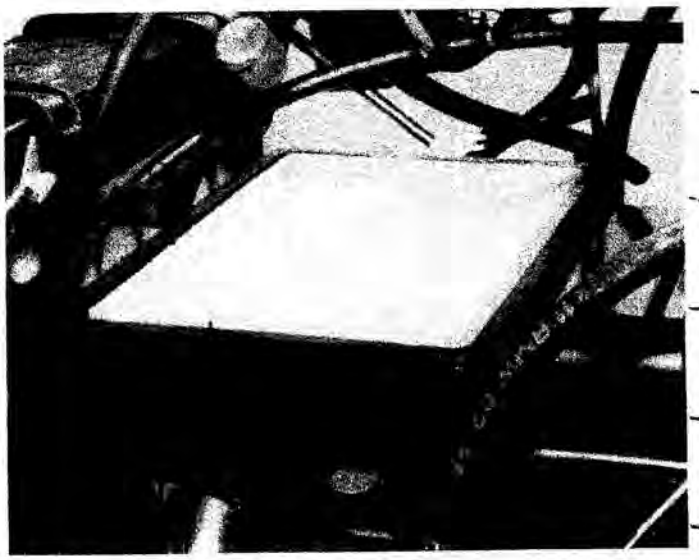
All models 1981 on (UK), 1980 on (US)

Using a screwdriver, prise off from the filter top cover the four metal clips, two on each side, which retain together the two filter halves. Raise the filter upper half as much as possible and lift out the filter element to the left. The element can be cleaned using a soft brush to remove larger particles of dirt, but the most effective method is to blow the dirt away by directing a jet of compressed air from the underside of the element.

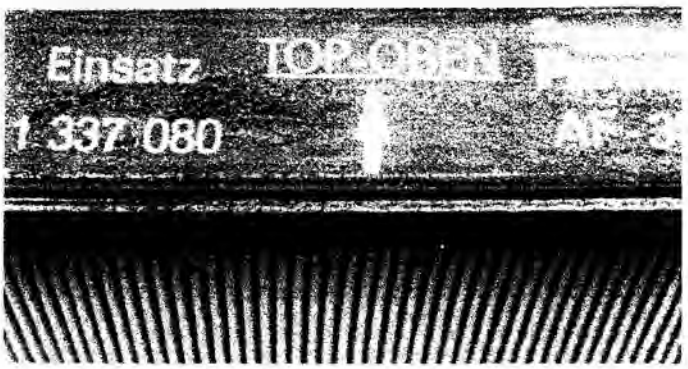
On refitting ensure that the element is inserted correctly, so that the 'Top/Oben' marking is facing upwards and so that the rounded corners are at the front. A light application of grease around the outside edge of the element will provide a more efficient seal in the exceptionally dusty or wet conditions, but ensure at all times that the filter top cover is properly seated and is securely fastened by all four metal clips.



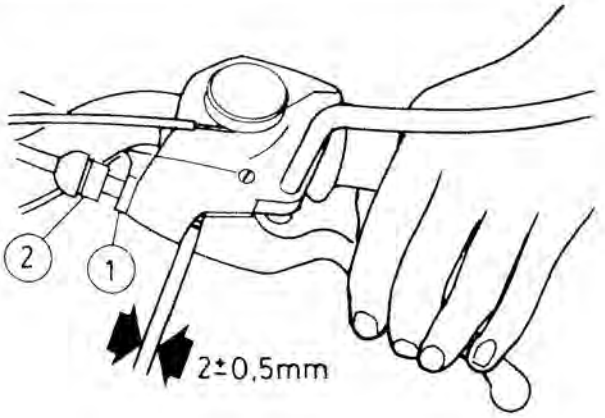
All later models – prise off metal clips ...

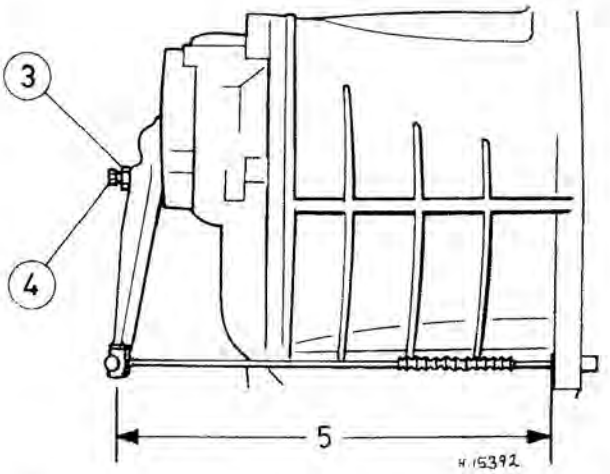


... and lift off upper half to release element



Ensure filter element is refitted the correct way up





Adjusting the clutch operating mechanism – all models 1981 on

1 *Locknut*
2 *Cable handlebar adjuster*
3 *Locknut*
4 *Adjusting screw*
5 *Exposed length of cable*

9 *Adjust the clutch*

All models up to 1980

The clutch is correctly adjusted if there is 3 mm (0.12 in) free play in the cable measured between the handlebar lever butt end and the handlebar clamp (equivalent to approximately 2 mm/0.08 in of free movement at the operating lever on the gearbox) and if the operating lever is parallel to the gearbox end cover joint halfway through its travel. There must be no sign of clutch slip or drag.

To adjust the clutch first use the cable adjuster at the handlebar lever; if there is insufficient adjustment slacken the operating lever adjuster locknut and tighten the adjuster to decrease cable free play. Do not forget to ensure that the lever is parallel to the gearbox at half travel; the clutch will require greatly increased pressure to operate if the lever is acting at a severe angle on the release piston. When adjustment is correct, tighten the adjuster locknut to a torque setting of 20 – 23 Nm (15 – 17 lbf ft), then tighten the handlebar adjuster locknut. Use a grease gun to lubricate the operating lever pivot via its grease nipple until fresh grease can be seen on each side of the bearing, then apply a few drops of oil to the cable end nipples.

If the clutch still shows signs of slipping or dragging, or if it is very sudden in action, it must be dismantled for examination. On reassembly the components should be lubricated (where specified) to ensure a smooth action. Refer to Chapter 2.

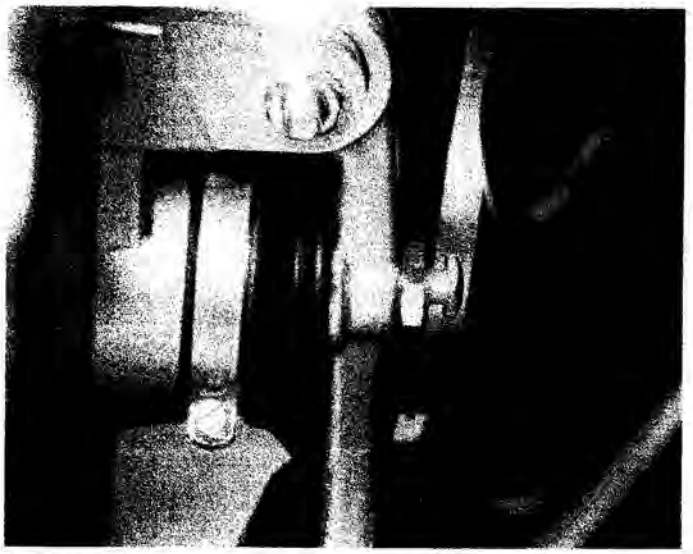
All models 1981 on

The clutch is adjusted correctly if there is 2 ± 0.5 mm (0.08 ± 0.02 in) free play in the cable measured between the handlebar lever butt end and the handlebar clamp (see accompanying illustration) and the clutch operates smoothly with no sign of slip or drag.

To adjust the clutch, slacken the handlebar adjuster locknut then rotate the handlebar adjuster as necessary until the distance between the forward edge of the clutch operating lever on the gearbox and the rear edge of the cable abutment on the gearbox outer casing (ie the exposed length of clutch cable inner wire) is 201 – 203 mm (7.91 – 7.99 in). The lever should be projecting rearwards by 4° approximately. Tighten the handlebar adjuster locknut.

Slacken the locknut of the adjuster set in the clutch operating lever at the rear of the gearbox and rotate the adjusting screw until the specified clearance of 1.5 – 2.5 mm (0.06 – 0.10 in) exists as described above at the clutch handlebar lever. Tighten securely both adjuster locknuts and operate the clutch lever once or twice to settle the cable. Check that the adjustment has remained the same, resetting it if necessary. Apply a few drops of oil to all cable end nipples, adjuster threads and lever pivots.

