BMW K100 & 75 Owners Workshop Manual

by Jeremy Churchill

Models covered

K75. 740cc. UK January 1987 on
K75 C. 740cc. UK September 1985 on, US February 1986 on
K75 S. 740cc. UK June 1986 on (including Special, January 1987 on), US September 1986 on
K75 T. 740cc. US February 1986 on
K100. 987cc. UK October 1983 on, US August 1984 on
K100 RS. 987cc. UK November 1983 on (including Motorsport Limited Edition of June 1986 and Special, May 1987 on), US August 1984 on
K100 RT. 987cc. UK and US August 1984 on
K100 LT. 987cc. UK January 1987 on, US September 1986 on

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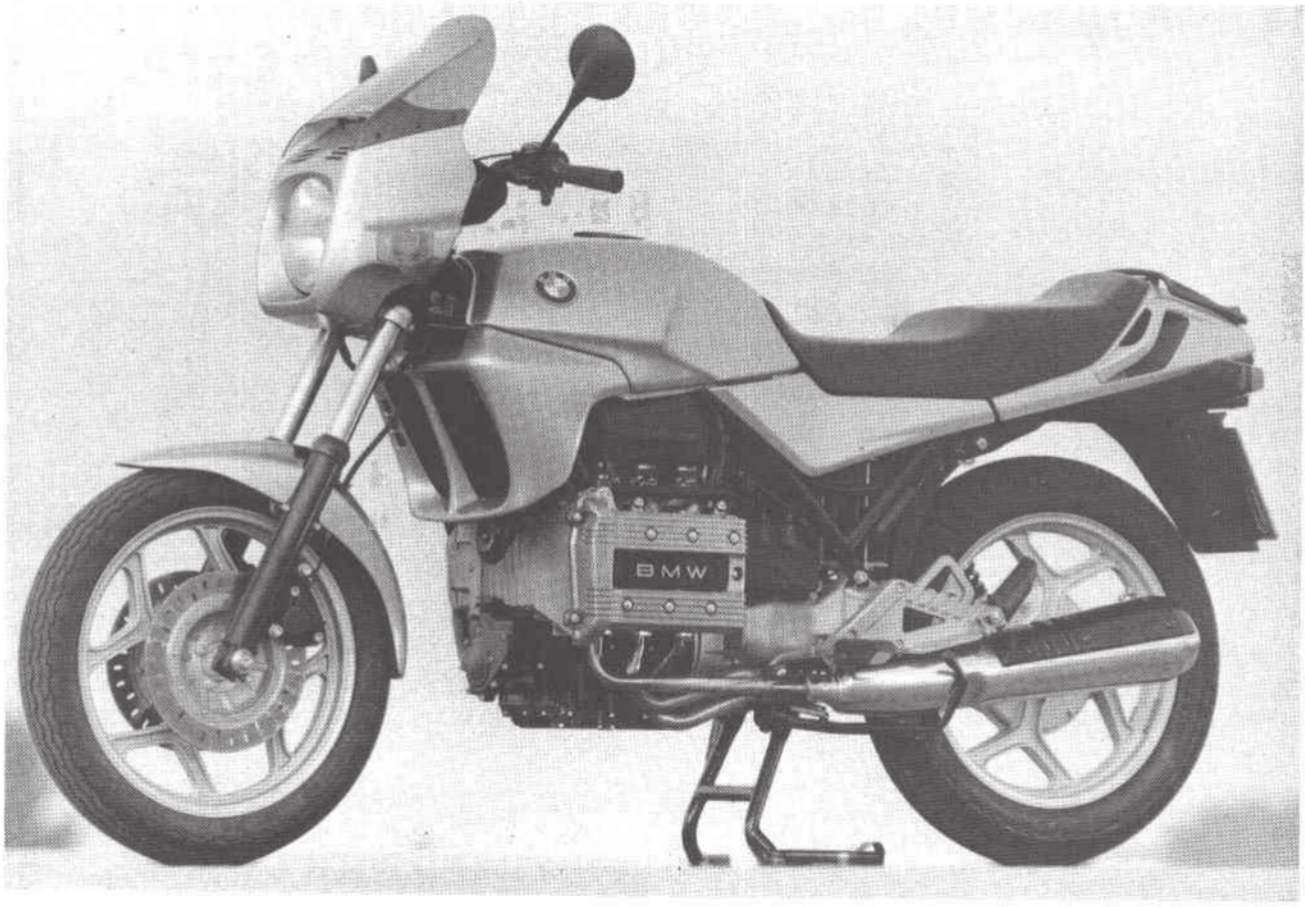
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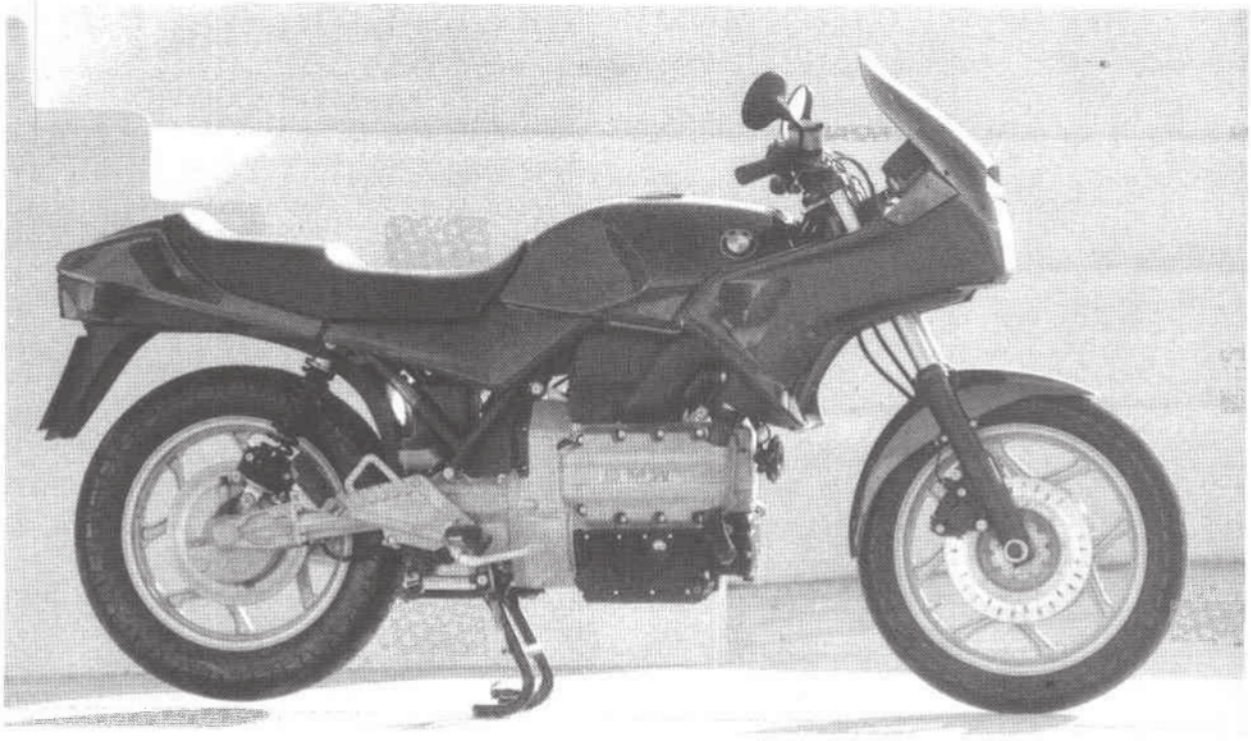
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The K75 C model



The K75 S 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 K100 and 75 models

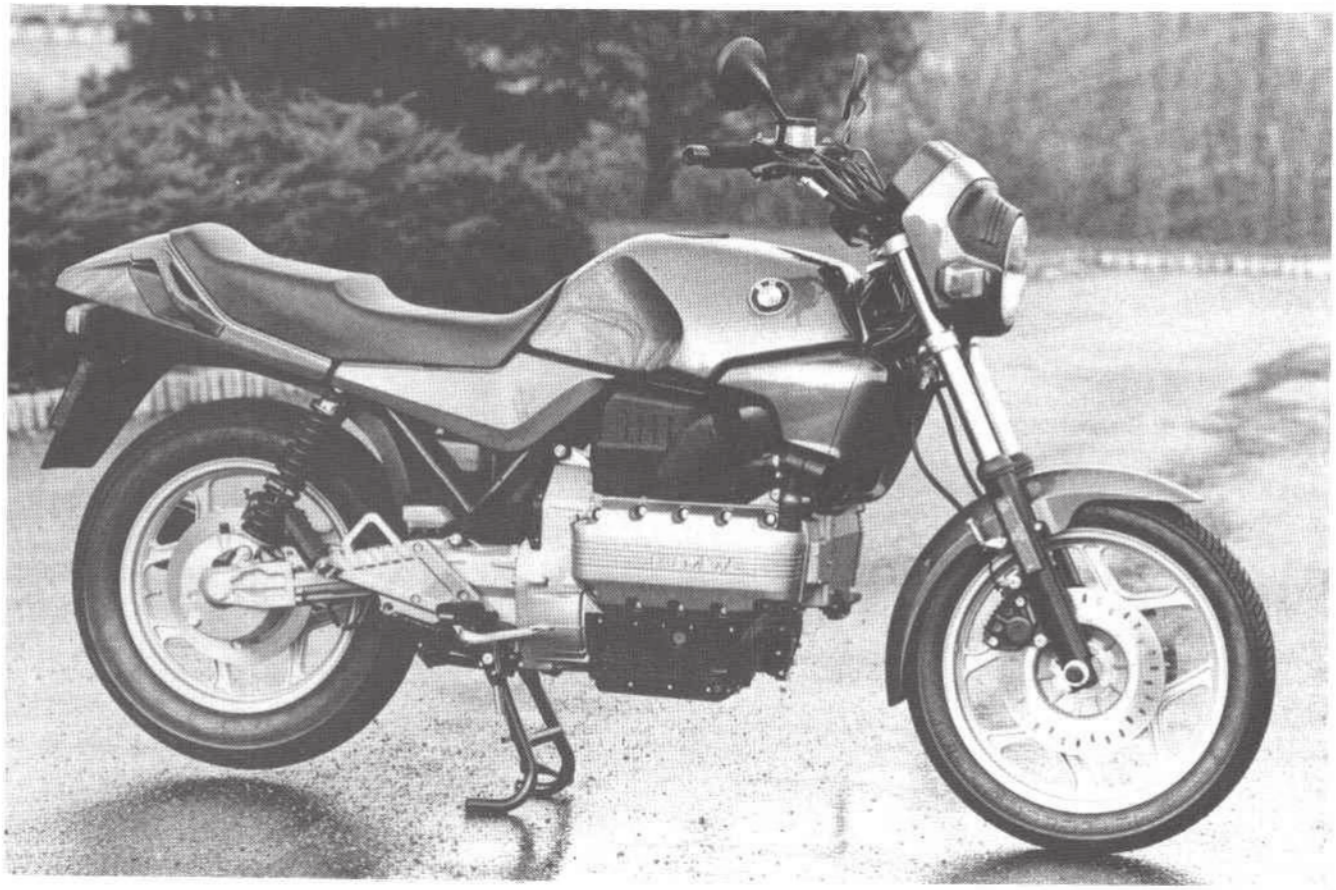
After nearly sixty years of producing flat twin engined machines of very high quality but basically simple specification, BMW gave the motorcycling world something of a shock when the K100 was first announced late in 1983. At first glance it seemed the complete opposite of all those qualities that the company had previously found so important in a motorcycle, but on closer inspection it becomes obvious that great efforts have been made to make the machines as light, simple, and compact as possible and yet attractive to the modern motorcyclist. The design is intended to provide a sound basis for a long-running production, taking into account all current and pending noise and emission control legislation.

Research started in the mid-1970s into a replacement for the flat twin engines which are already approaching the limits of reasonable development. A breakthrough came in 1979 with the patenting of the basic idea of taking a car engine, laying it on its side and transmitting the drive through a secondary output shaft. This provides a low centre of gravity and a very distinctive appearance, as well as the basis for a short compact engine/transmission unit. The transmission is very similar in layout to that used on the twins but is totally redesigned, using lightweight materials wherever possible, with emphasis on keeping it as short and as compact as possible. The tubular spine type frame is bolted to the unit and carries a pair of conventional telescopic forks to provide steering and front suspension.

After the introduction of the K100 and K100 RS in late 1983, followed by the K100 RT in 1984 the machines suffered one or two teething troubles, as is inevitable with any brand-new design, which were soon rectified by the introduction of modified components. In addition to this, one or two modifications have been made to cure problems which became evident in service; notably to reduce vibration and the build-up of heat under the fuel tank.

When the 750cc models were introduced, starting with the K75 C in late 1985, the opportunity was taken to modifiy many 100-model components to take advantage of commonality of parts; BMW claim approximately 70% of the components are common to both models. The development of the smaller machines proceeded alongside the 100 models but introduction was delayed until 1985/86; as a result the 75 models incorporate all the lessons learned from the earlier 100 models.

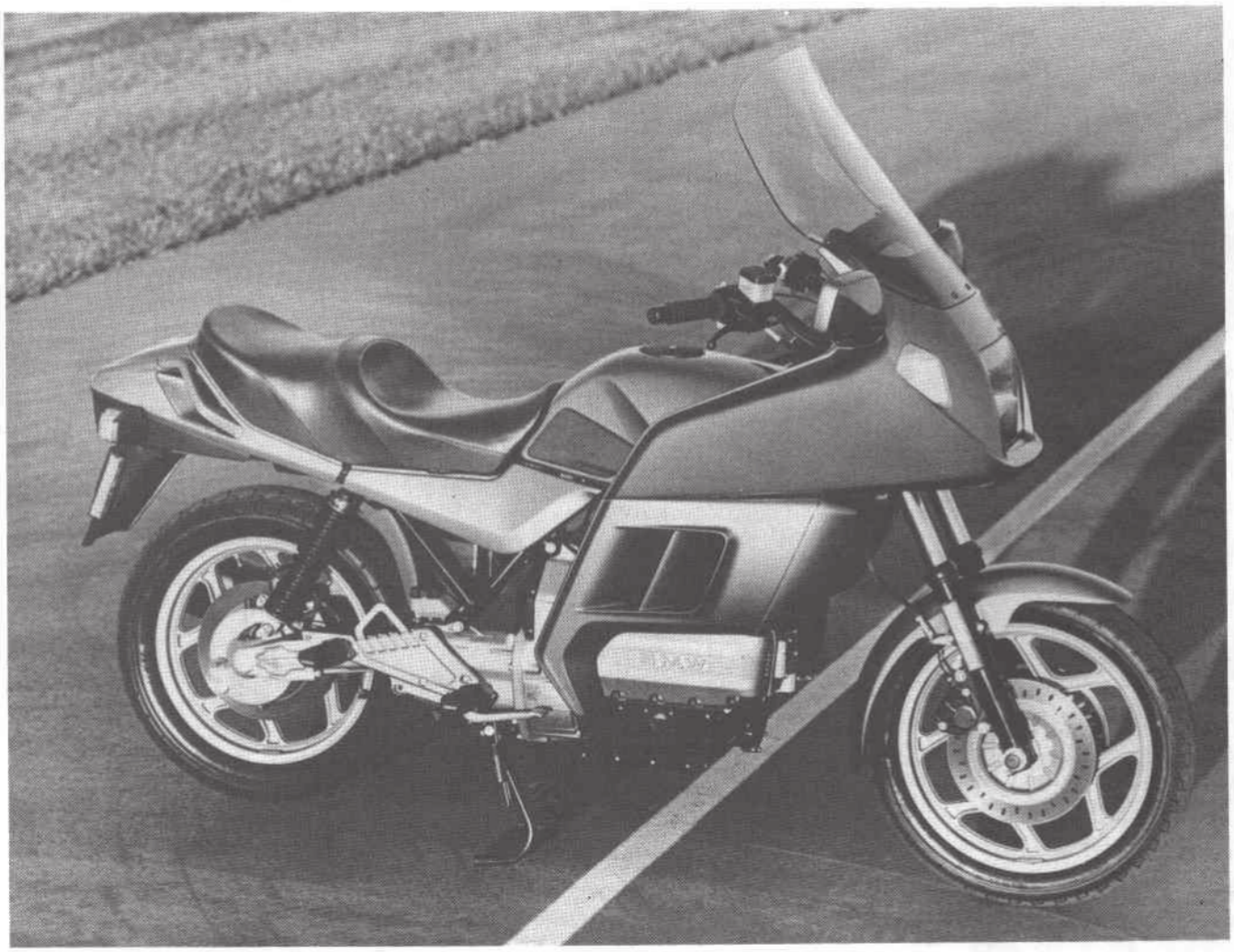
In common with their policy in previous years, BMW introduced various forms of each basic model to cater for as many tastes as possible. Thus the basic K100 was followed by the sports/touring K100 RS, the touring K100 RT and the fully-equipped K100 LT tourer. The first 75 model was the K75 C, which was followed by the more sports-orientated K75 S and then the basic K75. In all cases (except for final drive ratios, the sports suspension on the K75 S and the rear wheel and brake on the K75 and K75 C) the basic machine is exactly the same. **Note:** To avoid confusion with the basic K75 and K100 models, machines are refered to throughout the manual as '75' models or '100' models, except where a more precise definition is required.



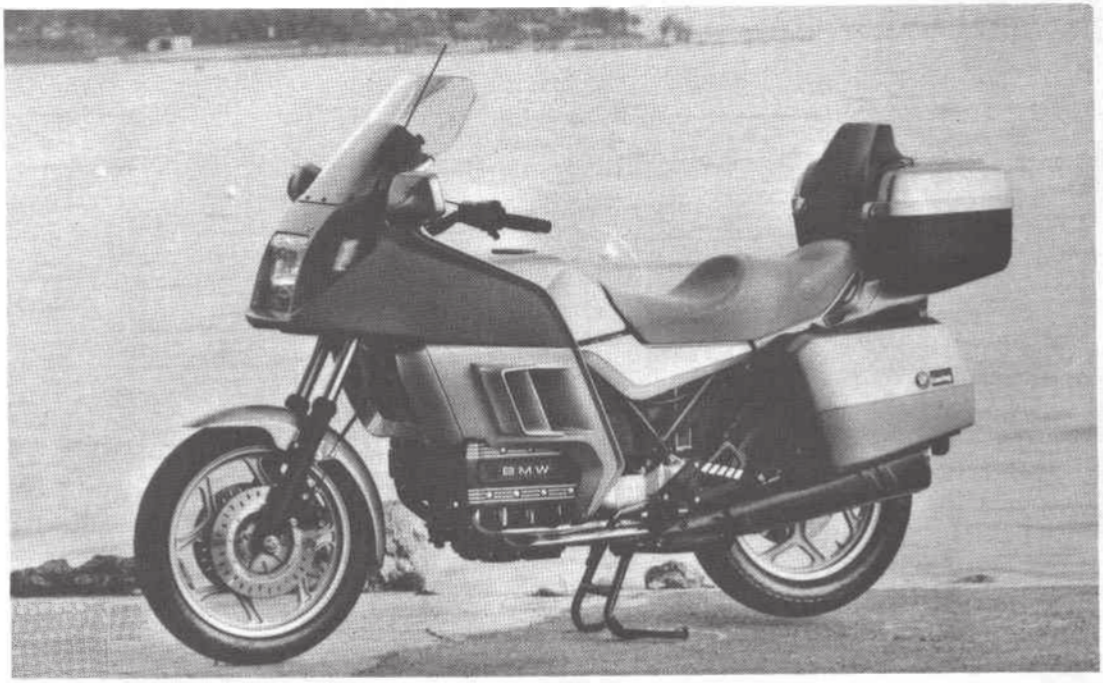
The K100 model



The K100 RS model



The K100 RT model



The K100 LT model

Model dimensions and weights

Overall width:	
K100 RS	800 mm (31.5 in)
K75 S	810 mm (31.9 in)
All other 75 models	900 mm (35.4 in)
K100 RT, K100 LT	920 mm (36.2 in)
K100	960 mm (37.8 in)
Overall height:	
K75, K75 T	N/Av
K100	1155 mm (45.5 in)
K100 RS	1271 mm (50.0 in)
K75 S	1290 mm (50.8 in)
K75 C	1300 mm (51.2 in)
K100 RT, K100 LT	1460 mm (57.5 in)
Seat height – unladen	810 mm (31.9 in)
Overall length	2220 mm (87.4 in)
Wheelbase – with rider weighing 165 lb (75 kg) seated	1511 mm (59.5 in)
Ground clearance – with rider weighing 165 lb (75 kg) seated	150 mm (5.9 in)
Kerb weight-machine with full fuel tank, tools etc:	
K75 T	N/Av
K75, K75 C	503 lb (228 kg)
K75 S	518 lb (235 kg)
K100	527 lb (239 kg)
K100 RS	558 lb (253 kg)
K100 RT	580 lb (263 kg)
K100 LT	624 lb (283 kg)
Gross weight limit – total of machine, passenger(s) and luggage:	
75 models, early 100 models	992 lb (450 kg)
Late 100 models (including all K100 LT)	1058 lb (480 kg)

Note: *100 models only – refer to machine's handbook, to the plate riveted to the frame, and/or label under seat for precise details. The weight limit was altered early in 1985 but a higher limit may be used* **only** *if the maximum axle loads of 441 lb/200 kg (front) and 694 lb/315 kg (rear) are not exceeded and that suitable tyres (see Chapter 9 Specifications) are used. If in doubt, check with a BMW dealer or the importer.*

Ordering spare parts

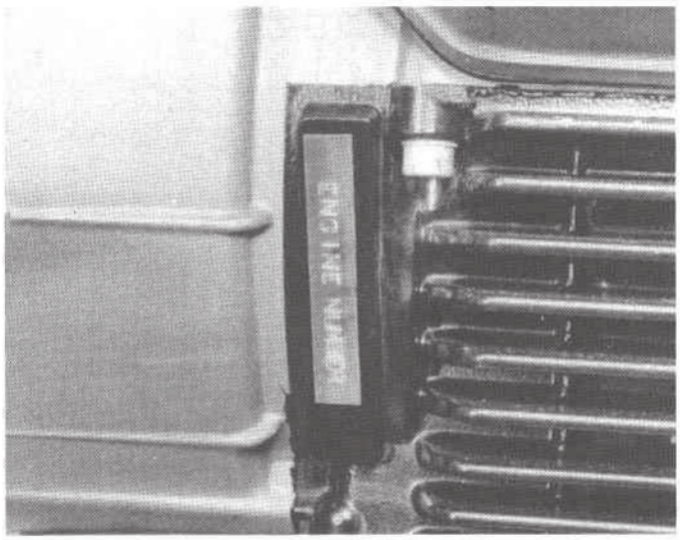
When ordering replacement parts, it is essential to identify exactly the machine for which the parts are required. While in some cases it is sufficient to identify the machine by its title eg K100 RS, the modifications to some components mean that it is usually essential to identify the machine by its BMW **production** or model year eg 1986. The BMW production year starts in September of the previous calendar year, after the annual holiday, and continues until the following August. Therefore a 1986 K100 RS was **produced** at some time between September 1985 and August 1986; it may have been **sold** (to its first owner) at any time from September 1985 onwards. To avoid any further confusion, except in a few cases concerned with modifications, 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. Dates are given as precisely as possible where relevant in the text of this manual but care is usually required since some machines may well have been modified already.