If the clutch still shows signs of slipping or dragging, or if it is very sudden in action, it must be dismantled for examination. On reassembly the components should be lubricated, (where specified) to ensure a smooth action. Refer to Chapter 2.



Clutch release mechanism adjuster is on gearbox rear cover

10 Check the tightness of the cylinder head nuts and adjust the valve clearances

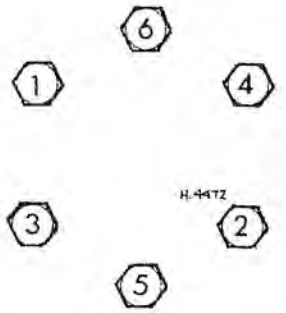
The engine must be completely cold before this task is undertaken. Remove both spark plugs and the rubber grommet from the ignition timing aperture in the crankcase. Remove both rocker covers; unscrew first the two 10 mm (spanner size) nuts at the front and rear of each rocker cover, between the second and third cylinder head fins, and remove them with their washers. Unscrew the single central cap nut on the outside of each rocker cover and tap the cover lightly with a soft-faced mallet to break the seal and release it. Be ready to catch any spilt oil and the cap nut washer.

To rotate the engine it is possible to use an Allen key in the alternator rotor retaining bolt, but it is preferable to select top gear and to rotate the engine by turning the rear wheel; this is much easier.

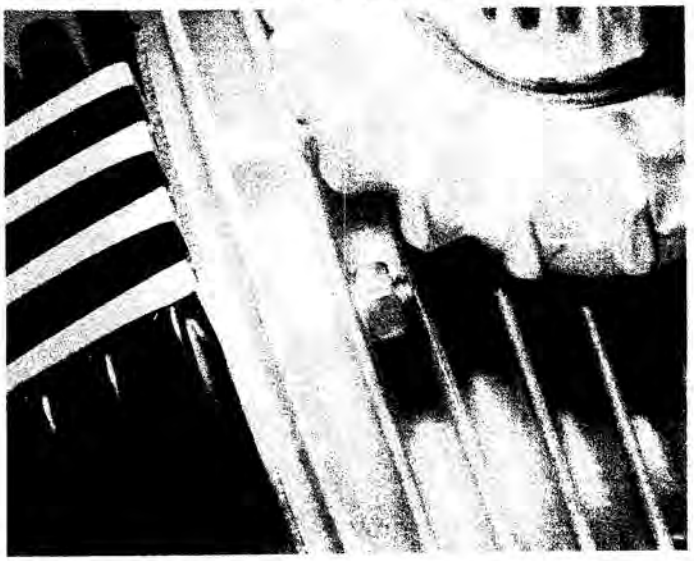
Turn the engine until the TDC mark (OT) appears in the crankcase aperture and check which cylinder is at TDC on the compression stroke, there should be free play at both rockers. If in doubt turn the engine over until the inlet valve on either cylinder has opened and closed again then turn the engine slowly until the TDC mark appears. If the clearances are so tight that free play cannot be detected, the cylinder head should be removed to check the valve seats.

Working in the **reverse** of the sequence shown in the accompanying illustration, **slacken** the cylinder head retaining nuts by ¼ turn each; do not slacken them further or the rocker arms may require re-aligning. Working in the sequence shown in the accompanying illustration, **tighten** the nuts to the appropriate torque setting.

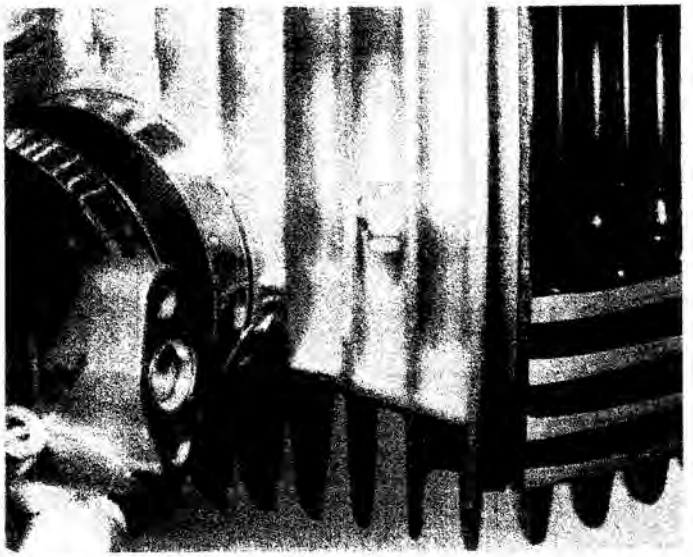
When the cylinder head nuts are known to be correctly fastened use feeler gauges of appropriate thickness to measure the clearances between the inlet and exhaust valve stem tips and the ends of their respective rocker arms. If the clearance is correct a feeler gauge of the correct thickness should be a tight sliding fit. **Note:** the clearances specified in this Manual are the latest recommendation for maximum performance and reliability and least noise; the recommended



Cylinder head retaining nut tightening sequence

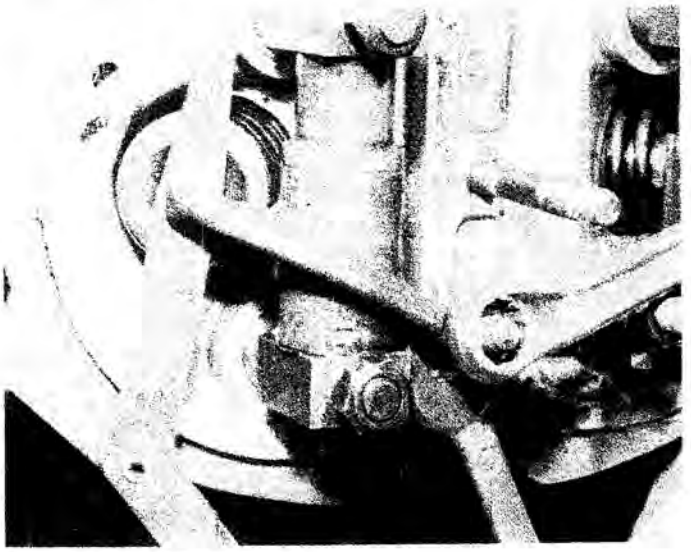


Removing rocker covers – unscrew two nuts at front ...



... and rear of cylinder head ...

... followed by central cap nut



Checking the valve clearances

Spark plug maintenance: Checking plug gap with feeler gauges

Altering the plug gap. Note use of correct tool

Spark plug conditions: A brown, tan or grey firing end is indicative of correct engine running conditions and the selection of the appropriate heat rating plug

White deposits have accumulated from excessive amounts of oil in the combustion chamber or through the use of low quality oil. Remove deposits or a hot spot may form

Black sooty deposits indicate an over-rich fuel/air mixture, or a malfunctioning ignition system. If no improvement is obtained, try one grade hotter plug

Wet, oily carbon deposits form an electrical leakage path along the insulator nose, resulting in a misfire. The cause may be a badly worn engine or a malfunctioning ignition system

A blistered white insulator or melted electrode indicates over-advanced ignition timing or a malfunctioning cooling system. If correction does not prove effective, try a colder grade plug

A worn spark plug not only wastes fuel but also overloads the whole ignition system because the increased gap requires higher voltage to initiate the spark. This condition can also affect air pollution

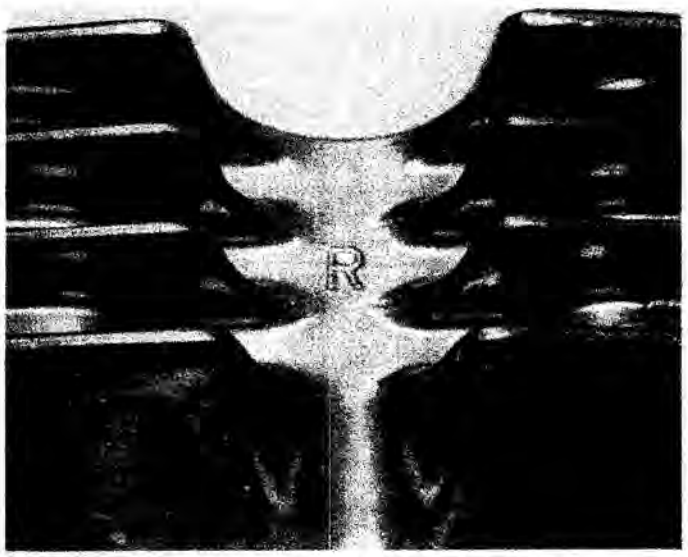
clearances have been altered several times and those specified here may not agree with those older settings given in the machine's handbook. Note also that BMW also recommend slacker clearances which are for use **only** during the running in of a brand-new machine. Although they are included in Chapter 1 for reference only, they should never be used at any other time; use only the normal clearances.