The engine number is stamped into a rectangular block raised up at the rear right-hand side of the crankcase lower section, immediately in front of the bellhousing joint. The frame number is stamped into the right-hand frame tube that joins the rear suspension unit top mounting to the gearbox mounting. Note that the number is duplicated in the plate riveted to the same tube.

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



Location of frame number

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.

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

When using an electric power tool, inspection light etc which works from the mains, 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.

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 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, using the BMW tool kit, which is sufficient for all normal maintenance tasks. 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 *How to Choose and Use Car Tools* available from the publishers of this manual. Although, as its title implies, this publication is directed at car owners, the information given is equally applicable to motorcycle owners. 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. It should be noted, however, that many car accessory shops and the large department stores sell tools of reasonable quality at competitive prices. The best example of this is found with socket sets, where a medium-priced socket set will be quite adequate for the home owner and yet prove less expensive than a selection of individual sockets and accessories. This is because individual pieces are usually only available from expensive, top quality, ranges and whilst they are undeniably good, it should be remembered that they are intended for professional use.

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 1/2-inch drive type is purchased to begin with as although bulkier and more expensive than the 3/8-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 – 12 mm (thread size)
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
Set of feeler gauges
Brake bleeding kit
Continuity tester (dry battery and bulb) – see relevant text for possible uses
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 in two places inside the engine 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 in regular use in the motor trade and will therefore only be available in specialist tool shops or auto accessory 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 compressors – car type (see text)
Universal bearing puller
Micrometer set
Vernier calipers
Dial gauge set
Cylinder compression gauge
Vacuum gauge set
Multimeter – must be used with great care (see text)

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, locknut, 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 locknuts 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	1/4 in AF
0.276	7 mm
0.313	5/16 in AF
0.315	8 mm
0.344	11/32 in AF; 1/8 in Whitworth
0.354	9 mm
0.375	3/8 in AF
0.394	10 mm
0.433	11 mm
0.438	7/16 in AF
0.445	3/16 in Whitworth; 1/4
0.472	12 mm
0.500	1/2 in AF
0.512	13 mm
0.525	1/4 in Whitworth; 5/16 in BSF
0.551	14 mm
0.563	9/16 in AF
0.591	15 mm
0.600	5/16 in Whitworth; 3/8 in BSF
0.625	5/8 in AF
0.630	16 mm
0.669	17 mm
0.686	11/16 in AF
0.709	18 mm
0.710	3/8 in Whitworth; 7/16 in BSF
0.748	19 mm
0.750	3/4 in AF
0.813	13/16 in AF
0.820	7/16 in Whitworth; 1/2 in BSF
0.866	22 mm
0.875	7/8 in AF
0.920	1/2 in Whitworth; 9/16 in BSF
0.938	15/16 in AF
0.945	24 mm
1.000	1 in AF
1.010	9/16 in Whitworth; 5/8 in BSF
1.024	26 mm
1.063	1 1/16 in AF; 27 mm
1.100	5/16 in Whitworth; 11/16 in BSF
1.125	1 1/8 in AF
1.181	30 mm
1.200	11/16 in Whitworth; 3/4 in BSF
1.250	1 1/4 in AF
1.260	32 mm
1.300	3/4 in Whitworth; 7/8 in BSF
1.313	1 5/16 in AF
1.390	13/16 in Whitworth; 15/16 in BSF
1.417	36 mm
1.438	1 7/16 in AF
1.480	7/8 in Whitworth; 1 in BSF
1.500	1 1/2 in AF
1.575	40 mm; 15/16 in Whitworth
1.614	41 mm
1.625	1 5/8 in AF
1.670	1 in Whitworth; 1 1/8 in BSF
1.688	1 11/16 in AF
1.811	46 mm
1.813	1 13/16 in AF
1.860	1 1/8 in Whitworth; 1 1/4 in BSF
1.875	1 7/8 in AF
1.969	50 mm
2.000	2 in AF
2.050	1 1/4 in Whitworth; 1 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	3.5 – 4.5	25 – 33

Choosing and fitting accessories

Owners of BMW machines can choose from a range of factory-built or recommended options far greater than those offered by any other motorcycle manufacturer. While these are admittedly expensive, there are often advantages to purchasing BMW-built accessories which may not always be immediately apparent. For example, refer to the notes given in Chapter 7 concerning engine protection bars.

Reference to some of the more fully equipped models of the range, on which much equipment is fitted as standard, can give the owner an idea of what the practical advantages and disadvantages are in purchasing and fitting such equipment. BMW owners are also very ready to discuss their machines with other riders, particularly other BMW owners, whether current or prospective.

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 as fitted to the K75 C and K75 T models, and frame mounted fairings as fitted to the K75 S, K100 RS, K100 RT and K100 LT models. Obviously the comments in this sub-section do not apply to these models unless one is seeking a cheaper alternative to repair crash damage or to change the machine's appearance. Note however that BMW advise against the fitting of the RS or RT type fairing to standard K100 models with rigid engine front mountings.

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. Note, however, that great care must be taken to ensure that the instrument rubber mountings are installed as on the standard machine. See Chapter 7. 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 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. Note that BMW's own range of luggage, while expensive, is of extremely good quality and matches perfectly with their machines.

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, can be extremely useful items of equipment which may 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.

The design of these machines is such that only the smaller engine protection bar can be fitted that is manufactured specifically for the model in question. Some owners feel that certain types of bar can do more harm than good since the only possible lower mounting points are the tapped holes in the bottom of the crankcase lower section or sump (oil pan); it has been known for these castings to crack or for the mounting bosses to tear out under the leverage imposed by even the most gentle impact. Since the crankcase lower section can only be renewed as part of the main cylinder block/crankcase casting, this means that the engine must be completely stripped and rebuilt or some extremely intricate (and therefore expensive) welding repairs carried out. BMW's own engine protection bars are fully rubber-mounted to minimise the chance of this happening, but it is felt by some that the simplest answer is not to fit crashbars at all; the engine unit is extremely strong in its own right, and the outer covers can be renewed separately if scarred or broken.

If any bars other than BMW's own are to be fitted, check that they are of well-finished heavy gauge tubing with strong mounting brackets. On machines with rubber bushes at the engine front mountings, ensure that the bar mountings do not inhibit the free movement of the mountings. If the right-hand rear mounting is attached to the bellhousing mounting point, ensure the bolt is refitted as described in Chapter 1 to provide a good earth point.

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 improve its appearance, or to find a cheaper alternative to the manufacturer's original equipment exhaust system.

Owners in search of more performance should note the they are not likely to gain a noticeable increase in power merely by changing the exhaust system. 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 onwards. Note that while the standard fuel and ignition systems appear to be capable of handling wide-ranging engine modifications, even turbo-charging, it is not easy to alter their settings should this be necessary; for example the fuel/air mixture ratio can be altered only at the airflow meter bypass screw and even this is only really effective at idle speed. All other settings are programmed into the ignition or fuel injection control units. Finally, note that raising the gearing to take advantage of any power increase would be impossible (using available components) on K100 RS models and extremely expensive on all others. The exhaust system manufacturer should be able to advise owners of any necessary changes; if not, that make should be avoided and a better quality one should be selected instead.

Owners wishing to change their exhaust for any other reason should first of all check that the replacement complies with all relevant legislation (whether current or pending) and that it is clearly marked to show this. The constraints imposed upon exhaust system designers by such legislation mean that there is very little to choose between the original equipment and aftermarket item except is appearance; the noise levels, power outputs, size and weight will all be similar. The standard exhaust, being made of stainless steel, should last much longer than usual and is not excessively bulky or heavy; owners should be careful to ensure that any aftermarket exhaust is at least as good as the standard system in these respects.

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 tightening the retaining nuts 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 torque settings are available, these should be used.

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 additional lighting at the front and rear to 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. While the alternator should be more than adequate, it may be advisable to replace the standard battery with the 30 Ah optional item. Also check that the equipment is compatible with the standard electrical system components; for example suppressors fitted to cure radio interference may well overload the ignition system, causing misfires or even component failure. Always seek expert advice before attempting to install additional electrical equipment. Another 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 motocycle 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

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1 Introduction

This Section provides an easy reference-guide to the more common faults 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.

Note: *If a fault is thought to lie in the fuel or ignition systems, the simplest solution may well be to take the machine immediately to an authorised BMW dealer for attention. Refer to Chapter 5 or 6 as appropriate, but always check all other possible causes first, eg a misfire can also be caused by dirty fuel. Items such as dragging brakes or under-inflated tyres should not be overlooked.*

Starter motor problems

2 Starter motor not rotating

- Engine stop switch off.
- Fuse blown. Check fuse number 1 located behind the left-hand side panel.
- 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.
- Load-shedding relay faulty. If the ancillary circuits are not cut off when the starter motor is operating the current drain may be sufficient to prevent the motor from rotating. Renew the relay.
- Neutral gear not selected.
- Faulty neutral indicator switch or clutch interlock switch. 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 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

- Starter motor clutch defective. Suspect jammed or worn engagement rollers, plungers and springs (early 100 models) or locking sprags (all other models). Note particularly that clutch may be rendered inoperable by build-up of oily sludge, in which case stripping and flushing out is required. Modified components may be available to effect a more permanent solution. Refer to Chapter 1 for more details.
- Damaged starter motor drive train. Inspect and renew components 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 engine

- No fuel or insufficient fuel in tank.
- Fuel pump faulty. Check first fuse number 6, located behind the left-hand side panel, then fuel injection relay before suspecting pump. Refer to Chapter 5 and/or 10.
- Tank filler cap air vent obstructed. Usually caused by dirt or water. Clean the vent orifice.
- Fuel 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. Renew the filter and clean the pump gauze strainer. 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

- If fuel is present under pressure in the rail but not reaching the intake port then either the injector is blocked or faulty of there is a fault in the fuel or ignition system components. Take the machine to an authorised BMW dealer for testing.

7 Engine flooding

- Flooding of the engine itself can be caused only by dirt jamming an injector open. Renew the injector and clean out the fuel system.
- An excessively rich mixture can only be caused by a fault in the fuel injection control unit, although it is possible for a faulty temperature sensor to cause the control unit to carry on feeding a rich mixture to the engine when it is fully warmed up.

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.
- Load shedding relay faulty, causing same symptoms as above. Renew the relay.
- 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 plugs thoroughly and reset the electrode gaps. Refer to the spark plug section and the colour

condition guide in Routine Maintenance. If a 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 caps fit securely over the plug and, where fitted, the screwed terminal on the plug ends are 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 6.

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 to 3. Check first the spark plug, this being the most likely culprit.

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 plugs and check that the threads in the cylinder head are not damaged. Check also that the plug sealing washers are 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

- Fuel system fault. See Chapter 5.
- Ignition malfunction. See Section 9, 'Weak spark at plug'.
- Fuel contamination. Clean the filter and, where water is in evidence, drain and flush the fuel tank.
- Intake air leak. Check for security of the hose connections, and for cracks or splits in the hoses.
- 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 affect the mixture ratio adversely. 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 plugs fouled, faulty or incorrectly adjusted. See Section 8 or refer to Routine Maintenance.
- Spark plug caps or high tension leads shorting. Check the condition of both these items ensuring that they are in good condition and dry and that the caps are fitted correctly.
- Spark plug type incorrect. Fit plugs 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.
- Ignition timing incorrect. Check the ignition timing.
- 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.
- Ignition system fault. Refer to Chapter 6.

13 Fuel/air mixture incorrect

- Intake air leak. See Section 11.
- Mixture strength incorrect. Adjust idle mixture strength using airflow meter bypass screw.
- Fuel system fault. Refer to Chapter 5.
- 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.
- 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.
- Fuel system fault. Refer to Chapter 5, checking particularly the airflow meter and throttle butterfly assembly.
- Brakes binding. Usually caused by maladjustment 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 an 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 item 2.

18 Compression low

- See Section 10.

Knocking or pinking

19 General causes

- Carbon build-up in combustion chamber. After high mileages have been covered a 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. 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. Refer to fuel recommendation given in Chapter 5.
- 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.

Overheating

20 Firing incorrect

- Spark plug fouled, defective or maladjusted. See Section 8.
- 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.

21 Fuel/air mixture incorrect

- Idle speed mixture strength incorrect. Adjust airflow meter bypass.
- 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 hose connections, and for cracks and splits in the hoses.
- 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.

23 Miscellaneous causes

- Radiator fins clogged, or other cooling system fault. Refer to Chapter 4.

Clutch operating problems

24 Clutch slip

- No clutch lever play. Adjust clutch according to the procedure in Routine Maintenance.
- Clutch plate worn or warped. Overhaul clutch assembly, replacing plate if necessary. See Chapter 2.
- Pressure or cover plates worn or warped. Overhaul clutch assembly, replacing plates if necessary. See Chapter 2.
- Clutch spring broken or worn. An old or heat-damaged (from slipping clutch) spring should be replaced with a new one.
- 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 piston. Replace parts as necessary.
- 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 release mechanism. See 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).
- Engine output shaft not properly located. Endfloat will permit movement of the clutch housing which may cause clutch drag. See Chapter 1.
- Loose clutch housing nut. See above. Tighten as described in Chapter 2.

Gear selection problems

26 Gear lever does not return

- Weak or broken spring. Renew the spring.
- Gearchange shaft bent or seized. Distortion of the gearchange shaft often occurs if the machine is dropped heavily on the gear lever. Provided that damage is not severe straightening of the shaft is permissible.

27 Gear selection difficult or impossible

- Clutch not disengaging fully. See Section 25.
- Gearchange shaft bent. This often occurs if the machine is dropped heavily on the gear lever. Straightening of the shaft is permissible if the damage is not too great.
- Gearchange arms 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.

● Selector claw arm spring broken. Renew spring.
● Gearchange drum detent cam or plunger damage. Failure, rather than wear, of these items may jam the drum thereby preventing gearchanging. The damaged items must be renewed.
● Selector forks bent or seized. This can be caused by dropping the machine heavily on the gearchange lever or 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 gearchange drum 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

● Detent plunger assembly worn or damaged. Wear of the plunger 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, gearchange drum 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.
● Bent gearchange shaft. Often caused by dropping the machine on the gear lever.
● 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

● Claw arm spring weak or broken. Renew the spring.
● Detent plunger worn or broken. Renew the damaged items.
● Detent roller arm spring worn or broken. Renew the spring.
● Selector claw arm ends worn. Repairs can be made by welding and reprofiling with a file.
● Selector limiter claw components 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 or partial seizure. 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. Either fit new pistons or renew the cylinder block.
● 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.
● Camshaft or cylinder head worn or damaged. The camshaft lobes are the most highly stressed of all components in the engine and are subject to high wear if lubrication becomes inadequate. The bearing surfaces on the camshaft and cylinder head are also sensitive to a lack of lubrication. Lubrication failure due to blocked oilways can occur, but neglect of oil changes and of topping-up is the usual cause.
● Worn camshaft drive components. A rustling noise or light tapping can be emitted by a worn cam chain or worn sprockets and chain. If uncorrected, subsequent cam chain breakage may cause extensive damage. The worn components must be renewed before wear becomes too far advanced.

33 Other noises

● Big-end bearing wear. A pronounced knock from within the crankcase which worsens 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. Renew the worn bearings and carry out a very careful examination of the crankshaft.
● Crankshaft excessively out of true. A bent crank may result from over-revving or damage from an upper cylinder component or gearbox failure. Damage can also result from dropping the machine on the right-hand side. Straightening of the crankshaft is not possible in normal circumstances; a replacement item should be fitted.
● 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 into the cam chain tunnel or oil return passages will increase crankcase pressure and may cause oil leakage at joints and oil seals. Also, oil contamination will be accelerated. 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.
● Loose clutch housing nut or cover plate bolts. Retighten securely. See Chapter 2.

35 Transmission noise

- Bearing or bushes worn or damaged. Renew the affected components.
- Gear pinions worn or chipped. Renew the gear pinions.
- Metal chips jammed 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.

Exhaust smokes excessively

36 White/blue smoke (caused by oil burning)

- Cloud of smoke released upon starting, especially if machine has been parked on side stand or if engine is still warm. This appears to be a characteristic possessed by all K-series BMWs to a greater or lesser extent, but should reduce considerably as the pistons and rings bed in. Provided little or no oil is used, there is nothing that can be done about this, other than to use the centre stand at all times. If oil consumption is significant, or increases suddenly, a full engine strip will be required to investigate the cause.
- Piston rings worn or broken. Breakage or wear of any ring, but particularly an oil control ring, will allow engine oil past the piston into the combustion chamber. Overhaul the cylinder block and pistons.
- Cylinder block cracked, worn or scored. These conditions may be caused by overheating, lack of lubrication, component failure or advanced normal wear. The cylinder block should be renewed.
- Valve oil seal 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 oil seals and, if necessary, the valve guides.
- Valve guides worn. See the preceding paragraph.
- Engine oil level too high. This increases the crankcase pressure and allows oil to be forced past the piston rings. Often accompanied by seepage of oil at joints and oil seals.
- Cylinder head gasket blown between cam chain tunnel or oil return passage. Renew the cylinder head gasket.
- 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)

- All items as for Section 7.

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).
- Engine oil screen clogged. Change oil and filter and service pickup screen. See Routine Maintenance and/or Chapter 5.
- Engine oil level too low. Inspect for leak or other problem causing low oil level and add recommended lubricant. See Routine Maintenance.
- Engine oil viscosity too low. Very old, thin oil, or an improper weight of oil used in engine. Change to correct lubricant.
- Camshaft or journals worn. High wear causing drop in oil pressure. Replace cam and/or head. Abnormal wear could be caused by oil starvation at high rpm from low oil level, improper oil weight or type.
- Crankshaft and/or bearings worn. Same problems as paragraph 5. Overhaul lower end (Chapter 1).
- Relief valve stuck open. This causes the oil to be dumped back into the sump. Repair or replace. (See Chapter 5.)

39 Electrical system failure

- Oil pressure switch defective. Check switch according to the procedures in Chapter 10. Replace if defective.
- Oil pressure indicator lamp wiring system defective. Check for pinched, shorted, disconnected or damaged wiring (Chapter 10).

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. Difficulty 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 if adjustment does not cure the fault.
- 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.
- Wheel bearings worn. Renew the worn bearings.
- 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. 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 spindle 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 fork yokes. A light impact, for instance with a pot-hole or low curb, can twist the fork legs in the 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.
- Wheel 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.
- Loose 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 the recommended type 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 7.
- 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.
- 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. 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 performance

- 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 8.
- Weak rear spring. If the suspension unit spring fatigues it will promote excessive pitching of the machine and reduce the ground clearance when cornering.
- 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.

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.
- Spring weak or broken. Makes a clicking or scraping sound. Fork oil will have a lot of metal particles in it.
- Steering head bearings loose or damaged. Clicks when braking. Check, adjust or replace.
- Fork yokes loose. Make sure all fork yoke pinch bolts are tight.
- Fork stanchion bent. Good possibility if machine has been dropped. Repair or replace tube.

47 Rear suspension noise

- Fluid level too low. Leakage of a suspension unit, usually evident by oil on the outer surface, can cause a spurting noise. The suspension unit should be renewed.
- Defective rear suspension unit with internal damage. Renew the suspension unit.

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 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 pedal improperly adjusted. Adjust the clearance between the pedal and master cylinder to take up lost motion, as recommended in Chapter 9.

49 Brakes drag – disc brakes

- Disc warped. The disc must be renewed.
- Caliper piston, caliper 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.
- Twisted caliper support bracket. This is likely to occur only after impact in an accident. Renew the caliper assembly.

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.
- Pad material incompatible. BMW state that some non-genuine brake pads are made of poor quality friction materials which cause excessive squeal; these should be avoided.
- Pad material. Friction material designed to cope with extreme temperatures may squeal at lower speeds, ie town use.
- 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. Inspect the pads for correct installation and security.

52 Brakes are spongy or ineffective – drum brakes

- 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 shoes as a pair if the linings are worn below the minimum thickness.
- 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.
- Brake components not centralised on wheel. See Chapter 9.
- Angle between operating lever and brake rod incorrect. See Routine Maintenance.

53 Brake drag – drum brakes

- Incorrect adjustment. Re-adjust the brake operating mechanism.
- Drum warped or oval. This can result from overheating or impact. 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 is normally the only satisfactory solution.
- Weak brake shoe return springs. This will prevent the brake shoes 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 pedal pulsates in operation – drum brakes

- Drum warped or oval. This can result from overheating or impact. 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 wheel 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.
- Return springs vibrating. See Chapter 9.

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 Section 50 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 Section.

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.
- Alternator failure.

58 Battery overcharged

- Alternator 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 frame main earth strap from the battery is securely affixed to the frame and is making a good contact.
- Ignition switch or power circuit failure. Check for current flow through the battery positive lead 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.

Routine maintenance

Specifications

Engine

Spark plugs	Bosch X5DC
Spark plug gap:	
Standard	0.6 – 0.7 mm (0.024 – 0.028 in)
Service limit	0.8 mm (0.032 in)
Valve clearances – engine cold (maximum coolant temperature 20°C/68°F):	
Intake	0.15 – 0.20 mm (0.006 – 0.008 in)
Exhaust	0.25 – 0.30 mm (0.010 – 0.012 in)
Idle speed	950 ± 50 rpm
Throttle and 'choke' cable free play	0.5 – 1.0 mm (0.02 – 0.04 in)
Clutch cable free play – at handlebar lever:	
75 models	2.0 – 2.5 mm (0.08 – 0.10 in)
100 models	4.0 – 4.5 mm (0.16 – 0.18 in)
Length of clutch inner cable at gearbox end	75 ± 1 mm (2.95 ± 0.04 in)

Cycle parts

Brake pad/shoe friction material minimum thickness	1.5 mm (0.06 in)	
Drum rear brake free play – at pedal tip	15 – 25 mm (0.6 – 1.0 in)	
Tyre pressures – tyres cold:	**Front**	**Rear**
75 models:		
Solo	29 psi (2.00 bar)	36 psi (2.50 bar)
Pillion	34 psi (2.30 bar)	42 psi (2.90 bar)
100 models:		
Solo	33 psi (2.25 bar)	36 psi (2.50 bar)
Pillion – up to 112 mph (180 km/h)	33 psi (2.25 bar)	39 psi (2.70 bar)
Pillion – above 112 mph (180 km/h)	39 psi (2.70 bar)	42 psi (2.90 bar)

Note: *information is correct at time of writing – check with machine's handbook or label on rear mudguard for updated information. Pressures apply to original equipment tyres only – check with BMW dealer/importer or tyre manufacturer or agent if non-standard tyres are fitted – pressures may vary.*

Recommended lubricants

Engine:	
Capacity - at oil and filter change	3.75 lit (6.6 Imp pint, 3.9 US qt)
Recommended oil	Good quality HD oil suitable for 4-stroke spark ignition engines. API classification SE or SF
Viscosity	See chart in Routine Maintenance
Gearbox and final drive case:	
Capacity:	
Gearbox	850 ± 50 cc (1.50 ± 0.09 Imp pint, 0.90 ± 0.05 US qt)
Final drive case	260 cc (0.46 Imp pint, 0.28 US qt)
Recommended oil	Good quality hypoid gear oil of API class GL-5 or to specification MIL-L-2105 B or C
Viscosity:	
Above 5°C (41°F)	SAE 90
Below 5°C (41°F)	SAE 80
Alternatively	SAE 80W90
Coolant	See Chapter 4
Fuel	See Chapter 5
Front forks:	
Capacity – per leg:	
K75 S, any model with 'S' suspension	280 ± 10 cc (9.86 ± 0.35 Imp fl oz, 9.47 ± 0.34 US fl oz)
K100, all other 75 models	330 ± 10 cc (11.62 ± 0.35 Imp fl oz, 11.16 ± 0.34 US fl oz)
K100 RS, K100 RT, K100 LT	360 ± 10 cc (12.67 ± 0.35 Imp fl oz, 12.17 ± 0.34 US fl oz)
Recommended oil	Use specified brands and types only – see Chapter 7
Brake fluid	DOT 4, eg ATE 'SL'
Splined couplings and joints, ie clutch plate, gearbox input shaft, final drive shaft	Staburags NBU 30 PTM compound, Optimol Paste PL or Uni Moly C 220 Slip Agent

Front wheel, steering head and swinging arm pivot bearings	Good quality high melting-point lithium fibre-based grease, eg Shell Retinax A
Fluidbloc steering head damper	Silicone grease **only** eg 'Silicone Grease 300 Heavy'
All other greasing points	As wheel bearing type
Battery terminals	Petroleum jelly (Vaseline) or acid-free grease eg Bosch Ft 40 V1
Control cable nipples and all other pivots	Engine oil or light machine oil
Control cables	Nylon lined – if lubrication is considered necessary use only suitable lubricant

Introduction

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:

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 5000 miles (7500 km)

Service intervals – time:

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

Additional recommendations:

Engine oil – in normal use the engine oil should be changed every six months at the latest. If the engine 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.

Final drive case 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.

Coolant – must be changed every two years at least.

Fuel filter – must be renewed every 20 000 miles (30 000 km) in normal use, ie every second major service, but if the fuel is dirty or of poor quality it must be renewed at every major service.

Wheel and steering head bearings – if conditions are very severe these bearings and the twistgrip must be cleaned and packed with new grease every 20 000 miles (30 000 km). Refer to the relevant Sections of Chapters 7 and 9.

Battery – should be checked at least every three months.

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

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.

Cleaning is especially important during the winter months despite its appearance of being a thankless task which very soon seems pointless. On the contrary, it is at this time that the paintwork, chromium plating, and the alloy casings suffer the ravages of abrasive grit, rain and road salt. A couple of hours spent weekly on cleaning the machine will maintain its appearance and value, and highlight small points, like chipped paint, before they become a serious problem.

Use a sponge and copious amounts of warm soapy water to wash surface dirt from these components. Remove oil and grease with a solvent such as 'Gunk' or 'Jizer', working it in with a stiff brush when the component is still dry and rinsing it off with fresh water. Be very careful to keep water away from the air intake, the brakes, wheel bearings, steering head and swinging arm pivot bearings, gearbox and final drive case breathers and all electrical components; never direct the jet from a hose or similar directly on to any of these vulnerable components. When the wash is finished, lean the machine on its side stand and shake it lightly until any water gathered on top of the crankcase has escaped through the drain channel provided; this is to avoid the cloud of steam that will be generated if engine heat is used to dry out the machine. If moisture is concentrated around the electrical components in this way, electrical faults through short circuits and corrosion will soon follow; BMW recommend that all electrical connectors are unplugged and coated at least once a year with a water dispersant lubricant or corrosion inhibitor such as WD40 or CRC5-56. See Chapters 5 and 6.

Apply wax polish to the painted components and those which are chromed. Keep the control cables well sealed to prevent the ingress of water and wipe the machine down if used in the wet.

Do not use strong detergents, scouring powders or any abrasive when cleaning plastic components; anything but a mild solution of soapy water may well bleach or score the surface. On completion of cleaning, wipe the component dry with a chamois leather. If the surface finish has faded, use a fine aerosol polish to restore its shine.

Note: while it is realised that cleaning a machine is quickest and most effective if carried out using a pressure washer, steam cleaner or even a very powerful hose, the very real disadvantages of such usage should be pointed out. Quite apart from the rapid deterioration of the finish of plastic components caused by the scouring action of caked-on dirt being blasted off, the operating pressure of such machines is high enough to force a mixture of dirt and water past oil seals etc and into the bearings, brakes, forks and suspension unit, causing their premature failure unless great care is taken to dismantle, clean and lubricate all cycle parts after cleaning. If cleaning must be carried out in this way, be very careful both when cleaning and afterwards; check also that the jet is also directed away from the fuel tank filler cap, the gearbox and final drive case breathers and from the handlebar switches and other electrical components.

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 Sections of Chapter 9 and of this section. 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.

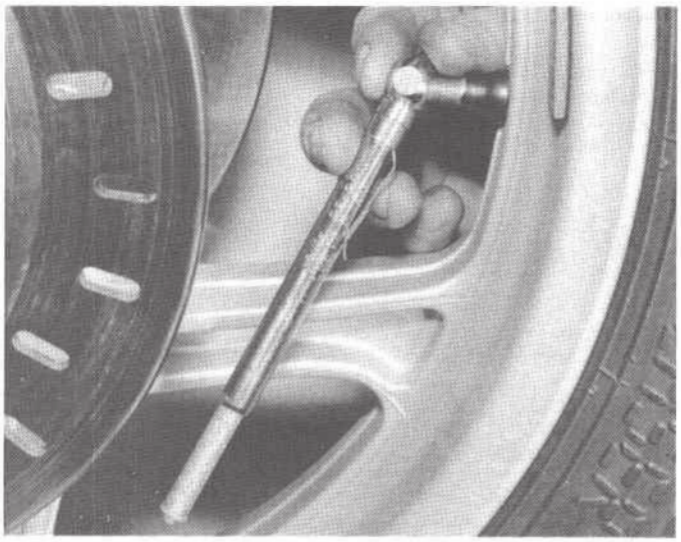
If new tyres are to be fitted, they must be of the correct size and speed or load rating, as listed in the Specifications Section of Chapter 9. However great care must be taken when choosing new tyres. First check with the importer or a good local BMW dealer what types of currently-available tyre are 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. Finally note the new pressures (if different) at all loads and speeds and keep this with the machine.

2 *Check the engine oil level*

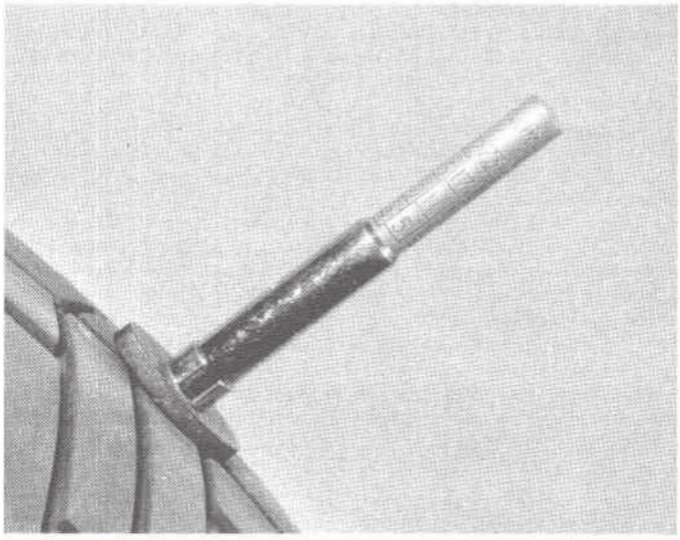
The engine must have been stopped for a few minutes so that the level settles before it can be checked accurately. If the engine is cold, warm it up to normal operating temperature, then switch off and wait before checking the level. With the machine on its centre stand, on level ground, check the oil level as seen in the sight glass set in the right-hand side of the crankcase lower section. The maximum and minimum level marks are indicated by imaginary horizontal lines drawn through the top and bottom of the circle marked on the glass; the oil level should be maintained between these marks; ie somewhere in the circle, at all times. Never run the engine with the level below the circle or above it; both conditions can lead to engine damage.

If topping-up is required, remove the filler plug from the rear end of the engine right-hand outer (crankshaft) cover and add the required amount of oil; it will take approximately 0.6 litre (1.06 Imp pint, 0.63 US qt) to fill the crankcase from minimum to maximum. 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.

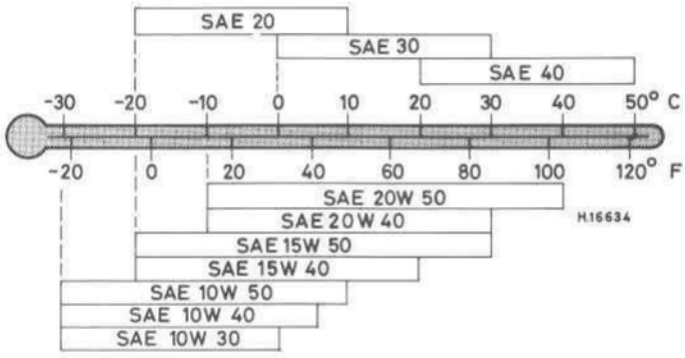
Note: In normal use the sight glass will be self-cleaning, but if the machine is used only in cold weather, or infrequently, or for very short journeys only, the glass will become obscured by deposits of emulsified sludge. The only way to avoid this is to take the machine regularly on a journey of sufficient length to warm it up thoroughly; this will evaporate the moisture from the oil and should clean the glass.



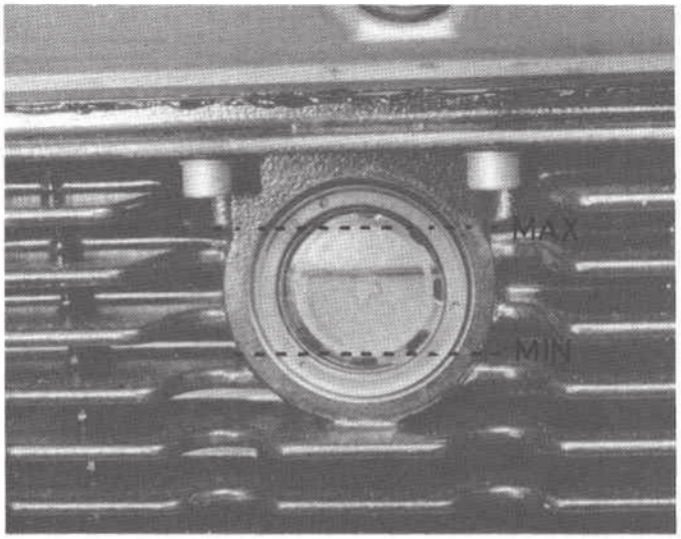
Use only an accurate gauge to check tyre pressures



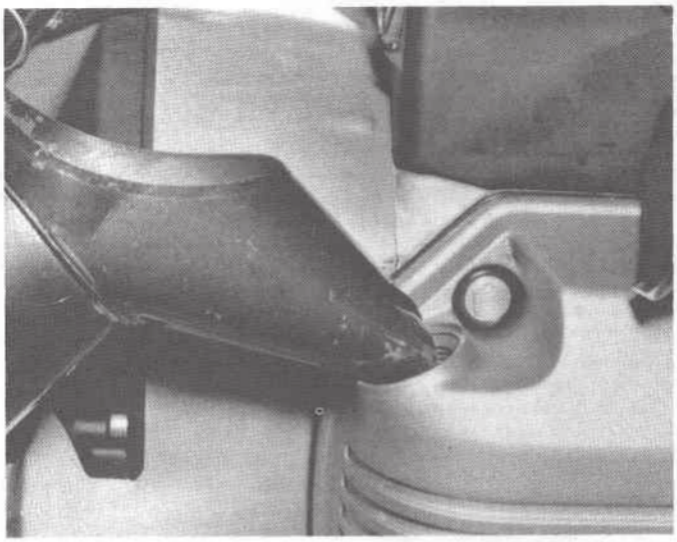
Tread depths are measured at centre of tread



Engine oil viscosity selection chart



Engine oil level must be maintained between maximum and minimum level lines



Use only good quality engine oil of specified type when topping up

If this is not possible, the engine oil must be changed at more frequent intervals (see additional recommendations) to keep it and the engine clean; note that the starter clutch may slip on early models if the sludge deposits are allowed to build up too much.

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. Be very careful not to allow dirt or water into the fuel tank, particularly when opening the filler cap, and never fill the tank to the brim; always leave a space at the top to allow for fuel expansion under engine heat. Owners of US models should note that the flap beneath the filler cap is fitted to prevent the tank from being overfilled; the flap must never be removed or modified. See Chapter 5. Note carefully the recommendations given in Chapter 5 concerning types and grades of fuel, and never use additives of any sort.

4 *Check the coolant level*

Since the coolant level varies with engine temperature, it must be checked only when the engine is cold. The expansion tank situated beneath the left-hand side panel has a level tube of clear plastic mounted on its front end with 'Maximum' and 'Minimum' level marks on the tank itself. If the level of coolant in the tube is below the minimum level mark, the tank should be topped up to the maximum mark by removing the filler cap and adding the specified type of coolant. See Chapter 4.

If the coolant requires repeated topping-up, the reason for the loss should be investigated as described in Chapter 4; only very small losses should occur in normal use. If the level tube is so discoloured that the coolant level cannot be seen, it should be renewed and the system should be refilled using the specified, nitride-free, antifreeze.

5 *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. See Chapter 10.

6 *Check the brakes*

Check that the front and rear brakes work effectively and without binding. Ensure that the rod linkage (where applicable) is 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.

7 *Check the controls*

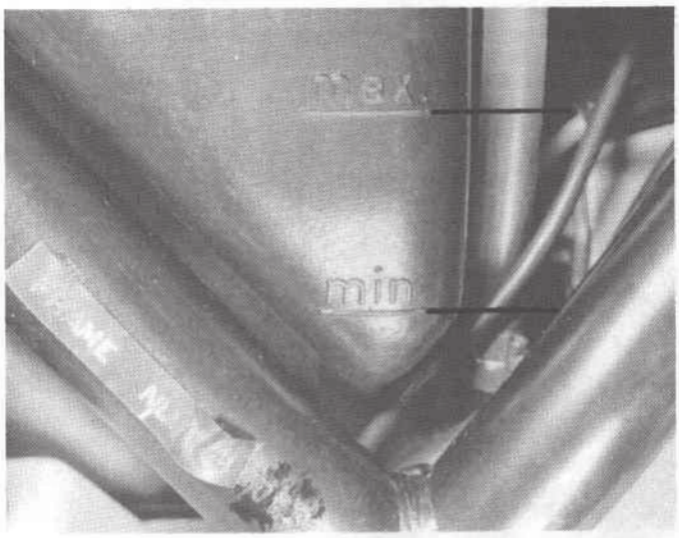
Check the throttle and clutch cables and levers and the gear lever to ensure that they are adjusted correctly, functioning correctly, and that they are securely fastened. If a bolt is going to work loose, or a cable snap, it is better that it is discovered at this stage with the machine at a standstill,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

8 *Rear suspension settings*

Except for machines with Nivomat rear suspension, ensure that the spring preload adjuster is at the correct setting for the machine's intended load.

9 *Check the tightness of all nuts and bolts*

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



Coolant level must be maintained between expansion tank level lines – check only when engine is cold

10 Check the battery

The battery must be checked regularly, at least every three months. If a quick check is being made, it is only necessary to unlock and raise the seat and to remove both side panels (see Chapter 7). If the terminals are being checked or the cells topped up the storage tray and fuel injection control unit must be removed as well, as described in Chapter 5. To remove the battery completely, unlock and raise the seat, remove both side panels and withdraw the storage tray and fuel injection control unit. Disconnect the battery terminals (negative terminal first, always) and vent tube, then remove the two long screws securing the battery retaining strap to the battery tray. Withdraw the strap, noting that this will release the coolant expansion tank which must be secured out of harm's way. Tilt the battery backwards and withdraw it upwards and to the rear.

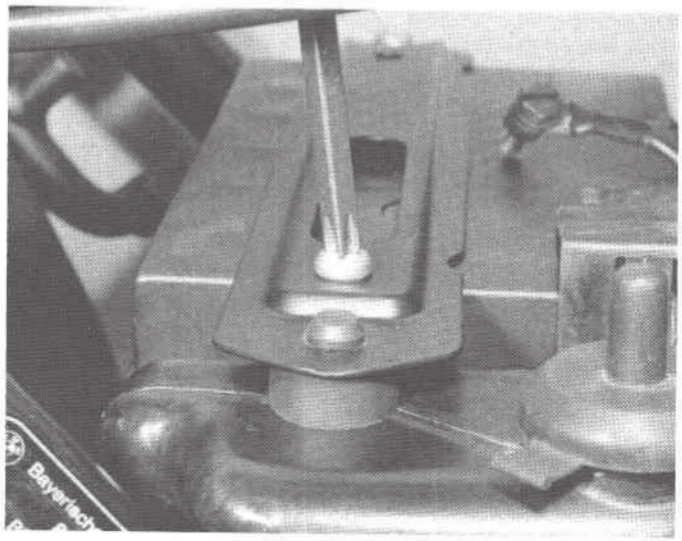
On refitting, insert the battery carefully, with its terminals to the front, and settle it on the rubber pads on the tray. Route the vent tube through the hole at the base of the rear mudguard and check that it is clear, with no blockages or kinks, and that it hangs down well clear of any other component particularly the rear wheel or exhaust system. Position the coolant expansion tank on its mountings and refit the battery retaining strap; tighten the retaining screws securely but do not overtighten them or the battery will be cracked. Check that the terminals are scraped clean and coated with the specified acid-free grease to prevent corrosion, then reconnect the positive (+ve) terminal first, followed by the negative (–ve). Tighten the terminal nuts and bolts securely and refit their covers.

To check the electrolyte level, position the machine so that the battery is level. Where level marks are provided on the battery casing ensure that the electrolyte level is between the marks; if not the level in each cell must be between 5 – 10 mm (0.2 – 0.4 in) below the black plastic top. If topping-up is necessary, remove the battery retaining strap and use a coin or similar to unscrew each cell cover plug. Use only distilled water to top up to the maximum level mark, then refit the cell cover plugs and retaining strap.

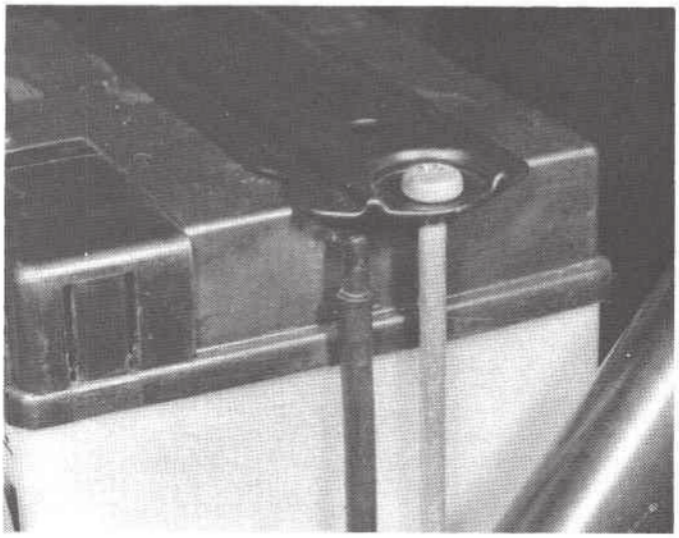
Check that the vent tube is clear and that it has no kinks or blockages, also that it hangs well clear of any other component (see above). If the terminals are loose or corroded, disconnect them (negative terminal first, always) and scrape them clean. On refitting, apply a coat of petroleum jelly or acid-free grease to each to prevent corrosion and tighten the retaining nuts and bolts securely.

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 spares are available on the machine should the need arise.