If adjustment is required slacken the locknut and turn the adjusting screw until the correct feeler gauge fit is obtained. Do not overtighten the locknut; a torque setting of 18 – 23 Nm (13.5 – 17 lbf ft) is specified and should be used to avoid distorting the adjuster threads and making future adjustment very difficult. When both valves have been adjusted, turn the engine over until that cylinder again comes to TDC on the compression stroke and recheck the clearances.

Note that if that cylinder has been producing excessive noise, the rockers should be checked for correct endfloat (see Chapter 1). The modified rocker assembly introduced on 1985 models is designed to reduce noise from this area and can be fitted to models from 1976 on.

If the gasket is in good condition it can be re-used. If both sealing surfaces are clean and unmarked jointing compound is not necessary, but if oil leaks have been encountered all traces of the old gasket should be removed and both mating surfaces should be carefully cleaned and checked for damage. Using a new gasket if necessary, refit the rocker cover. On all /5 and /6 models the covers are interchangeable, but on all other models they are handed and must be fitted only on the correct cylinder or there is a risk of a rocker touching the cover at high engine speeds (note also that the cover finning would then be inclined instead of horizontal). The covers can be identified either by the words 'Links' (left) or 'Rechts' (right) cast on the inside or by the letter 'L' or 'R' cast into the outside of the waisted section of each cover. Fit the washer and cap nut, then tighten the nut carefully but securely (note the specified torque setting for 1985 on models), followed by the two smaller nuts and their washers.

Turn the engine to TDC on the compression stroke for the remaining cylinder and repeat the operation.



Note cast marks identifying left- and right-hand rocker covers – later models only

11 Check the spark plugs

Detach the plug leads and unscrew both spark plugs. Those specified as original equipment will prove satisfactory in most operating conditions, alternatives are available to allow for varying altitudes, climatic conditions and the use to which the machine is put. If a spark plug is suspected of being faulty it can be tested only by the substitution of a brand new (not second-hand) plug of the correct make, type and heat range.

Note that the advice of a competent BMW dealer or similar expert should be sought before the plug heat range is altered from standard. The use of too cold, or hard, a grade of plug will result in fouling and the use of too hot, or soft a grade of plug will result in engine damage due to excess heat being generated. If the correct grade of plug is fitted, however, it will be possible to use the condition of the spark plug electrodes to diagnose a fault in the engine or to decide whether the engine is operating efficiently or not. The accompanying series of colour photographs will show this clearly.

It is advisable to carry a set of new spare spark plugs on the machine, having first set the electrodes to the correct gap. Whilst spark plugs do not often fail, a new replacement is well worth having if a breakdown does occur. Ensure that the spares are of the correct heat range.

The electrode gap, which should be 0.6 – 0.7 mm (0.024 – 0.028 in), can be assessed using feeler gauges. If necessary alter the gap by bending the outer electrode, preferably using a proper electrode tool. **Never** bend the centre electrode, otherwise the ceramic insulator will crack, and may cause damage to the engine if particles break away whilst the engine is running. If the outer electrode is seriously eroded as shown in the photographs, or if the spark plug is heavily fouled, it should be renewed. Clean the electrodes using a wire brush or a sharp-pointed knife, followed by rubbing a strip of fine emery across the electrodes. If a sand-blaster is used, check carefully that there are no particles of sand trapped inside the plug body to fall into the engine at a later date. For this reason such cleaning methods are no longer recommended; if the plug is so heavily fouled it should be renewed.

Before refitting a spark plug into the cylinder head, coat the threads sparingly with a graphited grease or Copaslip to aid future removal. Use the correct size spanner when tightening the plug, otherwise the spanner may slip and damage the ceramic insulator. The plug should be tightened by hand only at first and then secured with a quarter turn on the spanner so that it seats firmly on its sealing ring. Where possible, use the specified torque setting of 20 – 30 Nm (15 – 22 lbf ft).

Never overtighten a spark plug otherwise there is risk of stripping the thread from the cylinder head, especially as it is cast in light alloy. A stripped thread can be repaired without having to scrap the cylinder head by using a 'Helicoil' thread insert. This is a low-cost service, operated by a number of dealers.

12 Check the contact breaker gap and ignition timing – all models up to 1980

/5, /6, /7 up to 1978 – contact breaker gap

Remove its three Allen screws and withdraw the engine front cover, remove both spark plugs, then insert an Allen key in the alternator rotor centre bolt and turn the engine (clockwise, looking at the alternator from the front of the machine) until the points are fully open. Check the condition of the contact breaker points. They should be an even grey colour. Slight pitting may be removed with a breaker points file. Blow out all abrasive dust. Badly pitted or worn points must be renewed. The faces of the points must be parallel when closed.

The points must be renewed as soon as pitting becomes bad. Short contact breaker points life may be due to a faulty condenser.

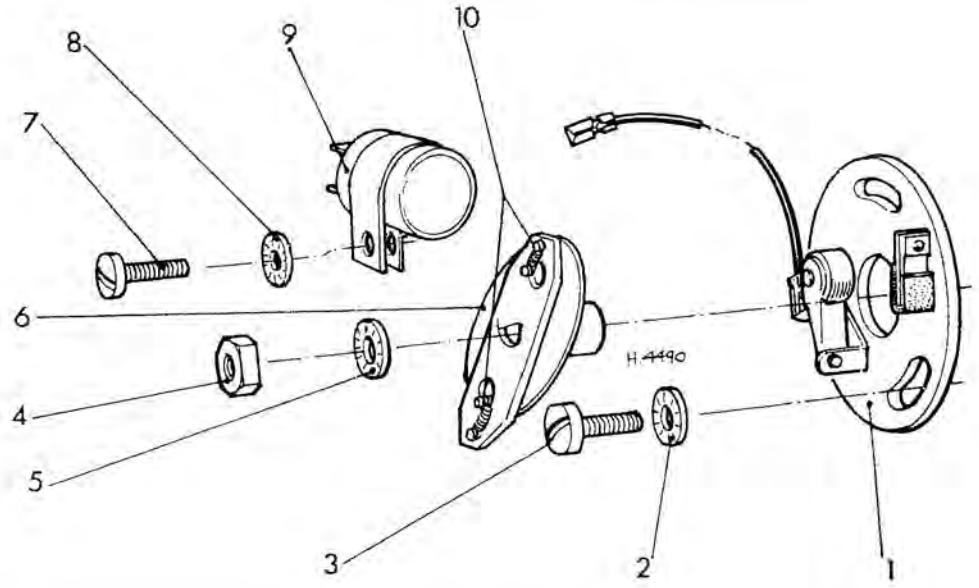
To replace the contact breaker points, unscrew the cheese head screw retaining the points to the backplate, and the screw retaining the cable clip. Remove the points and pull off the spade terminal from the condenser. Pull the wire out of the condenser grommet.

When replacing the contact breaker points, ensure that the pivot pin locates in the hole in the contact breaker backplate. Clean the points with solvent to remove oil or grease. Re-set the points gap, which should be 0.35 – 0.40 mm (0.014 – 0.016 in). To adjust, slacken the points fixing screw slightly. Put a screwdriver between the two pins at the top of the contact breaker backplate and turn to move the points carrier until the gap is correct. Tighten the fixing screw and recheck the gap. After adjusting the contact breaker gap, check the ignition timing.