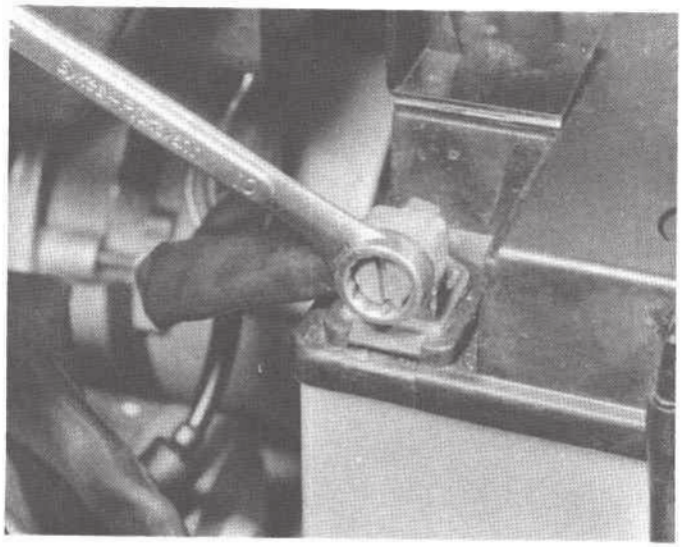
At regular intervals remove the battery and check that there is no pale grey sediment deposited at the bottom of the casing. This is caused by sulphation of the plates as a result of re-charging at too high a rate or as a result of the battery being left discharged for long periods.



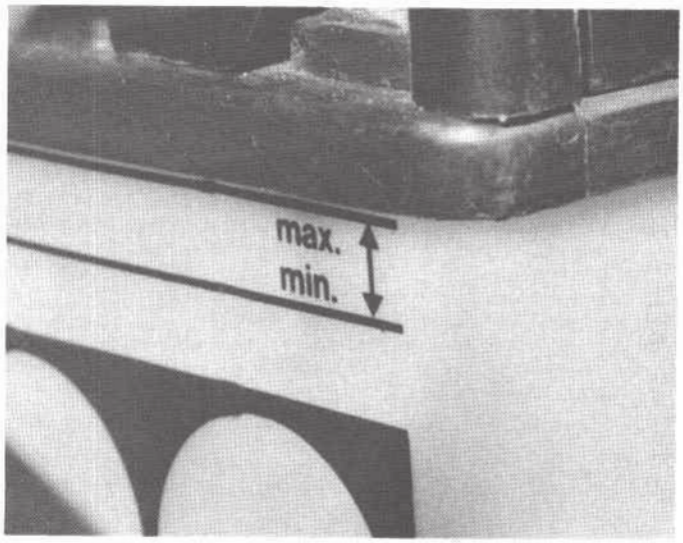
Battery (and coolant expansion tank) is retained by a single strap – unscrew securing screws to release



Ensure vent tube is free from blockages or kinks on refitting



Battery terminals must be completely clean and securely fastened at all times



Electrolyte level must be maintained between level lines on battery casing

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 10.

1 Minor service

1 Change the engine oil and filter

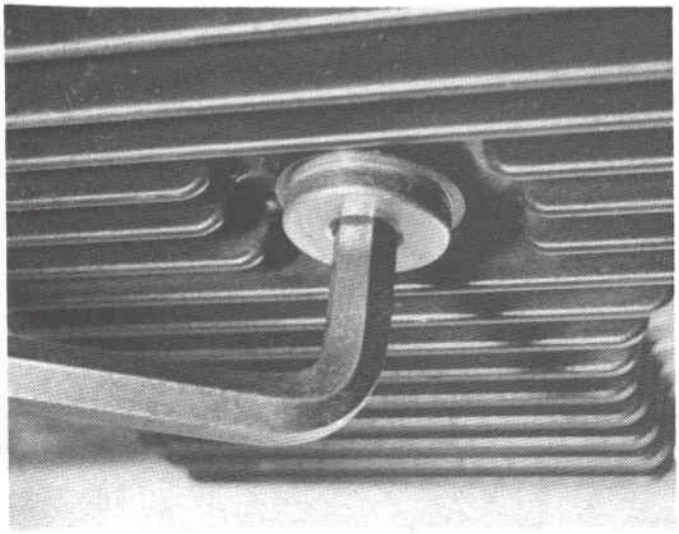
Oil changes will be much quicker if the machine is first ridden far enough to warm up the engine to normal operating temperature: this will thin the oil and ensure that any particles of dirt or debris will be retained in suspension in the oil and flushed out with it.

Place the machine on its centre stand on level ground, place a container of at least 4 litres (approx 7 Imp pints, 4 US qts) beneath the crankcase. Unscrew the filler plug from the engine right-hand outer (crankshaft) cover, then use a suitable Allen key to unscrew the drain plug from the centre of the sump (oil pan). While the oil is draining into the container, clean the drain plug carefully, wiping any metal particles off its magnetic insert, and renew its sealing washer if it is worn, flattened or damaged.

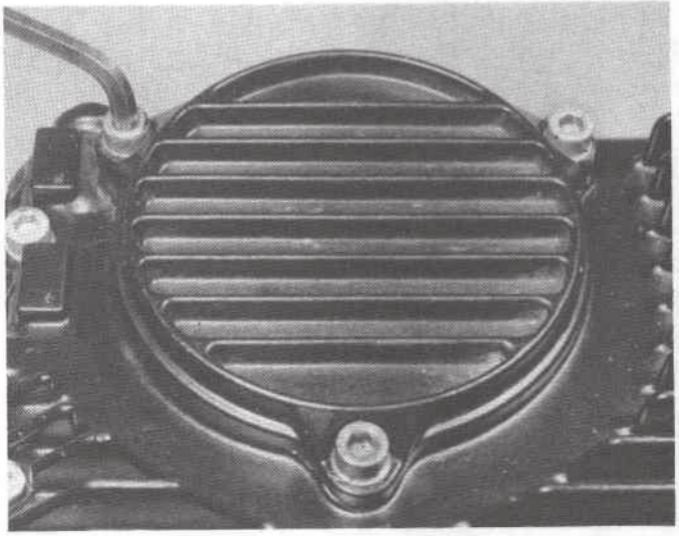
Remove the three retaining screws and withdraw the oil filter cover, noting the sealing O-ring. Wash the cover in a high flash-point solvent and renew the O-ring if it is worn or damaged.

Unscrew and discard the oil filter element. On very early 100 models the element had a hexagon form moulded into its lower end to permit fitting and removal, using a suitable spanner. However, it was overtightened by some owners to the point where the filter cracked or its seal failed under pressure, or even the crankcase lower section was cracked. The machining of the filter sealing surface was modified on later models to lessen the risk of this happening, and a modified filter element was introduced which has no hexagon and therefore requires a special tool, BMW part number 11 4 650 to fit and unscrew it. The tool is reasonably cheap and should be easily available from any authorised BMW dealer; in fact aftermarket versions of it are already available. If the tool is not available, the sump (oil pan) must be withdrawn (see Chapter 5) and the filter unscrewed using a strap wrench or similar car-type filter removal tool; if this is done the oil pump pick-up screen should be cleaned as described in Chapter 5. Note that none of the early type filters should now remain in service; all should have been replaced by the later modified type.

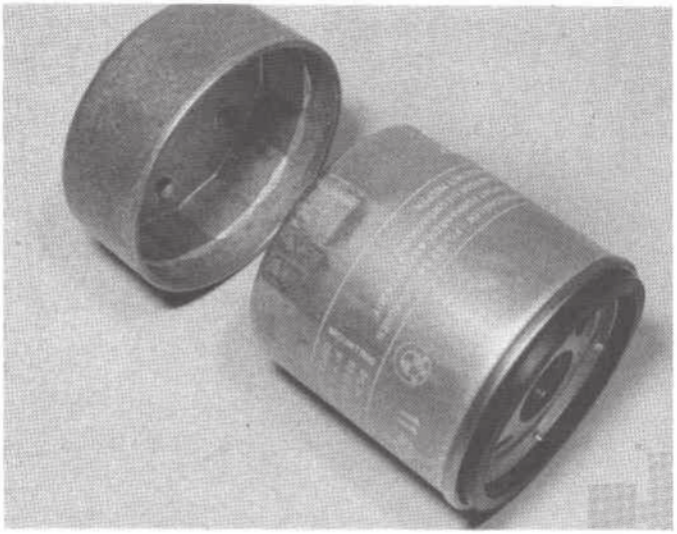
When all the old oil has drained, thoroughly, clean the filter sealing



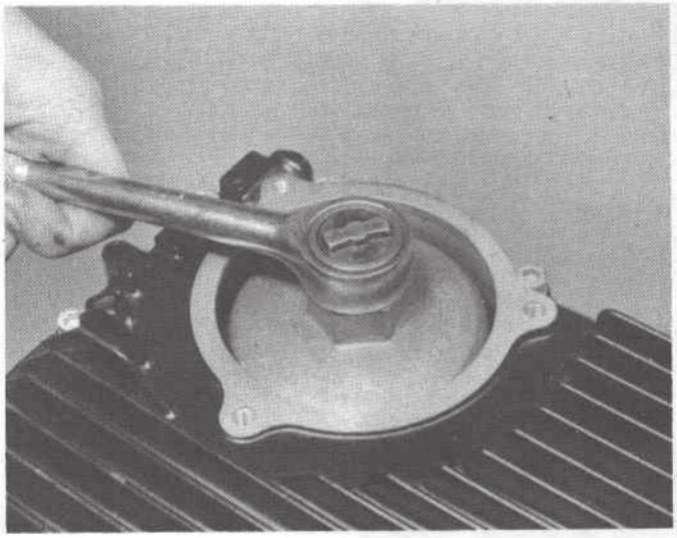
Unscrew drain plug from centre of sump (oil pan) to drain engine oil



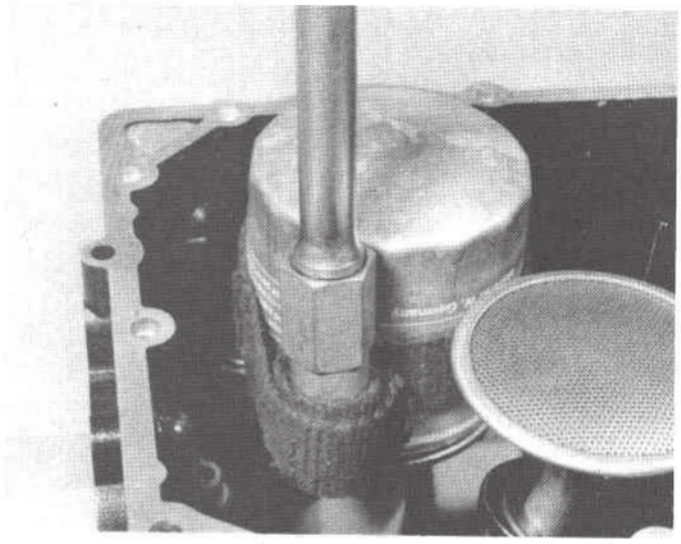
Engine oil filter is located inside separate cover bolted to sump (oil pan)



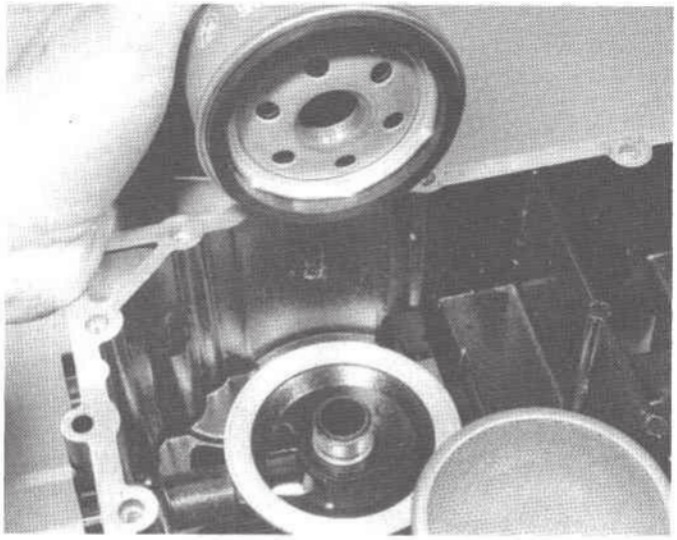
Oil filter element must be removed using a special tool which engages its shaped end ...



... and is unscrewed using a spanner or other tools as shown



If special tool is not available car-type filter strap wrench can be used as shown after sump (oil pan) has been removed

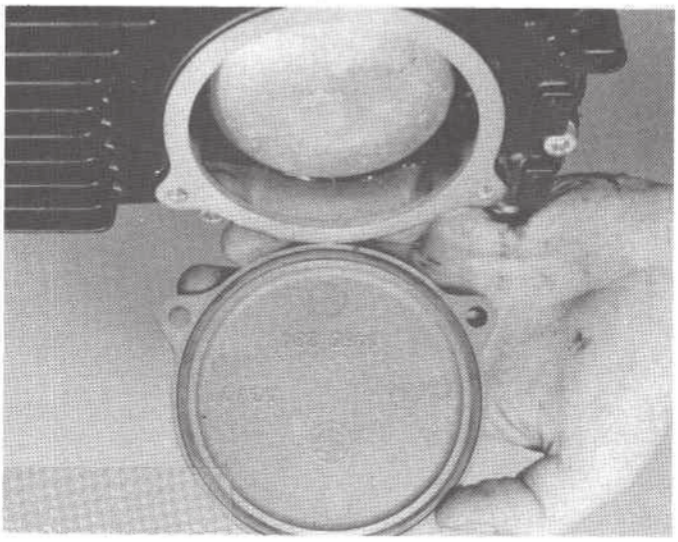


Fit filter element as described in text, being careful not to overtighten – note oil pump pick-up filter gauze, which must be cleaned whenever sump (oil pan) is removed

surface and apply a film of oil to the new filter's sealing ring. Screw the new element into place by hand only until it seats lightly, then tighten it by a **maximum** of half a turn. If tools other than the BMW special tool (or a pattern version of it) are being used, be very careful not to overtighten the filter element or to damage its casing as it is installed. Refit the sump (oil pan) as described in Chapter 5, if applicable. Ensuring that the sealing O-ring is correctly installed, refit the filter cover and tighten the retaining screws securely; use the specified torque wrench setting, where available. Ensuring that its sealing washer is correctly installed and its threads are clean and dry, refit the engine oil drain plug and tighten it securely to its specified torque wrench setting.

Fill the crankcase with the specified amount of the correct type and viscosity of engine oil, refit the filler plug, then start the engine and allow it to warm up to normal operating temperature to distribute the new oil fully around the engine. Stop the engine and wait a few minutes for the level to settle then check it and top up, if necessary, as described under the daily check heading. Wipe off any spilt oil, check that both filler and drain plugs (and other disturbed components) are securely and correctly refitted, and check subsequently for signs of oil leaks.

Note that whenever the sump (oil pan) is removed, the crankcase interior should be wiped clean with a lint-free cloth and the oil pump pick-up filter gauze should be cleaned. Refer to Chapter 5.

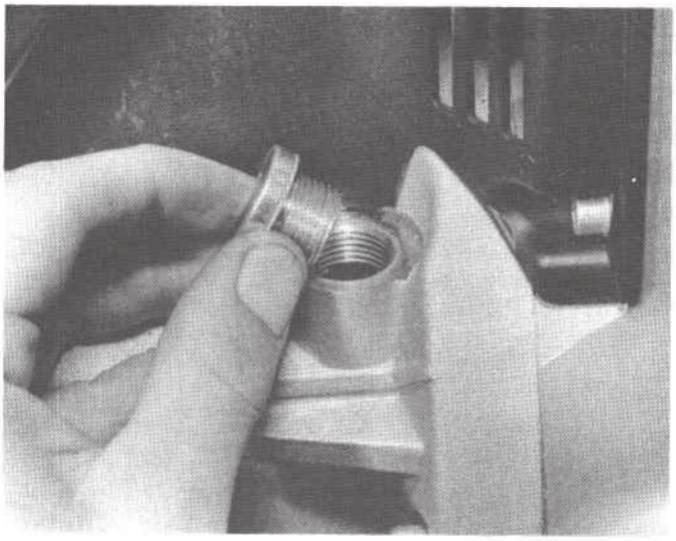


Check sealing O-ring is correctly installed when refitting filter element cover

2 *Check the gearbox oil level*

With the machine supported upright on its centre stand on level ground, remove the gearbox oil filler plug. The C-spanner provided in the machine's toolkit is also designed to serve as a dipstick for the gearbox. If the spanner, part number 71 11 2 300 061, is not available, it can be ordered from any authorised BMW dealer or a substitute can be fabricated from the dimensions shown in the accompanying illustration.

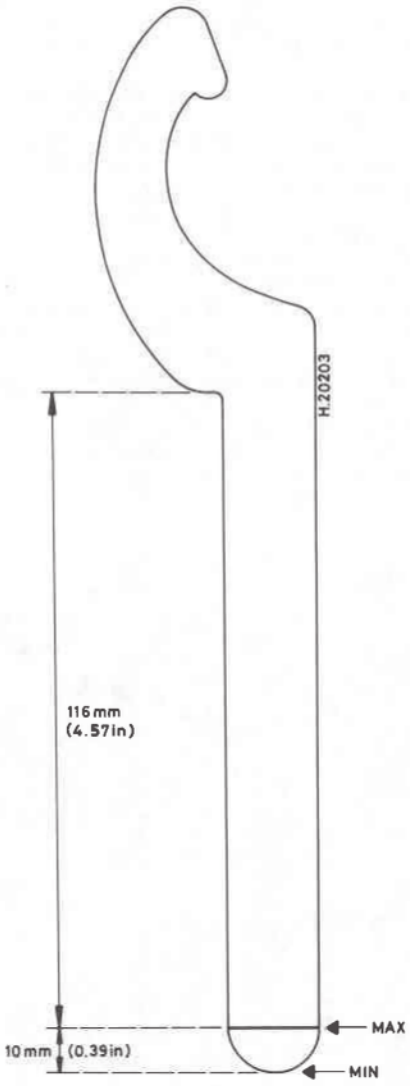
Insert the spanner into the gearbox filler orifice until the spanner's shoulder rests on the machined filler plug sealing surface. The oil level should be above the minimum mark formed by the spanner's bottom end, but below the maximum mark formed by the line etched across the spanner handle. Remove any surplus oil. 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 securely, to the specified torque setting (where given). Wash off any spilt oil.



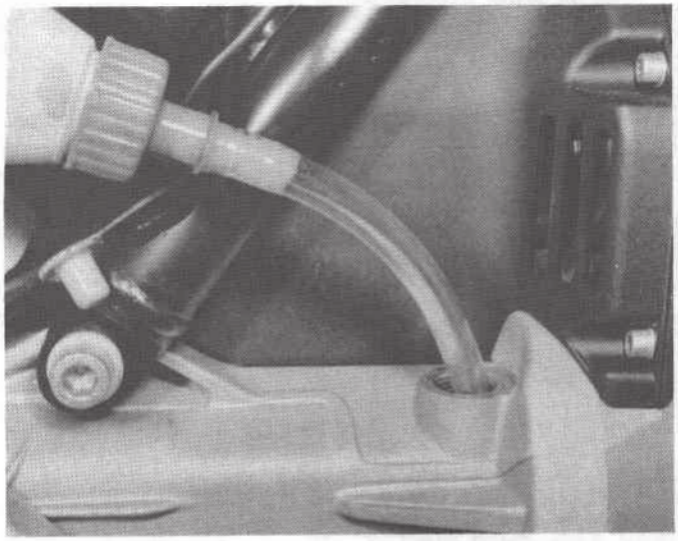
Remove gearbox filler plug to check oil level

3 *Check the final drive case oil level*

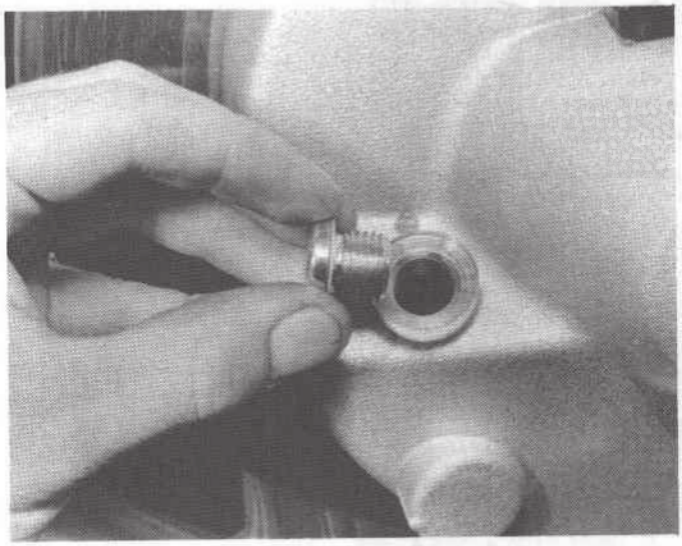
With the machine supported on its centre stand on level ground, remove the filler plug from the final drive case. The oil level should be up to the bottom thread of the filler plug orifice ie 12 mm (0.47 in) below the machined filler plug sealing surface – the filler plug must not



Gearbox oil level dipstick



Use only good quality oil of specifed type when topping up



Remove final drive case filler plug to check oil level

dip into the oil. Remove any surplus oil using a syringe or similar, to prevent oil being blown on to the rear tyre or brake components 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 securely to the specified torque setting (where given). Wash off any spilt oil from the housing and swinging arm.

4 Lubricate the controls and stand pivots

The front brake lever can be removed by unscrewing the locknut and unscrewing or tapping out (as applicable) the pivot pin or screw; withdraw the lever, noting the presence of any shims that may be fitted. The clutch lever can be withdrawn similarly, after the cable adjusters have been slackened and the cable end nipples have been withdrawn from their respective levers. Note that a slotted nipple retainer is fitted at the handlebar lever (also at the gearbox end on some models); this must not be allowed to drop clear and be lost.

To release the throttle cable, first remove the injector cover (where fitted), then rotate the cable pulley inwards and carefully disengage the cable end nipple from the pulley. Withdraw the cable from its stop on the throttle butterfly assembly and carefully pull it clear of the machine, noting exactly how it is routed; note particularly that the cable is routed over the top of the air filter top half/plenum chamber connecting hose. Removing the handlebar cover, if necessary, first withdraw the single screw clamping the right-hand switch cluster to the twistgrip assembly, then remove its single retaining screw and withdraw the twistgrip top cover, noting how its protruding tang locates with the twistgrip drum. Disconnect the cable end nipple from the slot in the block at the chain end, then withdraw the cable. On reassembly, grease liberally all twistgrip components, noting that the handlebar weights fitted to some models must be removed by slackening the screw which secures the expander bolt retaining system; be careful that the weight is not pushed so far against the twistgrip rubber on refitting that it drags and impairs free throttle movement. Before refitting the twistgrip top cover, align the mark on one of the twistgrip drum teeth with the line on the throttle pulley to ensure full throttle movement is available.