Note: *although it provides a more accurate setting if properly applied, the use of a dwell meter is very awkward on these models as the ATU assembly is rotating immediately above the points when the engine is running. If this method is to be used, follow its manufacturer's instructions when connecting the dwell meter to the machine, start the engine (having first cleaned or renewed the points) and allow it to idle. If the meter reading is larger than that specified, the points gap must be increased and vice versa. Note that, while some meter needle flickering is normal, if the reading fluctuates wildly the ATU, camshaft and camshaft bearings should be checked carefully for wear.*

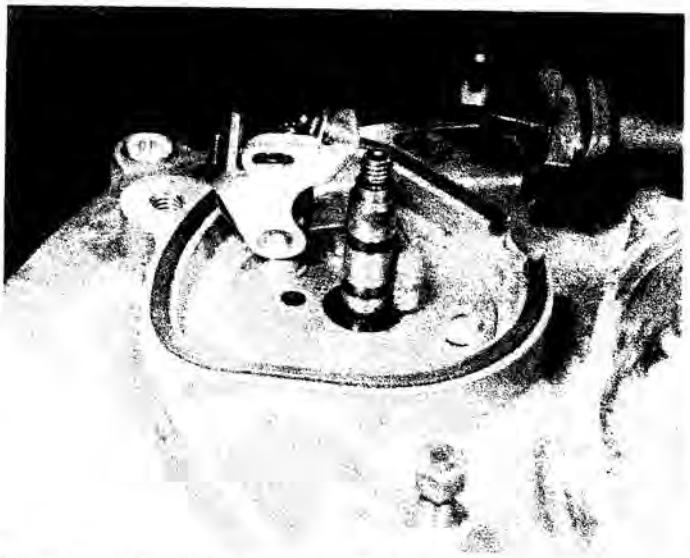
/7, R45 and R65 1979 – 80 – contact breaker gap

Remove the engine front cover which is retained by two Allen screws, then remove the single screw which retains the contact breaker

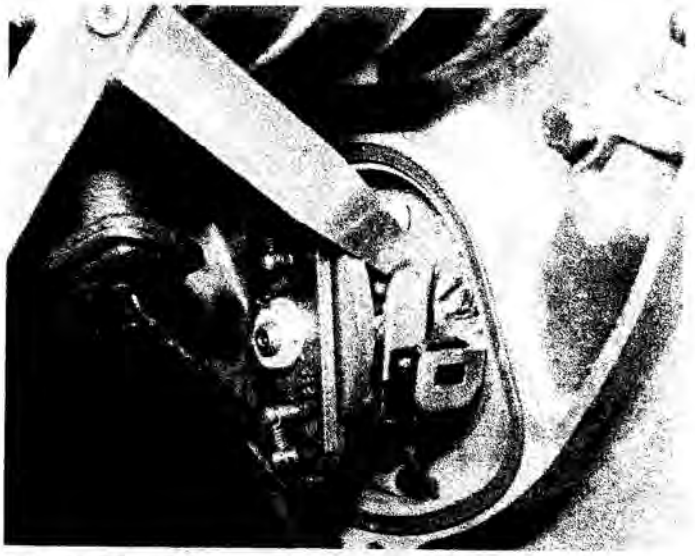


Contact breaker – all models up to 1978

1 *Backplate*
2 *Lock washer*
3 *Screw*
4 *Nut*
5 *Lock washer*
6 *Centrifugal advance unit*
7 *Screw*
8 *Lock washer*
9 *Condenser*
10 *Springs*



All models up to 1978 – contact breaker pivot pin must engage in hole in backplate



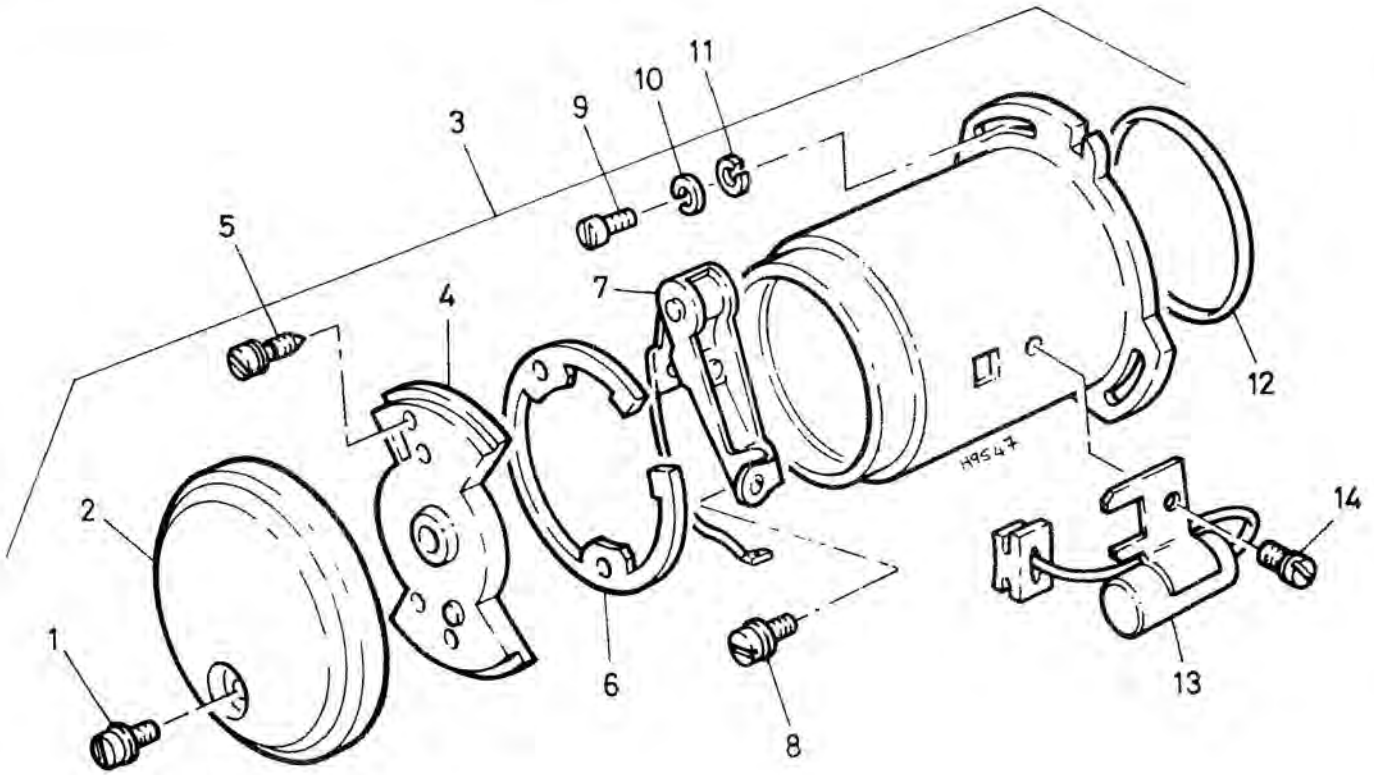
Adjust contact breaker gap when points are fully open

housing cover and withdraw the cover. Remove the spark plugs and rotate the engine clockwise, looking from the front of the machine rearwards, by using an Allen key in the alternator rotor retaining Allen bolt. Rotate the engine until the contract breaker points open to the maximum gap, then examine the condition of the contact point faces. Light burning or pitting may be reclaimed by careful dressing with a fine file or abrasive paper, but serious pitting or other damage will mean that the contact breaker assembly must be renewed.

To renew the contact breaker assembly, remove the two screws which secure the outrigger bearing plate at the forward end of the contact breaker housing, then carefully pull the bearing plate away. Remove the single screw which retains the contact breaker assembly, pull out the spade terminal to disconnect the points lead, and withdraw the contact breaker assembly. Refitting is the reverse of the above procedure, but a thin smear of the grease supplied with the new assembly should be applied to the contact breaker cam and the lubricating felt, and to the camshaft where it passes through the outrigger bearing. Check that the cam lubricating felt comes into correct contact with the cam. If a white plastic cap is fitted to the contact breaker assembly or is supplied with it, the cap should be discarded as it is not intended for use on these machines and will restrict engine performance at high engine speeds.

To adjust the contact breaker gap, rotate the engine clockwise as described above until the maximum gap is obtained and measure the gap using feeler gauges which should be a light sliding fit. Note that the gap should always be checked with the outrigger bearing plate in place. The correct clearance on these models is 0.40 – 0.50 mm (0.016 – 0.020 in) and is achieved by slackening slightly the contact breaker retaining screw and inserting a screwdriver into the slot in the contact breaker backplate. The screwdriver is then turned to move the backplate until the gap is correct. Tighten securely the retaining screw and rotate the engine fully clockwise until the points are again fully open, then recheck the gap, resetting it if necessary. Once the gap is known to be correct, refit the contact breaker housing cover, and check the ignition timing.