When refittng the throttle cable, be very careful to ensure that it is routed correctly with no kinks or sharp bends and that it does not foul or snag on any other component; check at all front fork positions. Particularly check that the outer cable does not foul the handlebar cover or any other component as it passes through the steering head area, also that there is a straight run from the outer cable stop on the throttle butterfly assembly to the cable pulley; it may be necessary to renew the stop, if this is bent out of true. Open the throttle and check

that it snaps quickly and easily shut at all handlebar positions. On some 1983 – 85 100 models (an authorised BMW dealer will have full details of the machines that may be affected) an additional earth wire should have been installed between the twistgrip/brake master cylinder assembly and the main frame earth point on the left-hand side of the frame top tube bracing gusset, to the rear of the steering head. If this wire is not installed and the stop lamp front switch should develop a short-circuit, since the handlebars are rubber-mounted and therefore insulated from the rest of the machine, the switch may earth through the throttle cable inner wire, causing it to heat up and drag on the outer cable. If in any doubt about the throttle operation, have the machine checked by an authorised BMW dealer.

To remove the choke (fast idle) control cable slacken its locknut and unscrew the cable adjuster at its lower end, then release the cable end nipple from the butterfly operating linkage. At the handlebar end, prise off the black plastic cap and unscrew the large retaining screw to dismantle the lever. Note how the lever detent spring is fitted.

Check all lever pivot components for wear, renewing any that are damaged or worn and grease them thoroughly on refitting. Check the control cable inner wires for signs of fraying, poorly-soldered nipples and other damage, and the cable outers for signs of chafing, damaged or broken covers, or frayed or damaged ends. If any cable appears to be damaged or worn, or if it is stiff and jerky in operation, it must be renewed immediately. All the cable inner wires are lined with nylon or a similar material which **must not** be lubricated with oil. 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.

Working as described in the relevant Section of Chapters 2, 7 and 9, dismantle, clean and grease at regular intervals the stand pivots, the clutch release mechanism and the brake operating linkages. Check also the footrests and all return springs for security and correct operation.

5 *Check and adjust the valve clearances*

This operation is described in two sub-sections since while checking the clearances is within the scope of any owner, adjusting them is a different matter. Owners are advised to read the instructions to get some idea of what is involved and to then decide whether to attempt all or part of the work themselves, or whether to take the machine to a dealer. Note that while the clearances should be checked carefully at the interval, this system of valve clearance adjustment does not usually require resetting until a much greater mileage has been covered.

Checking the valve clearances

The engine must be cold before the valve clearances can be checked accurately. First remove the spark plugs and the engine left-hand outer (cylinder head) cover. See Chapter 1. Select top gear and rotate the crankshaft to the desired position by turning the rear wheel.

The valve clearances must be measured at the base circle of the cam lobe ie with the lobe pointing directly away from the valve stem. This position is approximately just before Top Dead Centre (TDC) on the compression stroke for the exhaust cam and just after it for the intake cam. To find TDC on the compression stroke, rotate the crankshaft until the (upper) intake cam lobe for any particular cylinder has opened and closed its valve, then shine a torch down the spark plug aperture and slowly turn the rear wheel until that piston comes to the top of its stroke. It is easiest to work methodically, starting from number 1 (front, or cam chain end) cylinder and to then work backwards ie for 100 models from number 1 cylinder at TDC a half turn of the crankshaft brings number 3 cylinder to TDC, a further half turn brings number 4 to TDC, and a final half turn brings number 2 to TDC.

Note that if the ignition trigger assembly cover is removed the crankshaft can also be rotated (anticlockwise, looking at the trigger from the front of the machine) by means of an Allen key applied to the rotor retaining bolt.

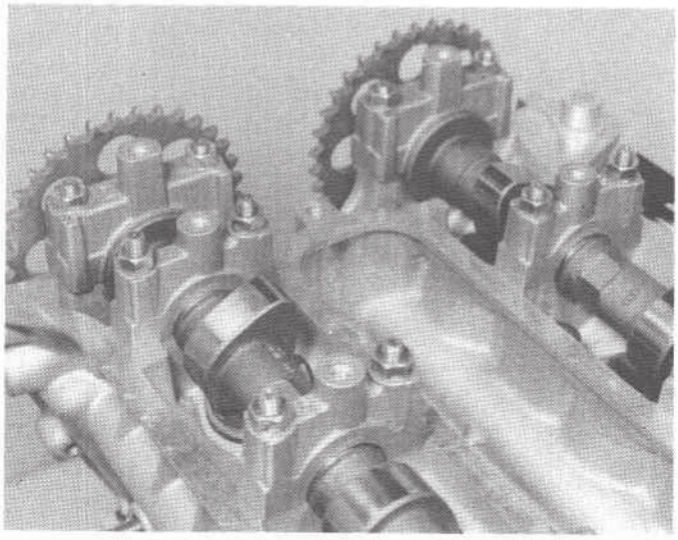
Whichever method is used, position the cams as described and use feeler gauges to measure carefully the clearance between each cam lobe and the shim sitting on its respective cam follower recess. The correct thickness feeler gauge blade will be a tight sliding fit between the two components. Carefully record all clearances on a sheet of paper.

If the clearance at any valve is outside the specified range, the shim must be replaced by a thicker or thinner one, as appropriate. This procedure is described below.

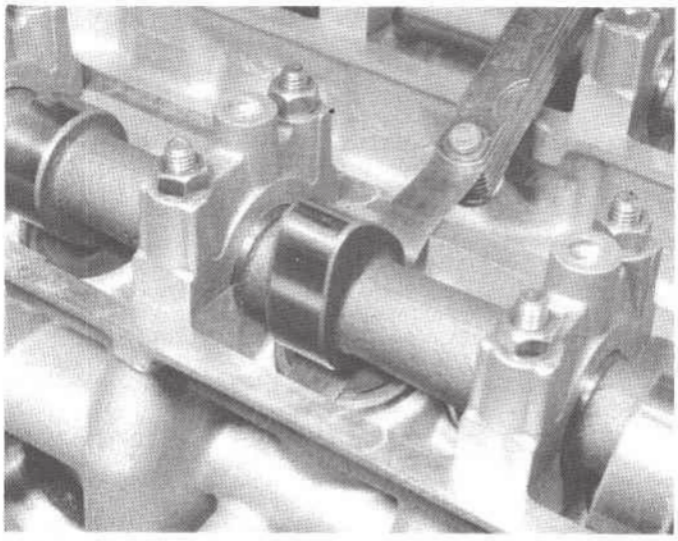
Adjusting the valve clearances with service tools

The shims are changed by pressing down the cam follower (tappet bucket) using a specially-shaped depressor lever, BMW part number 11 1 721, and holding it down using a spacer, BMW tool number 11 1 722; the shims can then be extracted using a pointed instrument or a pair of large tweezers or needle-nosed pliers. If these tools are available, proceed as follows.

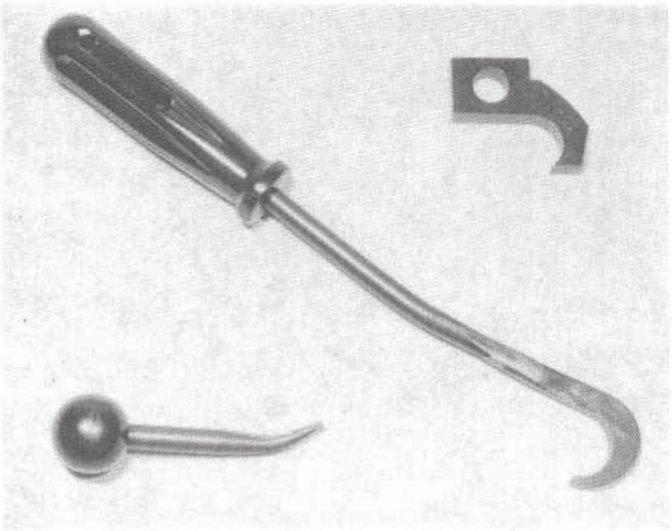
Position the cam lobe so that it is pointing directly away from the valve to be adjusted, then rotate the cam follower so that the notch in its raised edge faces in (towards the centre of the head); later models have followers with two notches to facilitate this. Insert the depressor lever under the camshaft next to the lobe, check that it bears fully on the shim, then press the handle upwards (intake valve) or downwards (exhaust valve) until it touches the cylinder head wall, thus pressing the valve assembly into the cylinder head. Fit the spacer so that it locks securely under the camshaft with its foot bearing squarely on the edge of the follower ie clear of the shim. **It is essential** that the spacer rests squarely on the edge of the follower, or it may slip and lock the follower



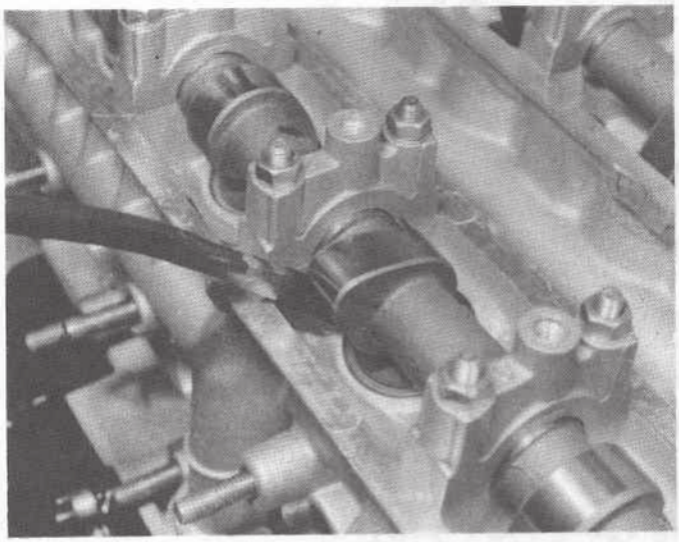
Cylinder is at TDC on compression stroke when piston is at the top of the bore with both valves closed – number 1 cylinder, 100 model shown



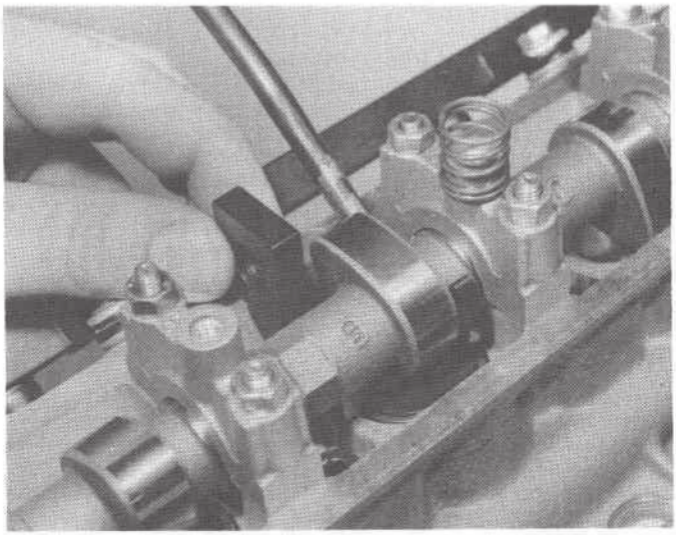
Valve clearance is measured with cam lobe pointing away from valve as shown



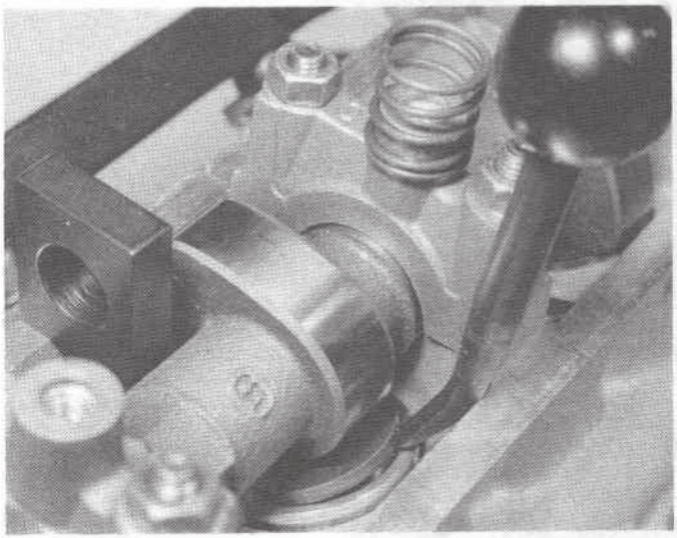
Valve clearance adjustment requires special tools if camshafts are not to be removed



Hook depressor lever under camshaft and press lever downwards for exhaust ...



... or upwards for intake until valve assembly is depressed sufficiently for spacer to be fitted

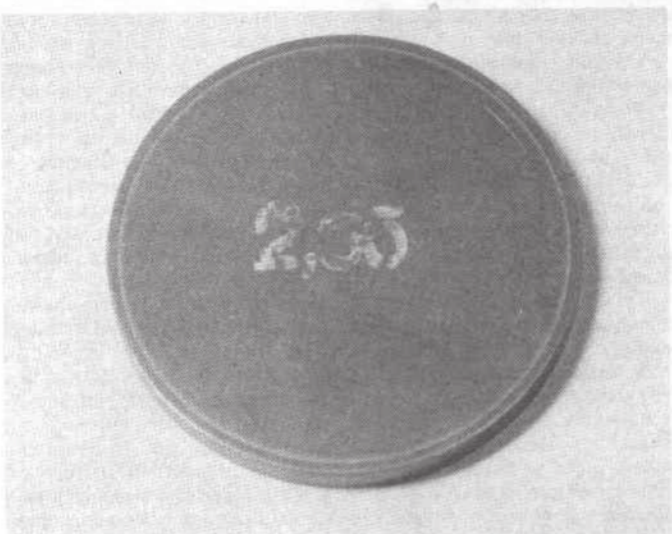


Shim can be prised out via notch in cam follower rim – check spacer bears securely on follower only

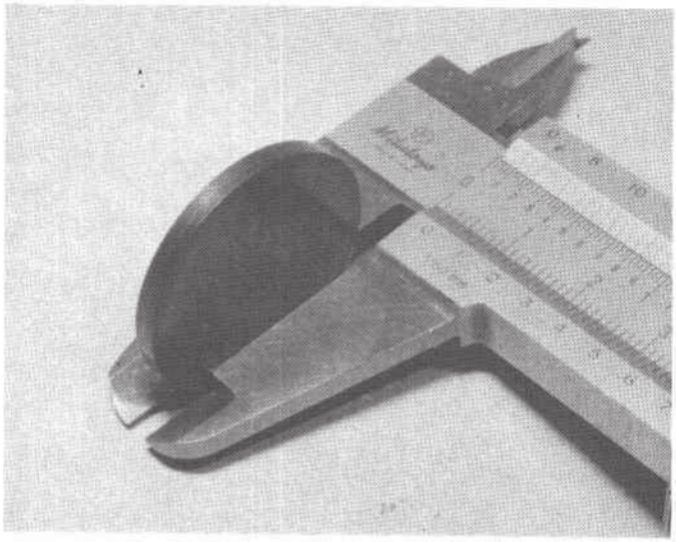
in place by raising a burr on the cylinder head. Using a pointed instrument, prise the shim out of its recess and withdraw it, noting the number painted on its underside.

Shims are available in increments of 0.05 mm (0.0020 in) in a range of thicknesses from 2.00 - 3.00 mm (0.0787 – 0.1181 in). To adjust a valve's clearance, note the thickness of the present shim; if the painted number has been polished away measure the shim with a micrometer or vernier caliper or similar and record it. If the measured clearance was too small, select the next size thinner shim, install it and recheck the clearance; if the clearance was too large a thicker shim must be installed. The clearance does not usually require adjusting by more than one shim size. Note that as a picture of the valve gear is built up it may be possible to reduce the cost by swapping shims between valves so that the smallest number of new shims has to be purchased.

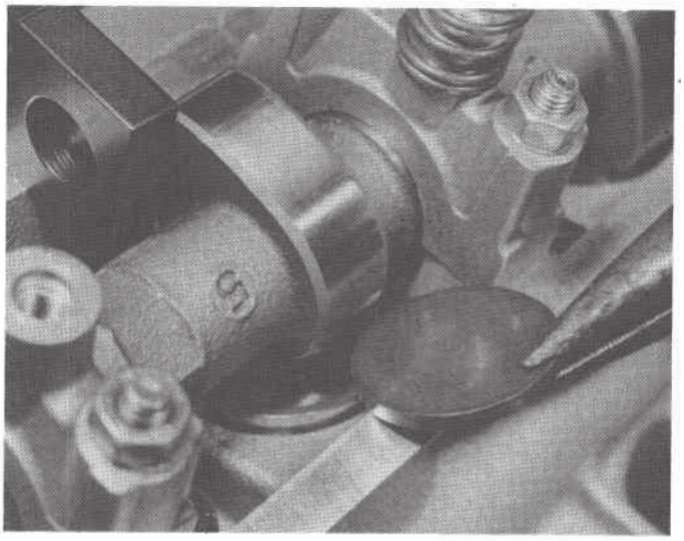
Refit the shims ensuring that their painted numbers are facing downwards so that they are not polished away by the cam lobe, and that each shim is seated fully in its recess. Refit the depressor lever and push down the valve assembly, withdraw the spacer and slowly move the depressor lever to release the cam follower. Rotate the follower through a full circle to ensure that the new shim is securely seated at all points, then measure the clearance again and record it. Repeat the process for all other valves.



Number painted on shim underside indicates thickness, in this case 2.05 mm



Measure shim thickness with caliper or micrometer if number is erased



Fit shims with number downwards and check that they are seated fully in their followers

When all clearances have been checked and adjusted, turn the engine over several times to settle all components (if the starter motor is used be careful to protect the ignition system components as described in Chapter 6), then recheck all clearances to ensure that none have altered through shims settling. If all is well, refit the cylinder head cover as described in Chapter 1. Note that if the clearances required significant alteration, the throttle butterfly assembly synchronisation should be checked as described in Chapter 5.

Note: Always record the date and mileage of each check and all relevant information ie original clearance, original shim thickness, new shim thickness and final clearance. In this way an extremely accurate picture can be obtained of the rate of wear of the valve gear, until it is almost possible to predict when a particular valve will need adjusting. Obviously if the pattern changes suddenly, the reason should be investigated before serious trouble is encountered. Note that with this system of valve clearance adjustment wear of the valve gear is minimal and it is more likely that thinner shims will be required to compensate for wear at the valve seat. Once the shins have been properly set up after running in, adjustment should be only rarely required, thus offsetting the extra expense of the system.

Adjusting the valve clearances without service tools

Owners who do not have access to the service tools mentioned above should note that it is possible to adjust the clearances without them, but that this involves a much longer procedure which requires very accurate measurements of the clearances. The task is outlined below; refer to the relevant Sections of Chapter 1 for full details.

Measure and record carefully the clearances of all valves (see above). If any require adjustment, remove the engine front and right-hand outer covers and withdraw the camshafts. See Chapter 1.

Note that only one camshaft should be removed at a time, to avoid confusion, and that great care must be taken to avoid shims dropping clear and becoming mixed up; remove the camshaft very slowly and substitute a wooden dowel or similar to retain the shims as soon as possible.

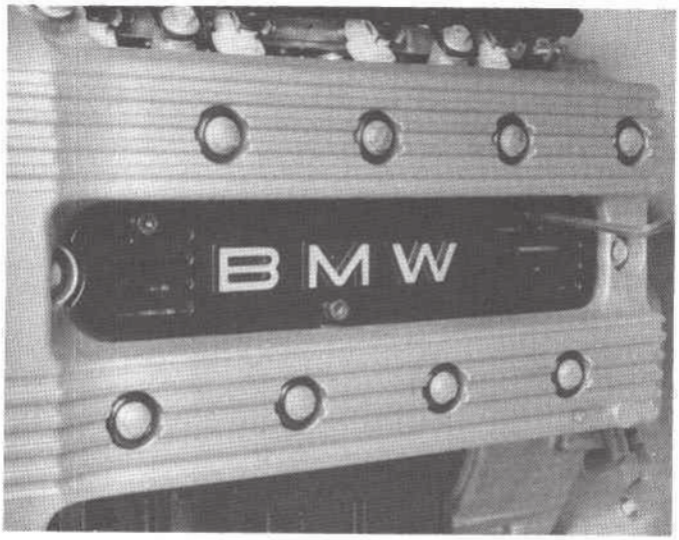
Measure or note the shim thicknesses and obtain thinner or thicker shims as described above, and refit them securely to the cam follower recesses.

When all valves have been adjusted, refit the camshafts, set the valve timing and refit the cam chain, then re-check all valve clearances. If the work has been sufficiently accurate, the clearances will be correct; if not, repeat the procedure until all are correct. As described above, make a careful note of all relevant information so that an accurate picture can be built up of the rate of valve or valve gear wear. When adjustment is complete, refit the engine outer covers and other disturbed components. Note that if the clearances required significant alteration it will be necessary to check the synchronisation of the throttle butterfly assembly. See Chapter 5.

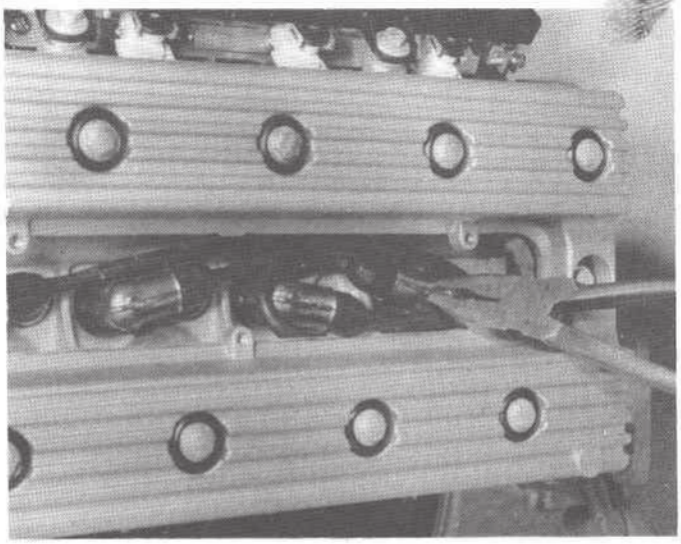
6 *Check and adjust the spark plugs*

Either perform this task when the engine is cold, or take great care to prevent personal injury through burning one's hands on the hot cylinder head. Remove the three retaining Allen screws and withdraw the spark plug cover plate from the middle of the engine left-hand outer (cylinder head) cover. Noting exactly how the leads are routed, pull off each spark plug suppressor cap using a heavy pair of pliers applied to the tab protruding from each cap. Clean off any particles of dirt or other foreign matter from the spark plug channel, then unscrew the spark plugs, keeping them clearly identified by cylinder number.

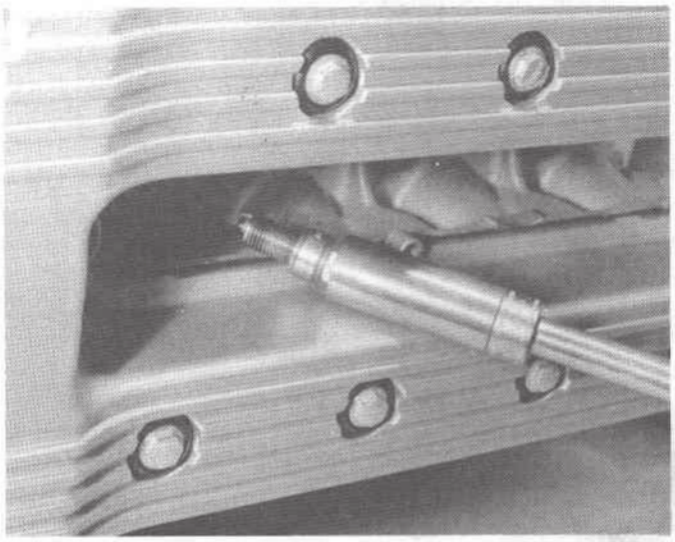
First use feeler gauges, preferably of the wire type for accuracy, to measure the gap between the spark plug electrodes; BMW state that the ignition system is so sensitive to spark plug condition and electrode gap that the plugs must all be renewed if the electrodes of any one spark plug have been eroded to a gap of 0.8 mm (0.032 in) or more. If this is found to be the case, or if the plugs are in any way suspect, new spark plugs of the specified make and type must be purchased and fitted. Note that if this particular make is difficult to obtain locally, the advice of an authorised BMW dealer should be sought; provided that exactly the equivalent heat range and type is obtained from a good



Remove spark plug cover plate from centre of cylinder head cover ...



... and use pliers to pull off suppressor caps, noting exactly how HT leads are routed



Spark plugs must be renewed as a set if any gap has worn to beyond the service limit

quality brand, spark plugs of alternative makes may be used eg NGK D7EA. Fit them as described below.

If the spark plugs are still serviceable, carefully compare the appearance of their electrodes with the accompanying colour section and note any information which can be obtained from this. If any plug appears to show a fault, seek expert advice as soon as possible; do not forget to take the old plugs with the machine to an authorised BMW dealer. The standard grade of spark plug should prove adequate in all normal use and a change of specification (such as fitting a hotter or colder grade of plug) should not be made without expert advice.

Clean the electrodes by carefully scraping away the accumulated carbon deposits using a small knife blade or small files and abrasive paper; take care not to bend the centre electrode or to chip or damage the ceramic insulator. The cleaning of spark plugs on commercial sand-blasting equipment is **not** recommended due to the risk of abrasive particles being jammed in the gap between the insulator and the plug metal body, only to fall clear later and drop into the engine; any plug that is so heavily fouled should be renewed.

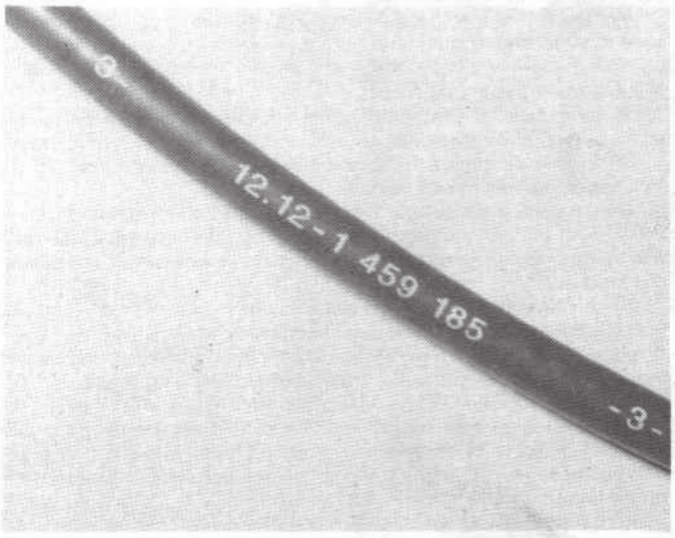
Once clean, file the opposing faces of the electrodes flat using a small fine file. A magneto file or even a nail file can be used for this purpose. Whichever method is chosen, make sure that every trace of abrasive and loose carbon is removed before the plug is refitted. If this is not done, the debris will enter the engine and can cause damage or rapid wear.

Whether a cleaned or new plug is to be fitted, always check the electrode gap before it is installed. Use a spark plug adjusting tool or feeler gauges to measure the gap, and if adjustment is required, bend the outer, earth electrode only. *Never* bend the centre electrode or the porcelain insulator nose will be damaged.

Before the plug is fitted, apply a fine coat of PBC or molybdenum disulphide grease to the threads. This will help prevent thread wear and damage. Fit the plug finger-tight, then tighten it by a further 1/4 turn only, to ensure a gas-tight seal. Beware of overtightening, and always use a plug wrench or socket of the correct size; tighten all plugs to the specified torque wrench setting, where possible.

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.

When refitting the spark plug suppressor caps, be careful to ensure that the HT leads are correctly routed; note that the leads are numbered as a further aid to identification.



HT leads are numbered to assist identification on refitting

7 *Final inspection*

Working as described in the relevant sections of Routine Maintenance, or in the relevant Chapters, work methodically round the machine checking the following items:

a) Check the rear wheel mounting bolts are tightened to the specified torque wrench setting
b) Check the operation of the clutch and gear change mechanism
c) Check the steering
d) Check the wheels, brakes and tyres
e) Check all lights and other electrical components and instruments
f) Check the idle speed and adjust if necessary

8 *Air filter*

Note that under severe operating conditions it may be necessary to clean or even renew the air filter element at this interval. See the major service operation.

Major service

1 *Change the engine oil and filter*

Refer to the minor service operation.

2 *Change the gearbox oil*

The machine must be taken on a journey of sufficient length to warm up the gearbox to normal operating temperature before the oil is drained.

With the machine supported on its centre stand on level ground, remove the filler and drain plugs and allow the oil to drain into a suitable container; a cardboard chute should be fabricated to direct the oil into the container, away from the centre stand. While the oil is draining, clean the drain plug carefully, wiping any metal particles off its magnetic insert, and renew its sealing washer if it is worn, flattened or damaged. When the oil is fully drained, refit the drain plug and tighten it securely to the specified torque wrench setting, where available.

Fill the gearbox with the correct amount of the specified type and viscosity of oil, then check the oil level as described in the minor service operation.

3 *Change the final drive case oil*

The machine must be taken on a journey of sufficient length to warm up the final drive to normal operating temperature before the oil is drained.

With the machine supported on its centre stand on level ground, remove the filler and drain plugs and allow the oil to drain into a suitable container. Use a sheet of cardboard to keep the oil off the rear wheel and tyre. Renew the plug sealing washers if they are damaged or flattened, and clean both plugs; wipe any metal particles from the drain plug magnetic insert. When the oil has fully drained, refit the drain plug, tightening it to the specified torque setting and pour in the correct amount of the specified type and viscosity of oil. Check the oil level as described in the minor service.

4 *Change the front fork oil*

Place a sheet of cardboard against the wheel to keep oil off the brake or tyre, place a suitable container under the fork leg and remove the drain plug which is a small hexagon-headed bolt at the rear of the fork lower leg, just above the wheel spindle.

Depress the forks several times to expel as much oil as possible, then repeat the process on the remaining leg. Leave the machine for a few minutes to allow any residual oil to drain to the bottom, then pump the forks again to remove it.

Renewing their sealing washers if worn or damaged, refit and tighten the drain plugs to the specified torque wrench settings, where given, then remove the fork leg top plastic plugs; it may be necessary to remove the handlebar cover to gain adequate working space.

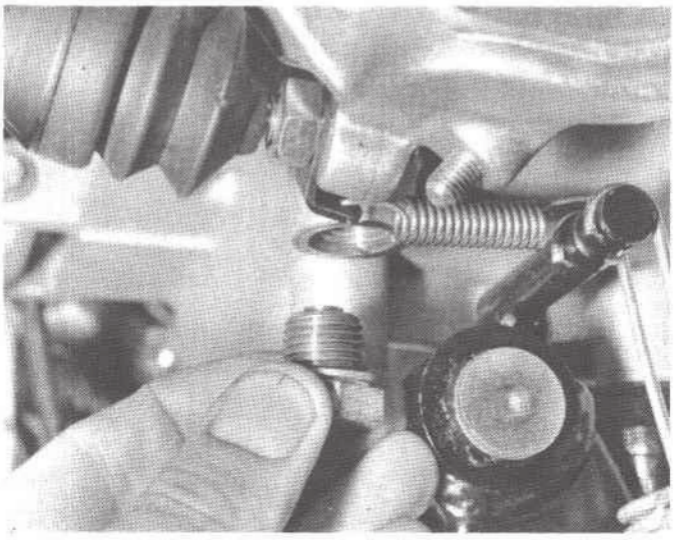
Unscrew the Allen screw filler plugs from the centre of each fork top plug, using an open-ended spanner to hold the top plug, then lift the machine on to its centre stand on level ground and wedge a block of wood or similar under the sump so that the front wheel is clear of the ground and the forks are fully extended.

Fill each leg with the specified amount of one of the recommended brands of oil (see Chapter 7). **Do not** use ordinary fork oil; BMW forks are designed to work with oils of (approximately) SAE 3 viscosity. Most proprietary fork oils are up to 10 times thicker than this and will produce a very stiff ride. Check the oil level by inserting a length of welding rod 1 metre (40 in) long by 5 mm (0.2 in) diameter into the fork leg; ensure that the level is the same in both fork legs. Refit the filler plugs, tightening them to the specified torque wrench setting, where given, followed by the plastic top plugs and/or any other disturbed components.

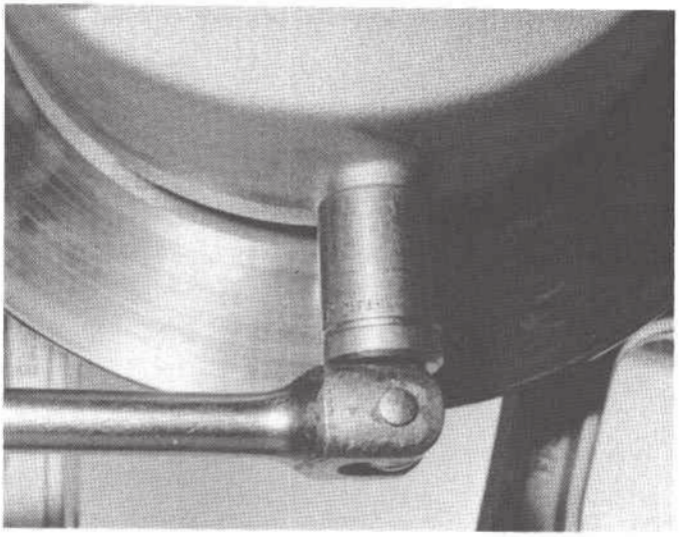
Push the machine off its stand, apply the front brake and pump the forks up and down 5 – 10 times until the damping effect can be felt to be fully restored.

5 *Clean the speedometer impulse transmitter*

Remove its single retaining screw and carefully prise the impulse transmitter out of the final drive case. Renew its sealing O-ring if worn or damaged and wipe the unit clean of oil and any dirt or foreign matter. Check it for signs of damage. On refitting, tighten the retaining screw securely but do not overtighten it.



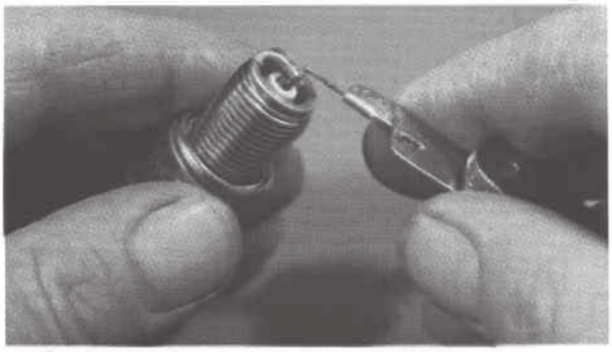
Gearbox oil drain plug is fitted with a magnetic insert – clean carefully



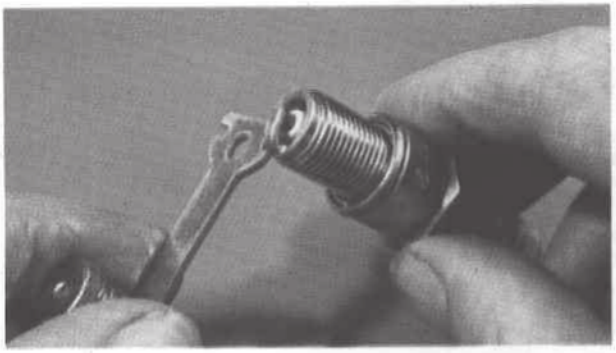
Final drive oil drain plug is situated on underside of final drive case



Speedometer impulse transmitter must be removed at regular intervals for cleaning



Spark plug maintenance: Checking plug gap with feeler gauges



Altering the plug gap. Note use of correct tool



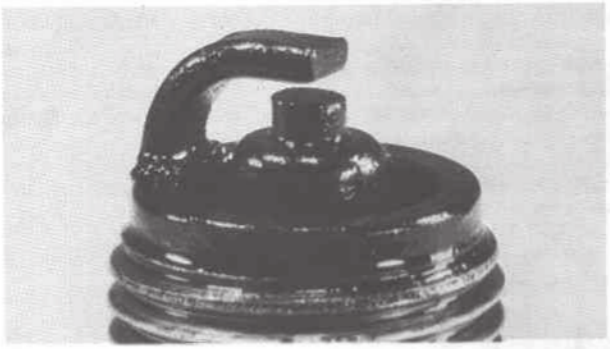
Spark plug conditions: A brown, tan or grey firing end is indicative of correct engine running conditions and the selection of the appropriate heat rating plug



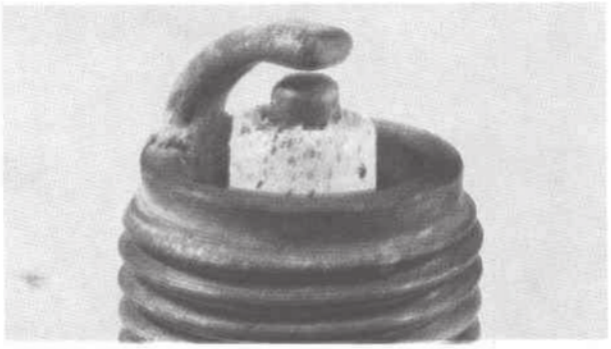
White deposits have accumulated from excessive amounts of oil in the combustion chamber or through the use of low quality oil. Remove deposits or a hot spot may form



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

6 *Renew the air filter element*

Note that in severe conditions the air filter element should be cleaned, blowing from the top surface downwards with a blast of compressed air and removing any large particles of dirt with a soft-bristled brush, at the minor service interval. At the major service interval the element should be removed as described in Chapter 5 and discarded. Fit a new element, ensuring that it is seated correctly, as described, and secure the filter top half by springing the retaining clips into place. A light application of grease around the sealing edges will help provide a good seal in very wet or dusty conditions.

7 *Check the cooling system*

With reference to Chapter 4 of this Manual, check the cooling system at regular intervals, looking for signs of leakage, damage or wear to any of the system's components. Check the coolant level and top up, if necessary. Note that the coolant must be renewed at least every two years, as described.

8 *Check and adjust the clutch*

The clutch is adjusted correctly if there is the correct specified amount of free play in the cable measured between the handlebar lever butt end and the handlebar clamp 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 outer cover on the gearbox housing (ie the exposed length of clutch cable inner wire) is 75 ± 1 mm (2.95 ± 0.04 in). Tighten the handlebar adjuster locknut.

Slacken the locknut of the adjuster set in the clutch operating lever at the rear of the gearbox and slacken the adjuster screw by one or two full turns to check that there is no pressure on it, then screw it in until light resistance is encountered; do not overtighten the screw. Hold the screw steady and tighten the adjuster locknut securely. Use the handlebar adjuster to set the specified clearance at the lever, then tighten its locknut; 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.

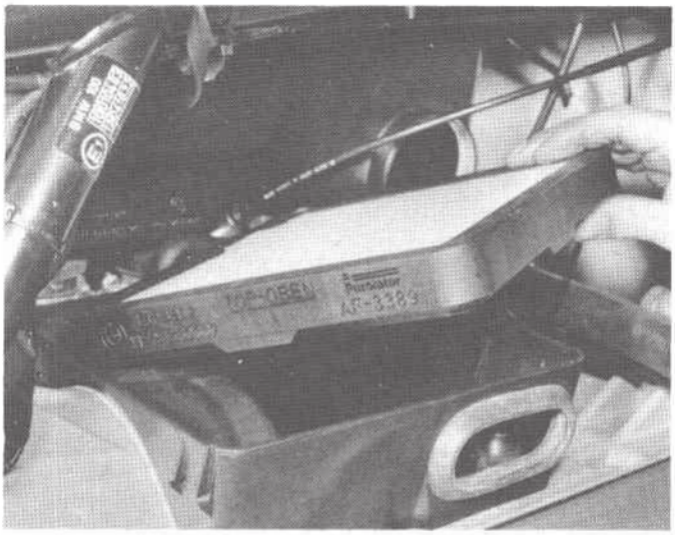
If the clutch still shows signs of slipping or dragging, or if it is very sudden in action, it must be dismantled for examination. On reassembly, the components should be lubricated, (where specified) to ensure a smooth action. Refer to Chapter 2.

9 *Lubricate the controls and stand pivots*

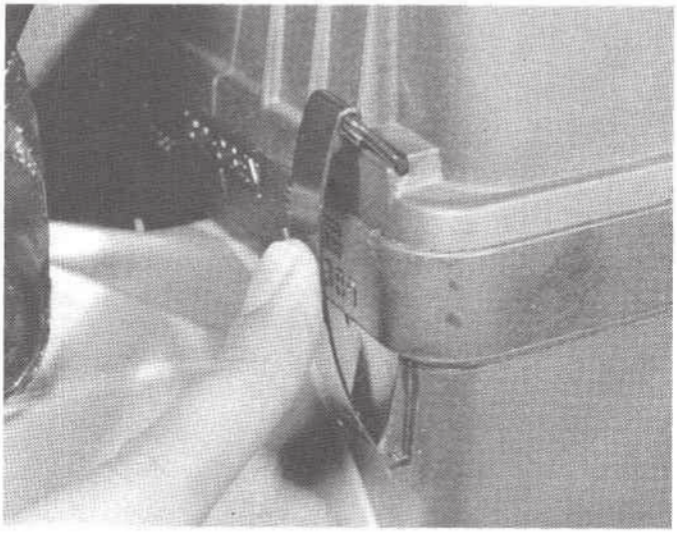
Refer to the minor service operation.

10 *Check the battery*

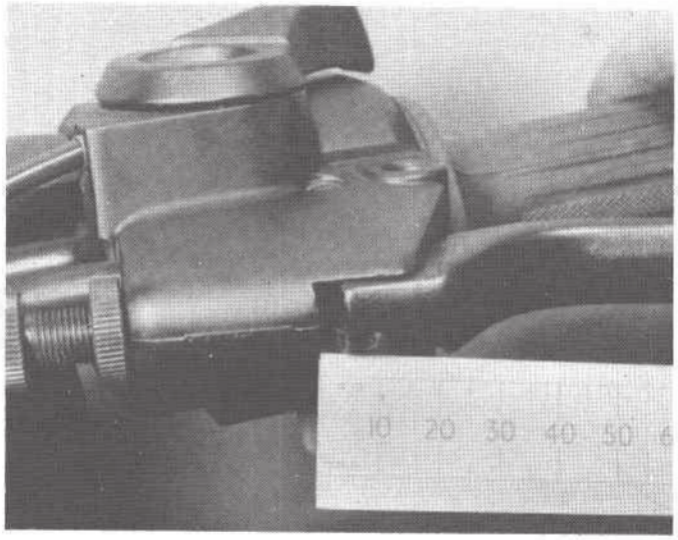
Refer to the daily (pre-ride) check.