It is preferable to use a dwell meter to set the points gap, as this provides a far more accurate setting. Connect the meter to the machine following the manufacturer's instructions, start the engine and allow it to idle. Adjust the gap as describd above until the specified reading is obtained. Note that the dwell angle (see Chapter 5 Specifications) is given in terms of degrees of crankshaft rotation or as a percentage figure: check that the correct figure is used for the meter.



Contact breaker – all models 1979 to 1980

1 *Screw*
2 *Housing cover*
3 *Contact breaker assembly*
4 *Outrigger bearing plate*
5 *Screw*
6 *Circlip*
7 *Contact breaker*
8 *Screw*
9 *Screw*
10 *Lock washer*
11 *Washer*
12 *O-ring*
13 *Condenser*
14 *Screw*

Checking the ignition timing – all models up to 1980

The ignition timing marks stamped on the flywheel are as follows for /5 and /6 models: the static or idle speed mark is a line stamped on the flywheel (at 9° BTDC) with the letter 'S' adjacent, the full advance mark being the letter 'F'. On /7 models both marks are the same in appearance except that the static or idle speed mark is now stamped on the flywheel rim at 6° BTDC; two further lines are marked, one on each side at a distance of 6 mm (0.236 in) from the 'S' mark. As 2 mm (0.08 in) of flywheel rim movement corresponds to 1° of crankshaft rotation, these extra lines make it easier to check that the difference (if any) between cylinders does not exceed the tolerance of ± 3°.

Check the ignition timing statically with a test lamp or buzzer after the points have been checked and adjusted. Connect one lead from the lamp/buzzer to the capacitor terminal and the other lead to earth. Switch on the ignition. Remove the rubber plug from the timing mark viewing hole behind the dipstick. Also remove both spark plugs. As the engine is turned clockwise by means of an Allen key in the alternator rotor fixing screw, the lamp should light when the 'S' mark on the flywheel coincides exactly with the mark on the crankcase (see accompanying illustration). The centrifugal advance bob weights should be at rest – ie., in the retarded position. The remaining cylinder should not vary by more than 3° (equivalent to 6 mm, 0.236 in of movement at the flywheel rim) above or below the 'S' mark.

If the ignition is too advanced or retarded, adjust as follows on all models up to 1978; slacken the two cheese head screws on the contact breaker backplate. Turning the backplate clockwise retards the timing and vice versa. Tighten the two screws and recheck the timing. If timing between the cylinders is outside the 3° tolerance, check the cam drive shaft for truth, or the camshaft bearing for slackness.

To adjust the ignition timing on 1979 – 80 models, slacken the two Allen screws which fasten the contact breaker housing and rotate the housing clockwise to retard the ignition timing, or anti-clockwise to advance it. Tighten securely the housing retaining Allen screws and recheck the ignition timing.

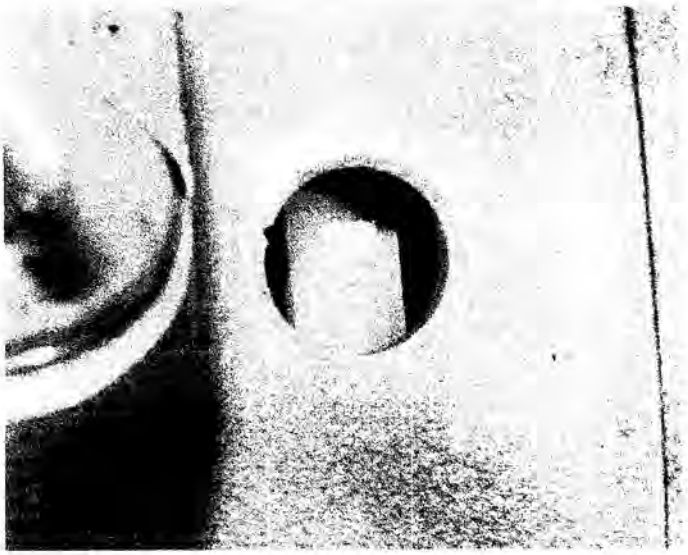
Retarded Correct Advanced

Ignition timing mark positions

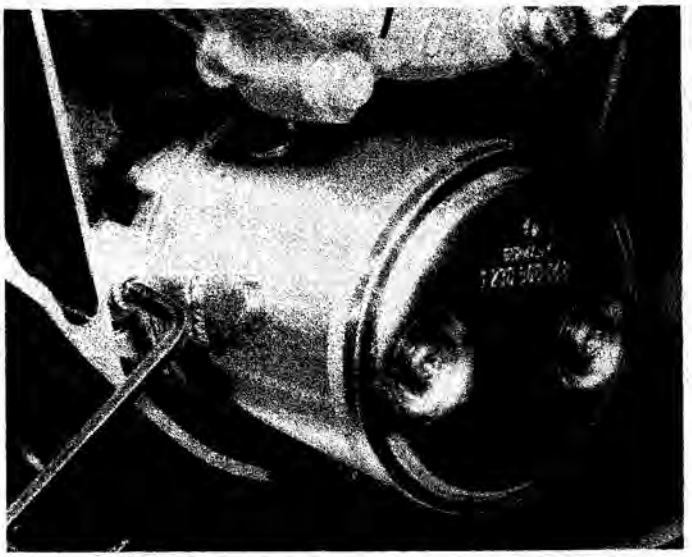
If one is tracing the cause of a fault such as lack of power the ignition timing should be checked on the other cylinder to discover if there is any discrepancy between the two. If such a discrepancy exists, or if the timing check reveals a fault in the ATU then the complete contact breaker housing assembly must be renewed. No parts are available with which this assembly can be reconditioned.

While the timing can be checked statically as described above, this is no longer recommended as a sufficiently accurate check, and the manufacturer advises the use of a strobe lamp instead. The best type of lamp is the more expensive xenon tube type which uses a separate power source, ie not the machine's battery. If such a lamp is not available, the machine should be taken to a BMW dealer for the work to be carried out professionally.

Connect the strobe according to the manufacturer's instructions and remove the black rubber inspection cap from the timing mark



Flywheel timing mark should align with notch in crankcase aperture as shown



Slacken retaining Allen screws and rotate distributor housing/ignition trigger unit to adjust ignition timing – all models 1979 on

viewing hole next to the dipstick. Start the engine and allow it to idle at the specified speed (see Chapter 4), then aim the strobe at the inspection aperture. The 'S' mark should align exactly with the crankcase index mark formed by a notch in the periphery of the timing mark viewing hole. Gradually increase engine speed to at least 3000 rpm and watch the timing marks. At just above idle speed (see Chapter 5) the 'S' mark should move upwards and disappear from view, and soon a white dot with the letter 'F' adjacent to it should rise into view. At full advance the 'F' mark should align exactly with the crankcase notch.

In the case of either the 'S' mark or the 'F' mark, if it appears above the crankcase notch, the ignition timing is advanced; and if below the notch, the timing is retarded. Adjust the timing as described above. Note that if the advance does not function correctly or return smoothly when the thorttle is released, the ATU mechanism is faulty. While this can be dismantled and greased on all models up to 1978 (see Major Service), it can only be cured by the renewal of the complete housing assembly on 1979 – 80 models; although there is nothing to be lost by attempting to lubricate the pivots as described for electronic ignition models (see Major Service).

13 Check the carburettors

On models with Bing carburettors release the spring clamps securing each carburettor float bowl, check that the fuel supply is switched off, tap each float bowl gently with a soft-faced mallet to break the seal and remove the float bowls. If dirt or droplets of water can be seen in the bottom of either bowl the fuel tap will require dismantling so that its filter(s) can be cleaned. If excessive amounts of dirt or water are seen the tank must be drained and cleaned out. Refer to the Major Service. Check that all jets are securely fastened and that the float bowl gasket is in good condition, then refit the float bowls and secure each with its clip. Switch on the fuel supply and check for leaks.

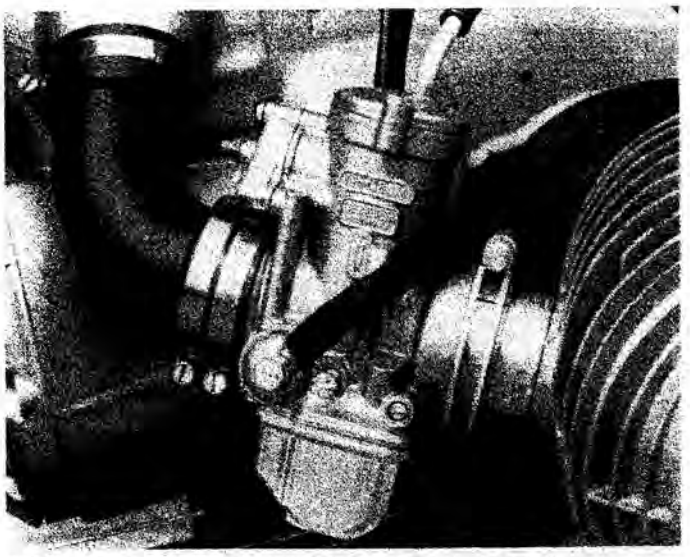
On R90S models switch off the fuel supply, unscrew the float bowl drain plug, detach the float bowl as described above and check the cleanliness of the fuel. Unscrew the bolt retaining each fuel banjo union, withdraw the union and clean the nylon filter gauze with a soft bristled brush. Refit the float bowl and banjo union to each carburettor, switch on the fuel supply and check for leaks.

On all models, check that there is 0.5 – 1.0 mm (0.02 – 0.04 in) free play in both throttle cables, measured at the carburettor top and use the cable adjusters to ensure that cable free play is at the correct amount and exactly the same on both carburettors. Check that the choke cable free play (where fitted) is 0.5 – 1.0 mm (0.02 – 0.04 in) and adjust, if necessary, in the same way.

Before the settings of the carburettors themselves are disturbed, the air filter must have been cleaned or renewed, the exhaust system must be in good condition, the valve clearances must have been checked and the contact breaker gap (where applicable) and ignition timing must have been checked and adjusted. Carburettors do not usually develop faults suddenly (inless a jet becomes blocked with dirt, for example) and faults which may appear to indicate a carburettor malfunction are usually due to a failure or maladjustment of another engine, ignition or induction system component. In addition to this, the engine must be warmed up to normal operating temperature.

While as a general rule carburettors should not be disturbed unnecessarily, BMW twins, especially the larger capacity models, are very sensitive to correct carburettor adjustment and particularly to correct synchronisation. If it is felt that adjustment is required, refer to the relevant Sections of Chapter 4. Owners of later model (1978 on) US models should note that local legislation may mean in practice that carburettor adjustment should be left only to a BMW dealer who has the necessary equipment to carry it out to the required standard.

Note that if rough idling and increased vibration at speed cannot be cured by carburettor adjustment, check that all jets are unblocked and



R90S only – when cleaning carburettors, do not forget filter gauze behind each fuel banjo union

the carburettor lines are undamaged. On models with Bing constant-depression carburettors check that the diaphragms are undamaged, that the O-rings sealing the pilot jets are in good condition and that the auxiliary starter carburettor levers return fully when the choke lever is closed. On earlier models it would be advisable to fit the lever return springs from later models to ensure that the levers are positively returned at all times. If this does not cure the problem carry out the compression test to check the condition of the engine (see Chapter 1).

14 Check the brakes

/5 and R60/6 – front

The front brake is adjusted corrrectly if there is 4 – 6 mm (0.16 – 0.24 in) of free play measured between the handlebar lever butt end and the handlebar clamp. If adjustment is required slacken its locknut and rotate the knurled adjuster at the handlebar lever, to give 8 – 15 mm (0.32 to 0.59 in) freeplay in the cable.

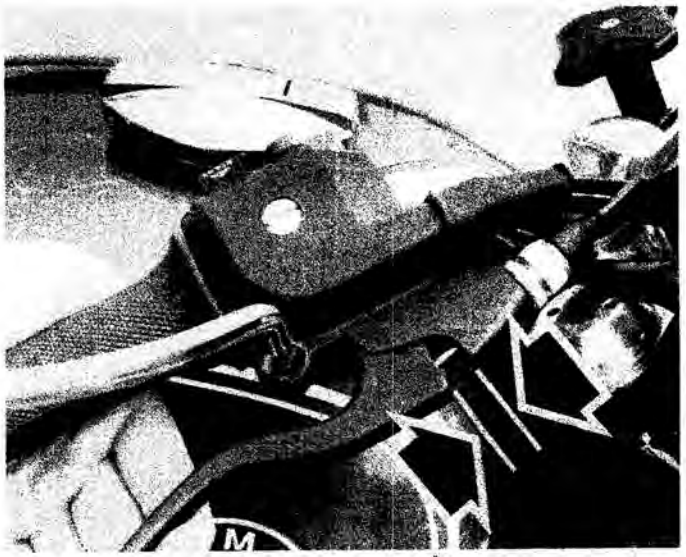
Loosen the locknut on the brake plate adjuster. Turn the centre screw fully anti-clockwise with an allen key, then turn it back until there is 4 mm (0.16 in) movement at the end of the lower brake cam lever. Tighten the locknut. Adjust the nut on the end of the inner cable, to give the correct free play at the handlebar lever.

There is no need to synchronise the action of the two brake shoes; this is achieved automatically by the action of the cable.

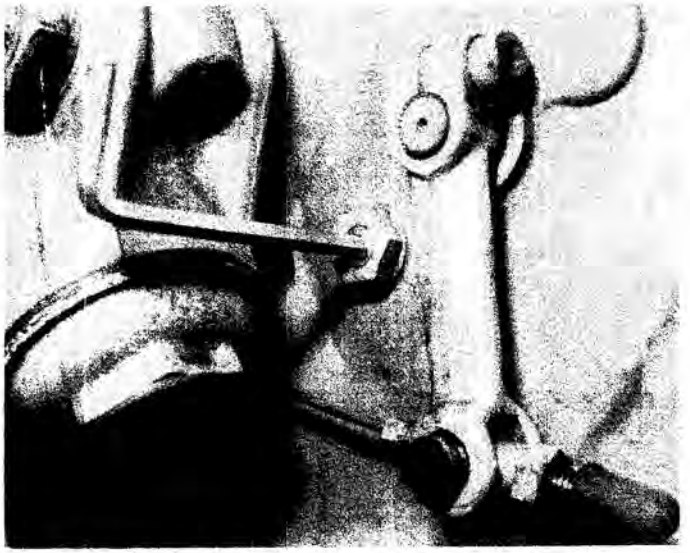
To check brake shoe wear on /5 and early R60/6 models the wheel must be removed from the machine. On later R60/6 models the friction material thickness can be checked through slots in the hub left-hand side. If the friction material is worn down at any point to 1.5 mm (0.06 in) or less, both shoes must be renewed. Refer to Chapter 8.

All other /6 and /7 models up to 1980 – front

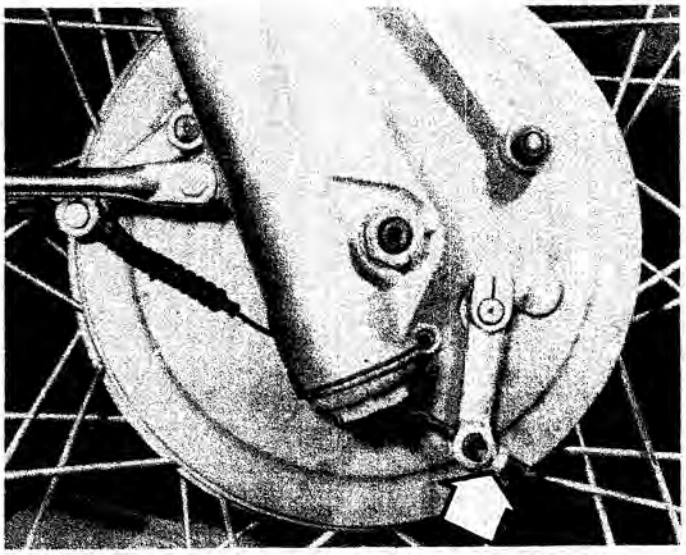
The front brake is adjusted correctly if there is approximately 4 – 6 mm (0.16 – 0.24 in) of free play measured between the handlebar lever butt end and the handlebar clamp. If adjustment is required remove the fuel tank (see Chapter 4) and peel off the rubber cover from the rear of the master cylinder. Slacken the cable adjuster locknut and insert the forked feeler gauge from the machine's toolkit into the groove in the master cylinder piston. If this is not available a replacement can be cut (similar to that shown in the accompanying photograph) from a sheet of metal 1.2 mm (0.0472 in) thick. Adjustment is correct when the feeler gauge is just free to move against the master cylinder body. Tighten securely the adjuster locknut and apply a few drops of oil to