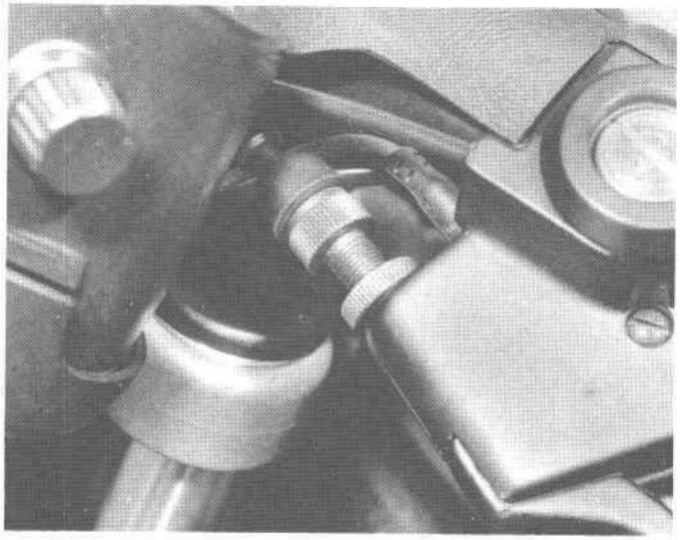
Ensure air filter element is correctly refitted to prevent entry of dirt into engine



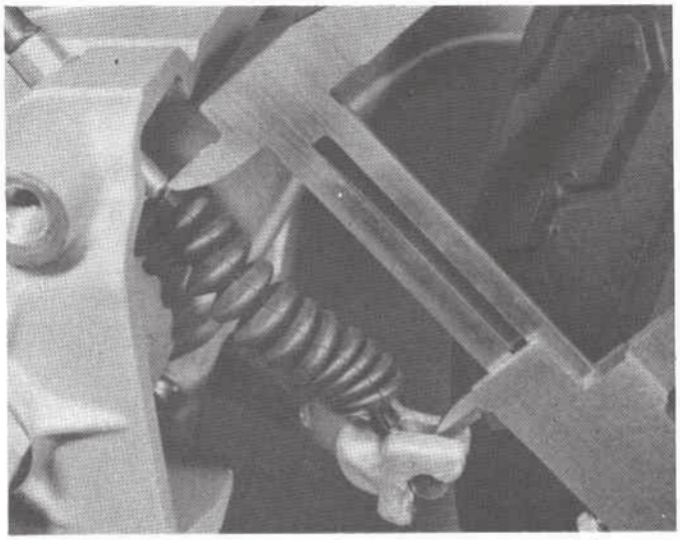
Filter casing top half is secured by spring clips



Measuring clutch cable free play – 100 model shown



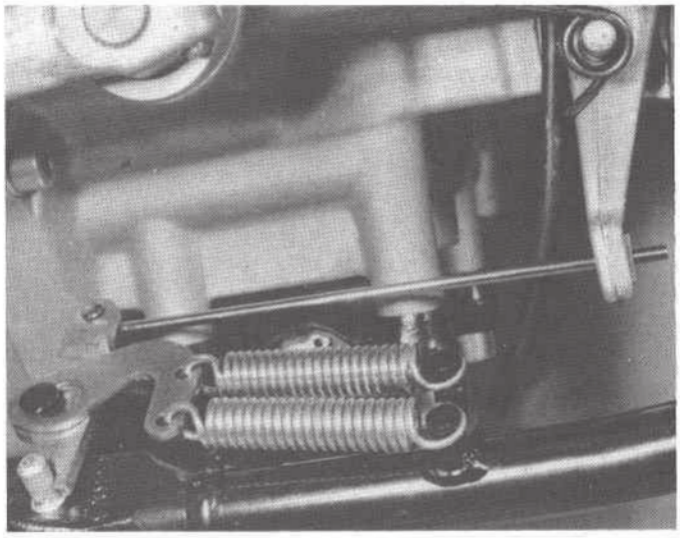
Use cable handlebar adjuster to set ...



... correct length of exposed cable inner wire, as shown



Clutch operating lever adjuster is used to set release mechanism



Where fitted, set side stand linkage so that free play is just eliminated with stand down

11 Check and adjust the valve clearances

Refer to the minor service operation.

12 Renew the spark plugs

The spark plugs should be renewed at this interval regardless of their apparent condition as they will have passed peak efficiency. Check that the new plugs are of the correct type and that they are correctly gapped before fitting them.

13 Check the fuel system

With reference to the relevant Sections of Chapter 5, check all pressure hoses for signs of leaks, check the adjustment and operation of the throttle and choke control cables and check the idle speed. Remember that if the valve clearances have been altered significantly, the synchronisation of the throttle butterfly assemblies should be checked, and adjusted if necessary. Note that the fuel filter must be renewed at regular intervals (see item 19).

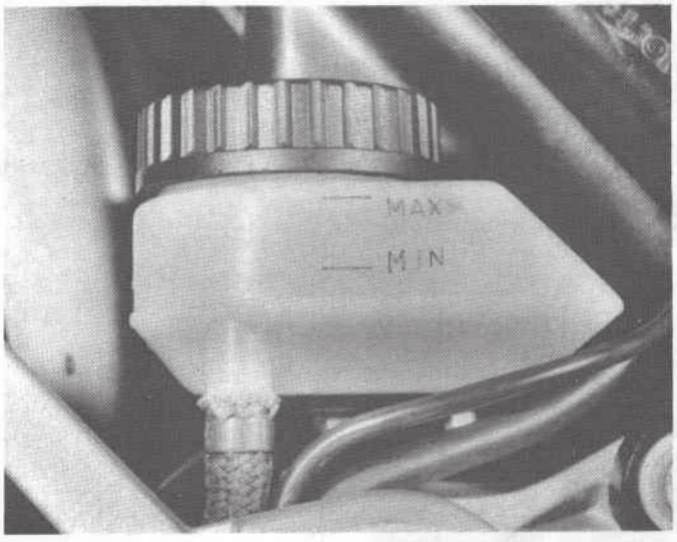
14 Check and overhaul the brakes

Disc brakes – front and rear

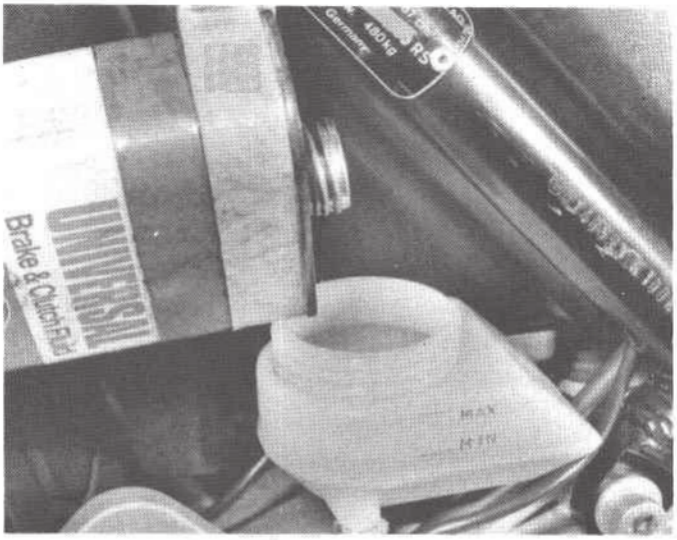
The hydraulic brake requires no regular adjustments; pad wear is compensated for by the automatic entry of more fluid into the system from the fluid reservoir. All that is necessary is to maintain a regular check on the fluid level and the degree of pad wear.

To check the fluid level, turn the handlebars until the reservoir is horizontal (front brake only) 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 falls below the lower level mark there is a risk of air entering the system; it is therefore sufficient to maintain the fluid level above the lower level mark, by topping-up if necessary. Do not top up to the higher level mark unless this is necessary after new pads have been fitted. If topping up is necessary, wipe any dirt off the reservoir, remove the retaining screws and lift away the reservoir cover or unscrew the cap, as appropriate, and withdraw the diaphragm. Use only good quality brake fluid of the recommended type and ensure that it comes from a freshly opened sealed container, brake fluid is hygroscopic, which means that it absorbs moisture from the air, therefore old fluid may have become contaminated to such an extent that its boiling point has been lowered to an unsafe level. Remember also that brake fluid is an excellent paint stripper and will attack plastic components; wash away any spilled fluid immediately with copious quantities of water. When the level is correct, clean and dry the diaphragm, fold it into its compressed state and fit it to the reservoir. Refit the reservoir cover or cap (and gasket, where fitted) and tighten securely, but do not overtighten, the retaining screws (where appropriate).

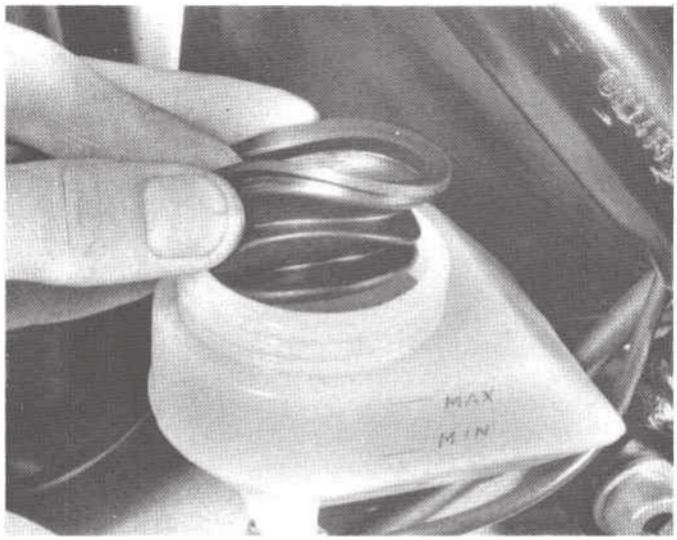
To check the degree of pad wear, prise the plastic cover off each caliper body and assess the amount of friction material remaining on each pad; if either is worn at any point so that the metal backing is



Brake hydraulic fluid level must be maintained above minimum level mark



Use only good quality fluid from a sealed container when topping up



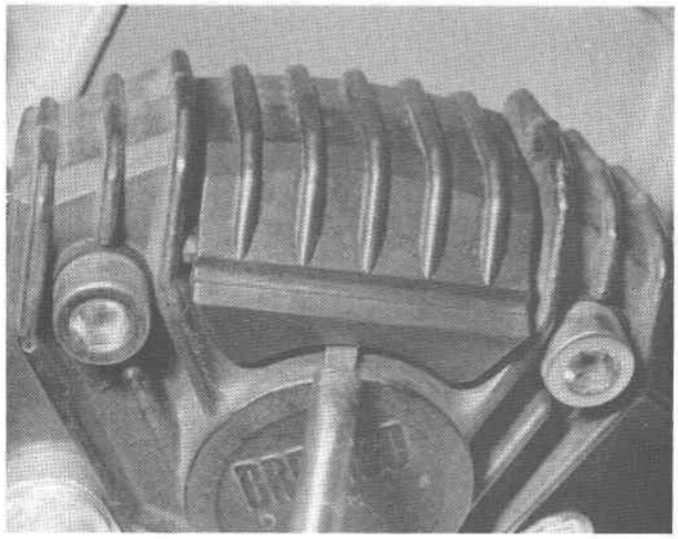
Ensure diaphragm is clean and dry before refitting

approaching contact with the disc, both pads must be renewed immediately. If the pads are so fouled with dirt that the friction material cannot be distinguished, or if oil or grease is seen on them, they must be removed for cleaning and examination.

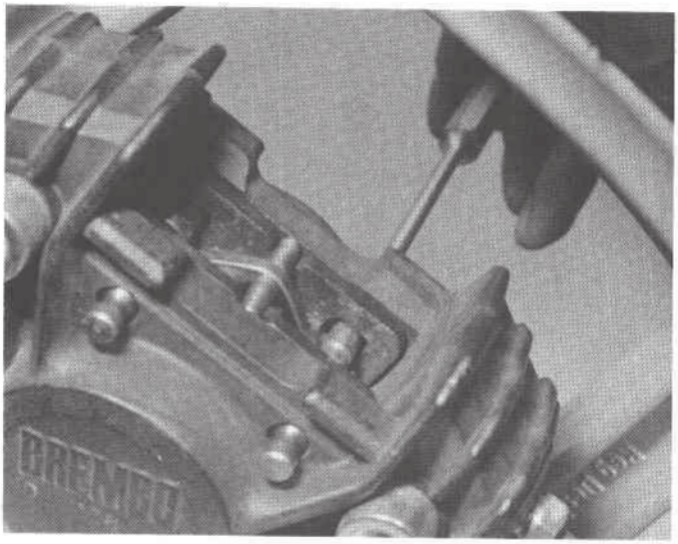
Unclip the plastic cover from the caliper and use a suitable drift to tap out the two pad retaining pins from the inside outwards; take care not to allow the retaining spring to fly off. Remove the central pin and withdraw both pads.

If the pads are worn to a thickness of 1.5 mm (0.06 in) or less at any point, fouled with oil or grease, or heavily scored or damaged by dirt and debris, they must be renewed as a set; there is no satisfactory way of degreasing friction material. If the pads can be used again, clean them carefully using a fine wire brush that is completely free of oil or grease. Remove all traces of road dirt and corrosion, then use a pointed instrument to dig out any embedded particles of foreign matter. Any areas of glazing may be removed using emery cloth.

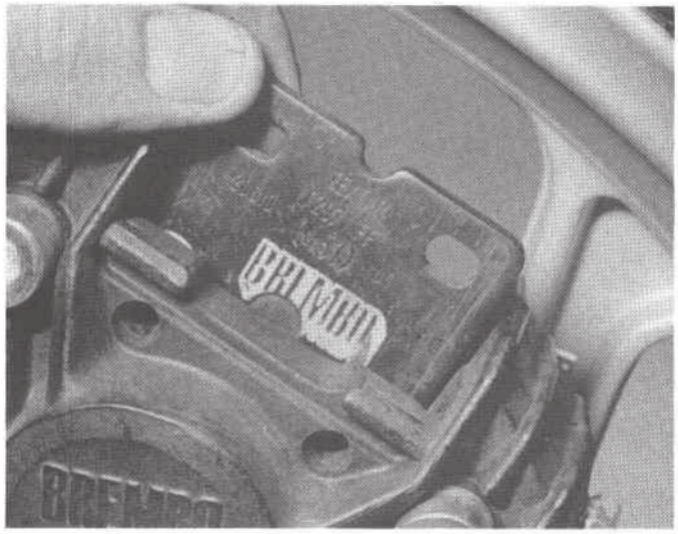
On reassembly, if new pads are to be fitted, the caliper pistons must now be pushed back as far as possible into the caliper bores to provide the clearance necessary to accommodate the unworn pads. It should be possible to do this with hand pressure only. If any undue stiffness is



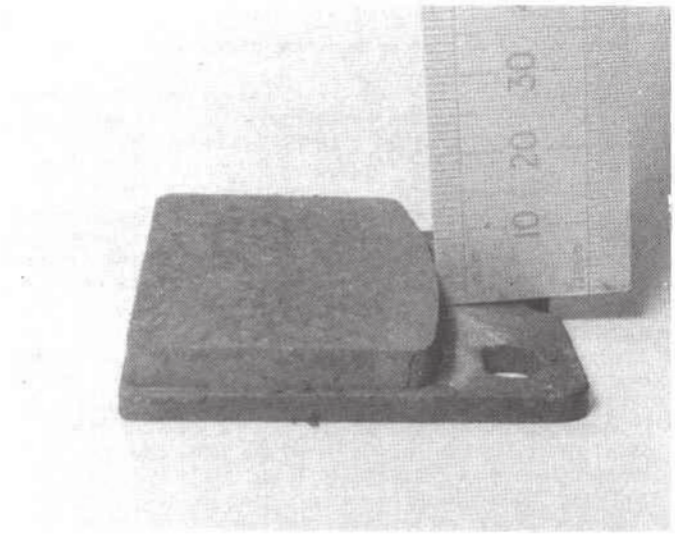
Prise plastic cover off caliper body to check brake pads



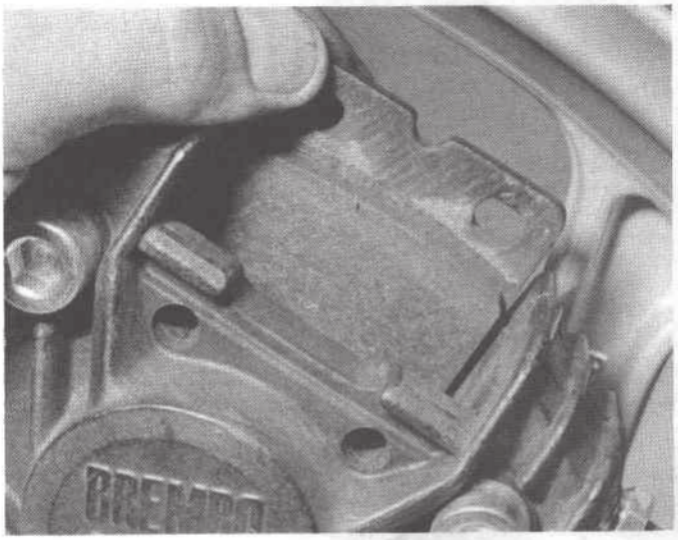
Use hammer and a long drift to tap out pad retaining pins from behind caliper – do not lose retaining spring or central pin



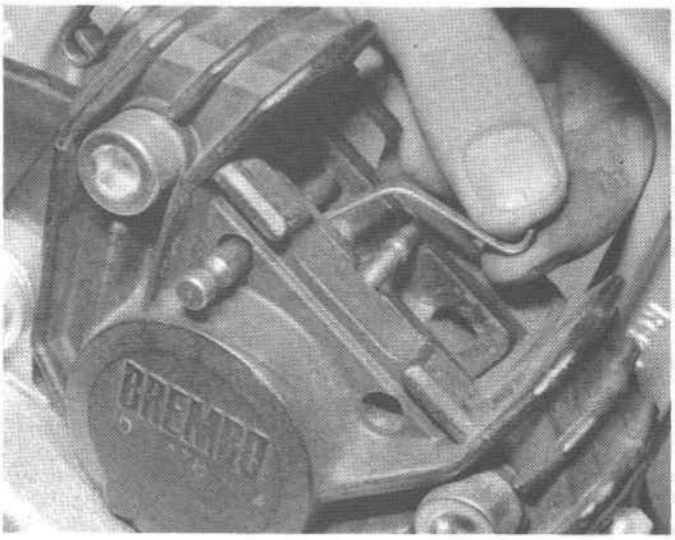
Remove pads, noting which way round each is fitted – check for uneven wear



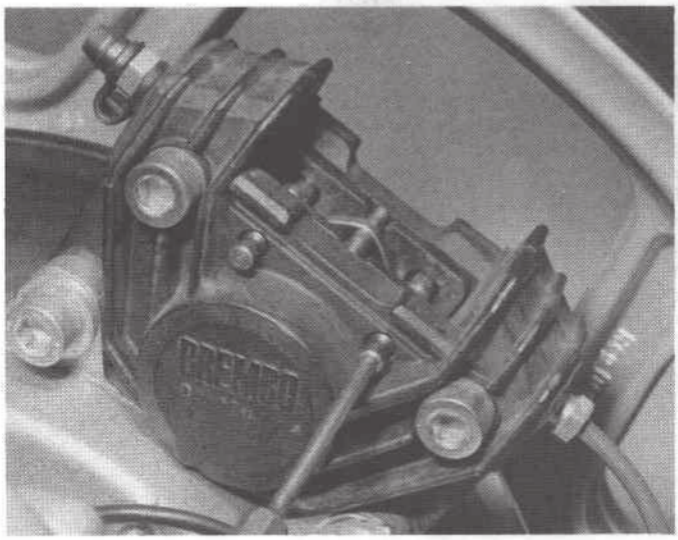
Pads must be renewed as a set if any is worn to service limit or less



Ensure friction material is against disc when refitting brake pads ...



... insert first retaining pin with spring, then refit central pin, as shown ...



... and tap second retaining pin into place, over spring end

encountered the caliper assembly should be dismantled for examination as described in Chapter 9. While pushing the pistons back, maintain a careful watch on the fluid level in the reservoir. If the reservoir has been overfilled, the surplus fluid will prevent the pistons returning fully and must be removed by soaking it up with a clean cloth. Take care to prevent fluid spillage. Apply a shin smear of caliper grease to the pad retaining pins. Take care to apply caliper grease to the metal backing of the pad only and not to allow grease to contaminate the friction material. Carefully fit the pads to the caliper and hold them in place while the first retaining pin (with the spring looped over it) is refitted. Place a central pin in the pad cutouts and press the spring over it and underneath the second retaining pin which should now be pressed into place. Refit the plastic cover.

Apply the brake lever gently and repeatedly to bring the pads firmly into contact with the disc until full brake pressure is restored. Be careful to watch the fluid level in the reservoir; if the pads have been re-used it will suffice to keep the level above the lower level mark, by topping-up if necessary, but if new pads have been fitted the level must be restored to the upper level line described above by topping-up or removing surplus fluid as necessary. Refit the reservoir cover or cap, gasket (where fitted) and diaphragm as described above.

Before taking the machine out on the road, be careful to check for fluid leaks from the system, and that the front brake is working correctly. Remember also that new pads, and to a lesser extent, cleaned pads will require a bedding-in period before they will function at peak efficiency. Where new pads are fitted use the brake gently but firmly for the first 50 – 100 miles to enable the pads to bed in fully.

Brake fluid renewal

Note that hydraulic brake fluid must be changed annually. It is necessary to renew the brake fluid at this interval to preserve maximum brake efficiency by ensuring that the fluid has not been contaminated and deteriorated to an unsafe degree.

Before starting work, obtain a new, full can of the specified hydraulic fluid and read carefully the Section on brake bleeding in Chapter 9. Prepare the clear plastic tube and glass jar in the same way as for bleeding the hydraulic system, open each bleed nipple by unscrewing it $^1/_4$ – $^1/_2$ turn with a spanner and apply the front brake lever gently and repeatedly. This will pump out the old fluid. **Keep the master cylinder reservoir topped up at all times,** otherwise air may enter the system and greatly lengthen the operation. The old brake fluid is invariably much darker in colour than the new, making it easier to see when it is pumped out and the new fluid has completely replaced it. Where more than one bleed nipple is fitted to a system (eg

the front brake) repeat the operation on both nipples to ensure that the old fluid is completely removed. Top up the master cylinder when the operation is complete.

Drum rear brake

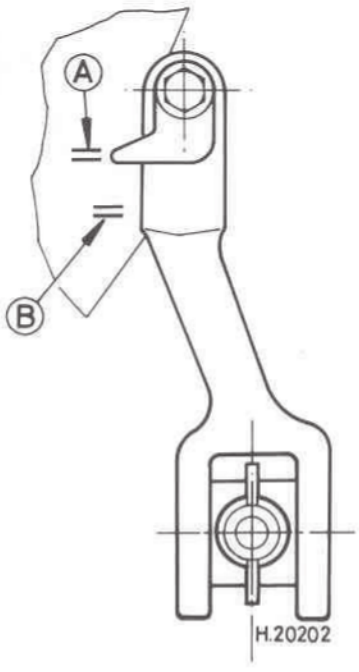
Note that the brake pedal height can be altered as required by setting the screw and locknut beneath the stop lamp rear switch; the pedal should be set so that it is as close as possible to the rider's foot in the normal riding position.