All models up to 1980 – front brake free play is measured as shown



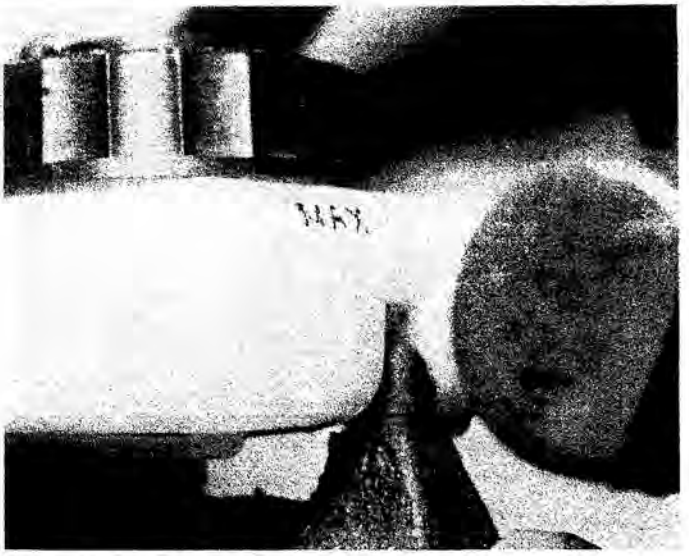
Use adjuster on brake plate to set correct shoe/drum clearance ...



... then set correct cable free play using adjuster nut (arrowed) – cable automatically synchronises the two shoes

Later R60/6 models – brake shoe wear can be checked through slots in hub

Early disc brake models – feeler gauge is necessary to adjust mechanism free play



Do not fill master cylinder above 'Max' level line – if excessive topping-up is necessary, check system for leaks or damage

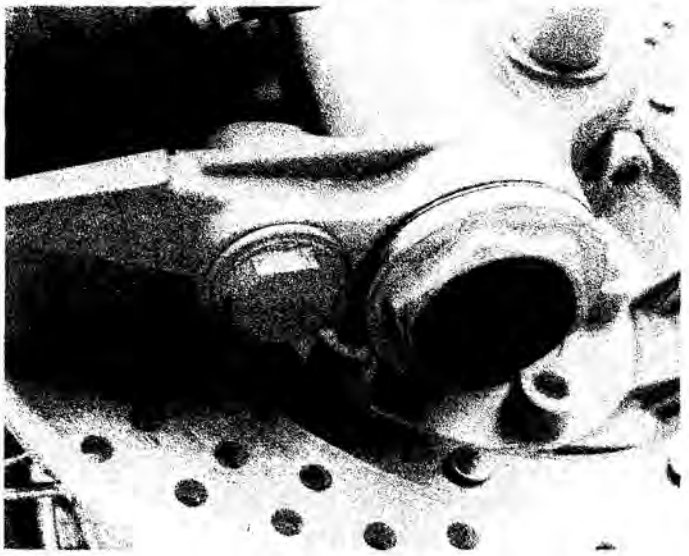
the cable end nipple and to the lever pivot. At regular intervals the cable should be disconnected and the master cylinder pushrod withdrawn so that both ends can be greased with a dab of Molykote BR2 or Liquid Moly LM47L. When adjustment and lubrication are complete refit the rubber cover and the fuel tank.

The brake fluid level is monitored by the warning light on the dash panel but the level should be checked whenever the fuel tank is removed. If topping up is necessary use only the specified brake fluid from a freshly-opened sealed container. Do not fill above the 'Max' level line or fluid will be spilled when the cap and float are refitted. Brake fluid is an extremely effective paint stripper and will attack any plastic or painted components; wash off any spilt fluid with copious quantities of fresh water. Note that it is quite normal for the fluid level to drop gradually as the pads wear, but any sudden drops in level must be investigated immediately. Check all hydraulic components for signs of fluid leakage and renew any seal or component that is found to be faulty.

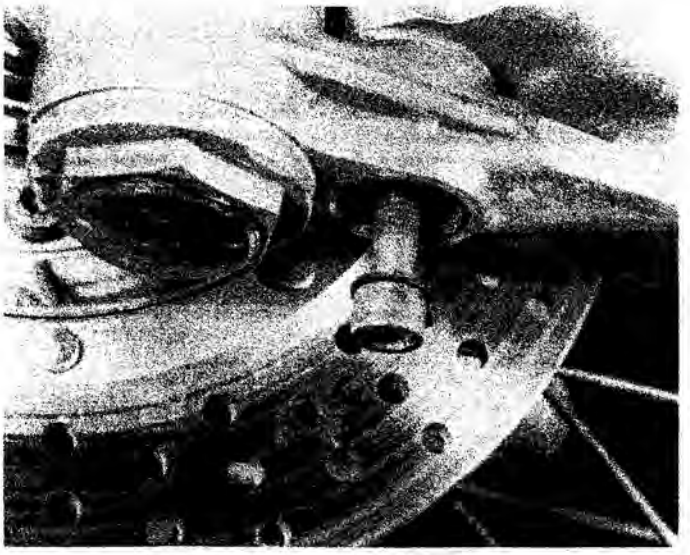
The amount of friction material remaining on the brake pads can be checked by looking at the caliper. Original equipment pads have painted wear limit marks; if either pad is worn so that these marks are in contact with the disc at any point, both pads must be renewed. If a twin disc system is fitted, the pads of both calipers should be renewed at the same time, even if only one is worn. Where painted wear limit marks are not provided, the pads must be renewed if any one is worn at any point to a friction material thickness of 1.5 mm (0.06 in) or less. If the pads are so fouled with dirt that they cannot be seen clearly, they must be removed and cleaned.

To renew the pads either the front wheel can be removed or the caliper(s) can be detached (in turn) from the fork leg(s). If the first course is chosen, refer to Chapter 8; if the second course is chosen, which is preferable as it permits the cleaning of the caliper pivot, proceed as follows. Unscrew the plug at the bottom of each caliper pivot and withdraw it complete with the coil spring. Unscrew one of the wheel spindle clamp Allen bolts and screw this into the thread of the caliper pivot. Extract the pivot and pull the caliper away from the disc taking care not to distort the metal brake pipe; if necessary remove the mudguard rear mounting bolt to release the brake pipe bracket. Unclip the fixed pad retaining wire clip and tap out the pad, then pull the moving pad out of the caliper piston.

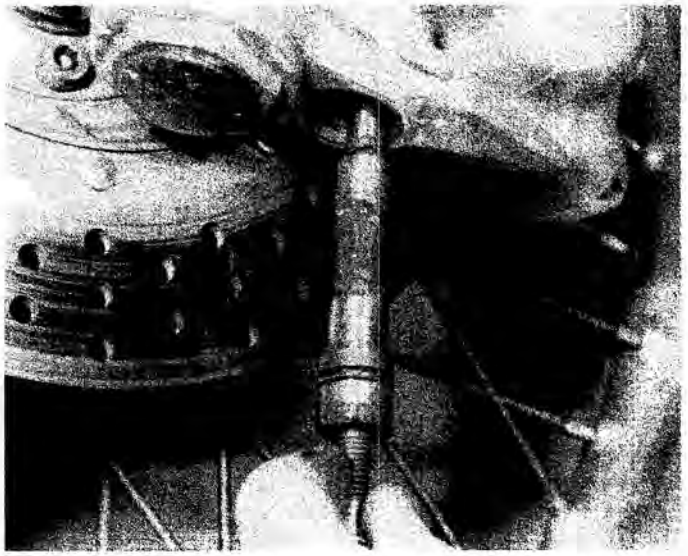
If the pads are worn out or fouled with oil or grease they should be renewed immediately; there is no satisfactory way of degreasing friction material. If they are still serviceable, clean them carefully using a fine wire brush until all traces of dirt, corrosion and old friction material are removed from the friction material and the pad metal backing. Pick out any embedded particles of dirt and use fine emery cloth or similar to ease down any glazed areas.



To remove swinging calipers, unscrew pivot retaining plug ...



... and use a wheel spindle clamp Allen bolt ...



... to extract caliper pivot. Note pivot O-ring and ensure pivot is clean and well greased before refitting

Release retaining clip to withdraw fixed brake pad

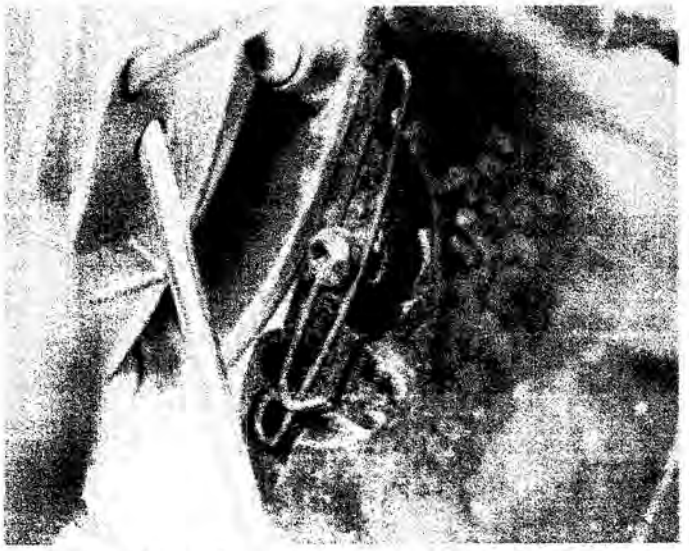
Thoroughly clean the caliper, caliper pivot and fork leg mountings, removing all traces of dirt, old grease and corrosion. Pack the caliper and fork leg pivot bores with Molykote BR2, Liquid Moly LM47L or any good quality brake caliper grease (silicone or PBC/Poly Butyl Cuprysil-based), and smear grease over the pivot itself. Note the O-ring around the pivot; this should be renewed if damaged or worn.

If new pads are to be fitted press back the caliper piston using a G-clamp or similar to make room for the new, thicker components. Renewing the O-ring on its locating pin and lubricating both pin and O-ring with a smear of the specified grease, press the moving pad into the piston bore. Fit the fixed pad to the opposite side of the caliper, ensuring that its locating shoulder engages correctly, then refit the retaining wire clip. Anchor it correctly, with the open end downwards (see accompanying photographs), and check that it is locked securely into the groove of the pad pin. Refit the caliper to the fork leg, check that the pivot is well-greased and insert it into the pivot bores rotating it to ensure that it is pressed fully into place; the pivot upper shoulder should butt firmly against the underside of the fork leg top mounting.

If the pads have been renewed, if the caliper setting has been disturbed or if the front wheel has been removed and refitted

Renew O-ring if necessary and grease locating pin on refitting moving brake pad

Ensure shoulder on fixed pad engages correctly with caliper body ...



... and be careful to refit retaining wire clip correctly, as shown

(possibly) the wrong way round, the caliper must be adjusted to align the fixed pad with the disc. If this has not already been done, remove the pivot threaded plug and coil spring.

Using a broad flat-bladed screwdriver, turn the eccentric pivot until the caliper is at its outermost position, ie furthest away from the wheel spindle, then turn the pivot slowly until the fixed pad is parallel to the disc. Using a piece of chalk or a thick-nibbed felt marker, apply one or two heavy radial lines to the inside of the brake disc, then pull the caliper outwards so that the fixed pad is in firm contact with this face and rotate the wheel until the marks have been rubbed across the pad. On close examination, if the marks have been fully wiped away or rubbed along their full length, the fixed pad is parallel to the disc and the setting is correct. If the marks have been only partially abraded, this shows that the pad is angled away from or towards the disc; carefully rotate the eccentric pivot (noting that only very small movements are required) and repeat the check until the setting is correct.

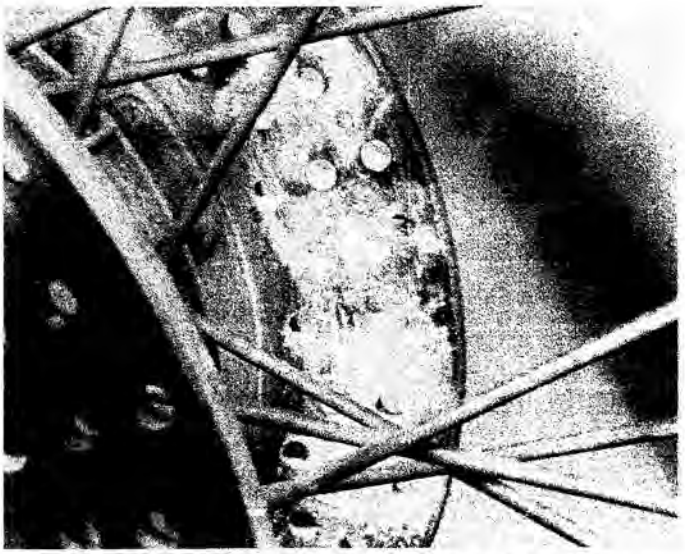
When the caliper pivot is correctly set, grease the spring to prevent corrosion and refit it and the threaded plug. Tighten the plug to the specified torque setting. Check that the caliper moves smoothly and easily on its pivot; this is essential for full braking performance. If there is any doubt about this the pivot should be removed and cleaned as described above. Lubricate the pivot and pivot bearings on refitting. Repeat the operation on the remaining caliper (twin-disc system).

Apply the handlebar lever several times to bring both pads into firm contact with the disc, then check the fluid level (removing the fuel tank, if necessary). If the level is above the 'Max' mark (as it may be if new pads have been fitted) carefully remove the filler cap and soak up the surplus fluid with a clean rag to restore the level. Refit the cap and wash off any spilt fluid.

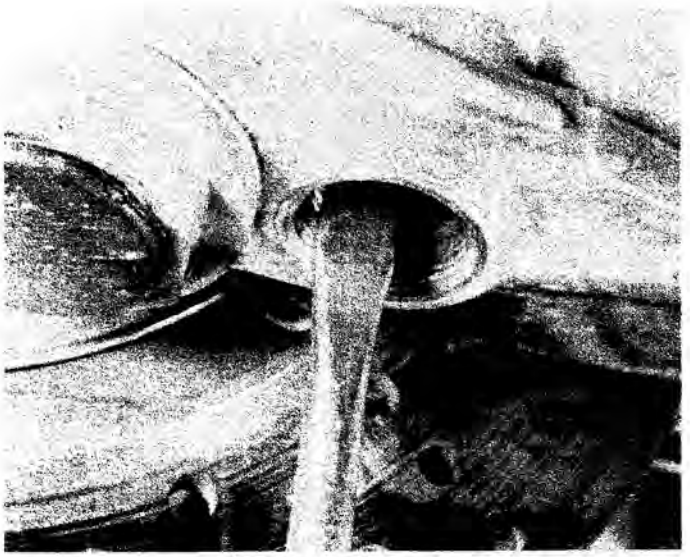
All other models – front

The hydraulic front brake fitted to later models requires no regular adjustments, pad wear is compensated for by the automatic entry of more fluid into the system from the handlebar reservoir. All that is necessary is to maintain a regular check on the fluid level and the degree of pad wear.

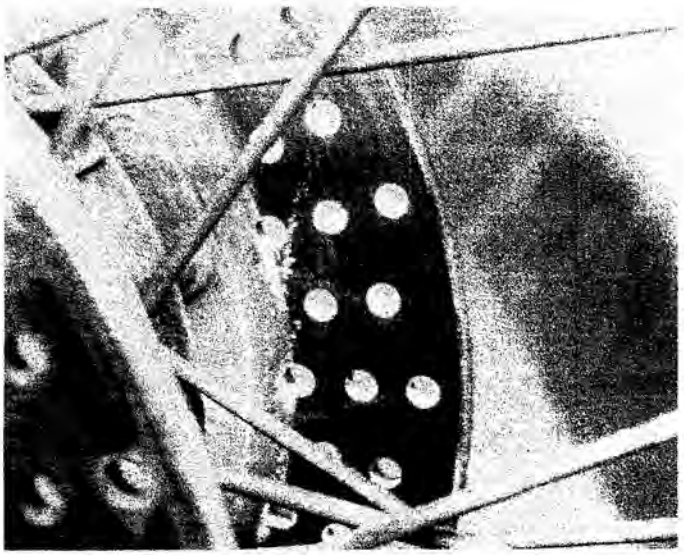
To check the fluid level, turn the handlebars until the reservoir is horizontal and check that the fluid level, as seen through the reservoir body, is not below the lower level mark. Remember that while the fluid level will fall steadily as the pad friction material is used up, if the level



To check caliper alignment, apply marks as described to disc inner face (shown greatly exaggerated for clarity)



If adjustment is necessary rotate caliper pivot in very small amounts ...



... until fixed pad is parallel to disc, shown by complete removal of marks

Grease coil spring and tighten threaded plug to specified torque setting on refitting