Adjustment is made by placing the machine on its centre stand with the rear wheel clear of the ground, then tightening the adjuster nut at the rear end of the brake operating rod while spinning the wheel until a rubbing sound is heard as the shoes begin to contact the drum. From this point slacken the nut by 3 – 4 turns until the rubbing sound has ceased. This should produce free play of 15 – 25 mm (0.6 – 1.0 in) at the brake pedal tip.

Brake shoe friction material wear can be checked by reference to the external wear indicator (see accompanying illustration) attached to the brake camshaft. With the brake correctly adjusted and fully applied, the pointer should align with the 'Max' line cast on the final drive case. As the shoes wear, the pointer will gradually move downwards. If it aligns with the 'Min' line at any time or extends beyond it, the brake shoes are worn out and must be renewed. See Chapter 9.

Note that if the rear brake appears spongy or imprecise at any time, but especially after the wheel has been disturbed, it is possible that centralising the brake components on the hub will effect an improvement. Slacken the rear wheel mounting bolts then spin the wheel and apply the rear brake firmly; maintain firm pressure while the mounting bolts are tightened securely to the specified torque setting.

At regular intervals check that the operating linkage is at its most efficient by ensuring that the angle formed between the brake rod and operating lever is less than 90° when the brake is firmly applied. If the angle is more than 90° at any time, the brake will not be as efficient; the operating lever must be removed from the camshaft splines, noting the position of the wear indicator pointer, and repositioned on the camshaft so that the angle is correct. This may require some trial and error to achieve the correct setting. Ensure that the operating lever is correctly refitted and securely fastened, that the wear indicator pointer is correctly aligned and that the brake is properly adjusted.



Drum rear brake wear limit marks

A Maximum friction material thickness
B Minimum friction material thickness

15 Check the wheels and wheel bearings

Wheels

Carefully check the complete wheel for cracks and chipping, particularly at the spoke roots and the edge of the rim. As a general rule a damaged wheel must be renewed as cracks will cause stress points which may lead to sudden failure under heavy load. Small nicks may be radiused carefully with a fine file and emery paper (No 600 – No 1000) to relieve the stress. If there is any doubt as to the condition of a wheel, advice should be sought from a reputable dealer or specialist repairer.

Each wheel is covered with a coating of lacquer or paint to prevent corrosion. If damage occurs to the wheel and the finish is penetrated, the bared aluminium alloy will soon start to corrode. A whitish grey oxide will form over the damaged area, which in itself is a protective coating. This deposit however, should be removed carefully as soon as possible and a new protective coating applied.

Check the lateral runout at the rim by spinning the wheel and placing a fixed pointer close to the rim edge. If the maximum runout is greater than 0.5 mm (0.02 in) the manufacturer recommends that the wheel be renewed. If warpage was caused by impact during an accident, the safest measure it to renew the wheel complete. Worn wheel bearings may cause rim runout. These should be renewed.

Note that impact damage or serious corrosion has wider implications in that it could lead to a loss of pressure from the tubeless tyres. If in any doubt as to the wheel's condition, seek professional advice.

Front wheel bearings

Support the machine on its centre stand on level ground so that the wheel to be examined is clear of the ground (wedge a wooden block or similar under the sump to raise the front wheel). Grasp the wheel firmly at top and bottom and attempt to rock it from side to side about its spindle; if any play is discovered, the wheel bearings must be renewed. See Chapter 9.

Rear wheel bearings

Support the machine on its centre stand on level ground so that the rear wheel is clear of the ground. Grasp the wheel firmly at the top and bottom and attempt to rock it from side to side about its centre. If any play is discovered the machine should be taken to a BMW dealer for the bearings in the final drive to be checked. Note that there should be no discernible endfloat (axial play) at the wheel hub.

16 Check the steering head bearings

The steering head should be checked for play with the motorcycle on the centre stand and the front wheel supported clear of the ground. Grasp the fork lower legs at the bottom and alternately push and pull, feeling for any play in the bearings. The forks should fall easily to either side, if moved slightly off centre. On 75 models the Fluidbloc retaining screws must first be removed.

If adjustment proves to be necessary, remove the handlebar cover and the fuel tank. On models fitted with frame-mounted fairings, remove the fairing inner panels if they prevent access to the fork yoke clamp bolts and to the steering head area. On all models, slacken fully the bottom yoke clamp bolts; the fork stanchions must be free to move up or down slightly in the bottom yoke.

On all 100 models and early 75 models slacken the steering stem top bolt and rotate the knurled, circular adjusting nut under the fork top yoke until the setting is correct, then tighten the top bolt, to its specified torque wrench setting if possible, to secure the nut. Tighten the bottom yoke pinch bolts and refit all disturbed components.

On later 75 models slacken the adjuster sleeve locknut and adjuster sleeve, then rotate the knurled, circular adjusting nut under the fork top yoke until the setting is correct, then tighten the adjuster sleeve to its specified torque wrench setting, followed by tightening the locknut to its torque wrench setting. Tighten the bottom yoke pinch bolts and refit all disturbed components.

On all models, check that all fasteners are tightened securely, to their specified torque wrench settings, if possible, then check that the forks move smoothly from lock to lock with no traces of stiffness or of free play.

17 Check the swinging arm pivot bearings

With the machine supported on its centre stand on level ground, check for play by pushing and pulling alternately on the end of the

swinging arm, while holding the frame firmly. If any free play is discovered, remove the left-hand footrest plate and slacken the swinging arm adjustable pivot stub locknut.

Tighten the adjustable pivot stub as hard as possible, using hand pressure alone on an ordinary Allen key, then slacken it fully and retighten it to the specified torque wrench setting. Hold the stub in that position and tighten the locknut securely, to its specified torque wrench setting, if possible.

If play still exists, one or both of the pivot bearings are worn and must be renewed.

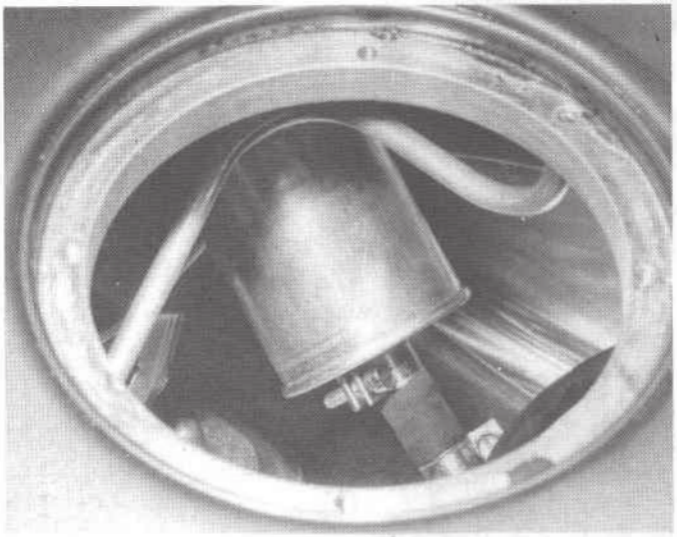
Note that the swinging arm must be removed (see Chapter 8) to permit the pivot bearings to be greased.

18 Final inspection

Proceed as described for the minor service operation but check also that the engine mountings, exhaust system mountings, rear suspension unit mountings and stand pivots and mountings are all securely fastened. Where possible, use a torque wrench to ensure that all nuts and bolts are tightened to their specified torque settings.

19 Renew the fuel filter

Note that the full-flow filter element fitted between the fuel pump and the fuel rail must be renewed at every second major service or, if the fuel used is of poor quality, at every major service. Refer to Chapter 5.



Fuel filter must be renewed at every second major service, or sooner if necessary

Chapter 1 Engine

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Specifications

Engine			
Bore	67 mm (2.64 in)		
Stroke	70 mm (2.76 in)		
	75 models	**100 models**	
Number of cylinders	3	4	
Capacity	740 cc (45 cu in)	987 cc (60 cu in)	
	UK 75 models, early US 75 models*	**Late US 75 models***	**100 models**
Compression ratio	11.0 : 1	10.5 : 1	10.2 : 1
Claimed maximum power – DIN (kw/bhp @ rpm)	55/75 @ 8500	51/70 @ 8200	66/90 @ 8000
Claimed maximum torque – DIN (Nm/lbf ft @ rpm)	68/50 @ 6750	65/48 @ 6500	86/63 @ 6000
* *Changeover date approximately mid-1986*			
Cylinder identification	Numbered consecutively front to rear. Number 1 cylinder at front (cam chain) end		
Firing order:			
75 models	3 – 1 – 2		
100 models	1 – 3 – 4 – 2		
Direction of rotation	Anticlockwise, looking at ignition trigger from front of machine		
Compression pressure – see Section 2			
Good	Over 10.0 bar (145 psi)		
Normal	8.5 – 10.0 bar (123 – 145 psi)		
Poor	Below 8.5 bar (123 psi)		

Valve timing – at 5/100 preload and 3 mm (0.12 in) lift	UK models	US models
Intake opens	5° BTDC	5° ATDC
Intake closes	27° ABDC	27° ABDC
Exhaust opens	28° BBDC	28° BBDC
Exhaust closes	5° BTDC	5° BTDC

Valve clearances – engine cold (maximum coolant temperature 20°C/68°F)	
Intake	0.15 – 0.20 mm (0.006 – 0.008 in)
Exhaust	0.25 – 0.30 mm (0.010 – 0.012 in)

Camshafts and cam followers	
Camshaft bearing journal OD:	
At front (thrust) bearing	29.980 – 29.993 mm (1.1803 – 1.1808 in)
At all other bearings	23.980 – 23.993 mm (0.9441 – 0.9446 in)
Cylinder head bearing ID:	
At front (thrust) bearing	30.020 – 30.041 mm (1.1819 – 1.1827 in)
At all other bearings	24.020 – 24.041 mm (0.9457 – 0.9465 in)
Camshaft radial clearance	0.027 – 0.061 mm (0.0011 – 0.0024 in)
Camshaft base circle	30.000 mm (1.1811 in)
Cam lift:	
Intake	9.3927 mm (0.3698 in)
Exhaust	9.3819 mm (0.3694 in)
Cam follower OD	33.475 – 33.491 mm (1.3179 – 1.3185 in)
Cylinder head bore ID	33.500 – 33.525 mm (1.3189 – 1.3199 in)
Cam follower/cylinder head clearance	0.009 – 0.050 mm (0.0004 – 0.0020 in)

Valves, guides and springs	
Valve head diameter:	
Intake	34 mm (1.3386 in)
Exhaust	30 mm (1.1811 in)
Valve head rim thickness:	
Standard	1.350 – 1.650 mm (0.0532 – 0.0650 in)
Service limit	1.000 mm (0.0394 in)
Valve head maximum runout	0.030 mm (0.0012 in)
Valve overall length:	
Intake	111.000 mm (4.3701 in)
Exhaust	110.610 – 110.810 mm (4.3547 – 4.3626 in)
Valve stem OD:	
Intake	6.960 – 6.975 mm (0.2740 – 0.2746 in)
Exhaust	6.945 – 6.960 mm (0.2734 – 0.2740 in)
Valve guide ID	7.000 – 7.015 mm (0.2756 – 0.2762 in)
Valve stem/guide clearance:	
Intake – standard	0.025 – 0.055 mm (0.0010 – 0.0022 in)
Exhaust – standard	0.040 – 0.070 mm (0.0016 – 0.0028 in)
Intake and exhaust – service limit	0.150 mm (0.0059 in)
Valve guide overall length	45 mm (1.7717 in)
Valve guide OD	12.964 – 13.044 mm (0.5104 – 0.5135 in)
Cylinder head bore ID	13.000 – 13.018 mm (0.5118 – 0.5125 in)
Valve guide oversize available	+ 0.2 mm (+ 0.0079 in)
Valve seat angle	44° 10′ – 44° 30′
Valve seat width	1.5 mm (0.0591 in)
Valve seat oversize available	+ 0.2 mm (+ 0.0079 in)
Valve spring standard free length	44.500 mm (1.7520 in)
Spring force at 29 mm (1.14 in) test length	740 – 800 N (166.36 – 179.85 lbf)

Cylinder block	
Bore ID	66.995 – 67.005 mm (2.6376 – 2.6380 in)
Piston/cylinder clearance:	
Standard	0.030 – 0.040 mm (0.0012 – 0.0016 in)
Service limit	0.080 mm (0.0032 in)

Pistons and gudgeon pins	At size code A	At size code B
Piston standard OD:		
Mahle – nominal	66.970 mm (2.6366 in)	66.980 mm (2.6370 in)
Mahle – actual	66.963 – 66.977 mm (2.6363 – 2.6369 in)	66.973 – 66.987 mm (2.6367 – 2.6373 in)
KS – nominal	66.973 mm (2.6367 in)	66.983 mm (2.6371 in)
KS – actual	66.966 – 66.980 mm (2.6365 – 2.6370 in)	66.976 – 66.990 mm (2.6368 – 2.6374 in)
Piston weight group	+ or − stamped in piston crown. All pistons must be of same weight group, ie carry the same marking	
Gudgeon pin OD	17.996 – 18.000 mm (0.7085 – 0.7087 in)	
Piston bore and small-end bearing bush ID	18.002 – 18.006 mm (0.7088 – 0.7089 in)	
Piston/gudgeon pin clearance	0.002 – 0.010 mm (0.0001 – 0.0004 in)	

Piston rings

Top compression ring:	
Thickness	1.178 – 1.190 mm (0.0464 – 0.0469 in)
End gap – installed	0.250 – 0.450 mm (0.0098 – 0.0177 in)
Ring/groove side clearance – 75 models (Mahle)	0.050 – 0.082 mm (0.0020 – 0.0032 in)
Ring/groove side clearance – 75 models (KS)	0.040 – 0.072 mm (0.0016 – 0.0028 in)
Ring/groove side clearance – 100 models	0.013 – 0.027 mm (0.0005 – 0.0011 in)
Second compression ring:	
Thickness	1.478 – 1.490 mm (0.0582 – 0.0587 in)
End gap – installed	0.250 – 0.450 mm (0.0098 – 0.0177 in)
Ring/groove side clearance – 75 models (Mahle)	0.040 – 0.072 mm (0.0016 – 0.0028 in)
Ring/groove side clearance – 75 models (KS)	0.030 – 0.062 mm (0.0012 – 0.0024 in)
Ring/groove side clearance – 100 models	0.012 – 0.026 mm (0.0004 – 0.0010 in)
Oil scraper ring:	
Thickness	2.975 – 2.990 mm (0.1171 – 0.1177 in)
End gap – installed	0.200 – 0.450 mm (0.0079 – 0.0177 in)
Ring/groove side clearance	0.020 – 0.055 mm (0.0008 – 0.0022 in)

Connecting rods and bearings

Maximum permissible weight difference between connecting rods – without bearing shells	± 4 grams (0.1411 oz)
Note: all rods must always be of same weight category, ie carry the same colour coding	
Small-end bearing bore ID – less bush	20.000 – 20.021 mm (0.7874 – 0.7882 in)
Big-end bearing bore ID	41.000 – 41.016 mm (1.6142 – 1.6148 in)
Big-end bearing width	21.883 – 21.935 mm (0.8615 – 0.8636 in)
Crankshaft big-end journal width	22.065 – 22.195 mm (0.8687 – 0.8738 in)
Connecting rod axial play (endfloat) – at big-end	0.130 – 0.312 mm (0.0051 – 0.0123 in)
Crankpin standard OD	37.976 – 38.000 mm (1.4951 – 1.4961 in)
Size groups:	
White	37.976 – 37.984 mm (1.4951 – 1.4954 in)
Green	37.984 – 37.992 mm (1.4954 – 1.4957 in)
Yellow	37.992 – 38.000 mm (1.4957 – 1.4961 in)
Big-end bearing radial clearance	0.030 – 0.066 mm (0.0012 – 0.0026 in)
Undersize bearing shells available:	
1st stage (1 paint mark)	−0.25 mm (−0.0098 in)
2nd stage (2 paint marks)	−0.50 mm (−0.0197 in)

Crankshaft and main bearings

Crankcase bearing bore ID	49.000 – 49.016 mm (1.9291 – 1.9298 in)
Crankshaft endfloat	0.080 – 0.183 mm (0.0032 – 0.0072 in)
Thrust bearing width:	
Standard	23.000 mm (0.9055 in)
At 1st stage undersize – crankshaft reground by −0.25 mm (−0.01 in)	23.200 mm (0.9134 in)
At 2nd stage undersize – crankshaft reground by −0.50 mm (−0.02 in)	23.400 mm (0.9213 in)
Main bearing journal standard OD	44.976 – 45.000 mm (1.7707 – 1.7717 in)
Size groups:	
White	44.976 – 44.984 mm (1.7707 – 1.7710 in)
Green	44.984 – 44.992 mm (1.7710 – 1.7713 in)
Yellow	44.992 – 45.000 mm (1.7713 – 1.7717 in)
Main bearing radial clearance	0.020 – 0.056 mm (0.0008 – 0.0022 in)
Undersize bearing shells available:	
1st stage (1 paint mark)	−0.25 mm (−0.0098 in)
2nd stage (2 paint marks)	−0.50 mm (−0.0197 in)

Primary drive

Reduction ratio – crankshaft to output/balancer shaft	1 : 1

Torque wrench settings

Component	75 models		100 models	
	Nm	lbf ft	Nm	lbf ft
Cylinder head cover drain plugs – early models only	N/App	N/App	7	5
Cylinder head cover bolts	8 ± 1	6 ± 0.5	6	4.5
Crankshaft (engine right-hand) cover bolts	8 ± 1	6 ± 0.5	N/Av	N/Av
Cam chain (engine front) cover screws	7 ± 1	5 ± 0.5	6	4.5
Cam chain top guide rail Torx screws	9 ± 1	6.5 ± 0.5	N/Av	N/Av
Camshaft bearing cap nuts	9 ± 1	6.5 ± 0.5	8.8	6.5
Camshaft sprocket bolts	54 ± 6	40 ± 4.5	54	40
Cam chain tensioner mounting screws	9 ± 1	6.5 ± 0.5	N/Av	N/Av
Crankshaft sprocket and ignition rotor flange retaining bolt	50 ± 6	37 ± 4.5	50	37
Cylinder head bolts – bolt threads lightly oiled:				
1st stage	30 ± 4	22 ± 3	30	22
2nd stage – after 20 minute wait	45 ± 5	33 ± 4	45	33

Component	Nm	lbf ft	Nm	lbf ft
Connecting rod big-end bearing cap retaining nuts:				
1st stage – to preload shells	30 ± 3	22 ± 2	30	22
2nd stage – applies to all models	Tighten (rotate) nuts through an angle of 80°			
Crankshaft main bearing cap bolts	50 ± 6	37 ± 4.5	50	37
Crankcase lower section to cylinder block:				
10 mm bolt – output shaft rear	40 ± 5	29.5 ± 4	40	29.5
8 mm bolt or screw – output shaft front	18 ± 2	13 ± 1.5	21	15.5
6 mm bolt or screw	7 ± 1	5 ± 0.5	6	4.5
Oil/water pump assembly mounting screws	7 ± 1	5 ± 0.5	N/Av	N/Av
Auxiliary drive shaft bearing retainer screws	9 ± 1	6.5 ± 0.5	N/Av	N/Av
Bellhousing Torx screws	9 ± 1	6.5 ± 0.5	N/Av	N/Av
Starter clutch body/auxiliary drive shaft:				
Early 100 models – 8 mm screws	N/App	N/App	24	18
Late models – 6 mm bolts	9 ± 1	6.5 ± 0.5	9 ± 1	6.5 ± 0.5
Alternator drive flange/auxiliary drive shaft retaining bolt	33 ± 4	24 ± 3	33	24
Engine and transmission unit/frame mountings:				
Early (1984, 1985) 100 models	N/App	N/App	32	23.5
Late (1986 on) 100 models, 75 models	40.5 ± 4	30 ± 3	40.5 ± 4	30 ± 3

1 General description

The engine is a liquid cooled four-stroke type, of three cylinders (75 models) or four cylinders (100 models). The cylinders are arranged in line but the crankshaft is disposed longitudinally, parallel to the machine's centre line and the cylinders are laid flat so that the cylinder head (or 'top' end) is on the machine's left and the crankshaft (or 'bottom' end) is on its right. All castings are of aluminium alloy, the main crankcase being made as light and compact as possible by the use of plated cylinder bores instead of separate (usually cast iron) liners. The pistons run in bores which are accurately machined in the crankcase and given a hard bearing surface by having a thin layer of nickel/silicon carbide ('Scanimet') deposited electrically and ground to the required tolerances. Passages for coolant are included in the cylinder head and block castings.

The forged steel crankshaft incorporates four (75 models) or five (100 models) plain main bearing journals which rotate in split shell bearings and are secured to the crankcase by large bolted-on caps. The rearmost crankshaft web is fully circular with gear teeth machined in its periphery, and a small sprocket and rotor flange are attached to the crankshaft front end to drive respectively the camshaft and ignition trigger assembly.

The connecting rods have detachable bolted on big-end caps; split shell bearings are fitted at the big-end bearing and a plain bush at the small-end bearing. The pistons are flat-topped and are fitted with two plain compression rings and one oil scraper ring.

The valves are set in deep wells in the cylinder head and are each closed by a single coil spring. An inverted bucket-type cam follower (or tappet) is fitted over each valve/spring assembly; these cam followers have a recess machined in their upper ends into which a thick steel shim is placed to permit adjustment of the valve clearances. The shims are hardened to withstand the action of the camshaft lobes which bear directly upon them.

The valve opening is controlled by two overhead camshafts which run in bearing surfaces machined directly in the cylinder head casting and are each retained by four (75 models) or five (100 models) separate bearing caps. They are driven from the crankshaft by a single-row roller chain which has plastic-faced guide blades between the camshafts and between the intake camshaft and the crankshaft, and a plastic-faced pivoting tensioner blade which is pressed against the chain 'slack' run (ie between the crankshaft and the exhaust camshaft) by a hydraulically-operated chain tensioner assembly.

Drive from the crankshaft is transmitted via the large gear on the rear web to a secondary shaft which is disposed parallel to and underneath the crankshaft along the machine's centre line. The matching gear on this secondary, or engine output, shaft is of the same size as the crankshaft gear to give a 1:1 reduction ratio but incorporates a spring-loaded anti-backlash gear to reduce noise. The shaft serves not only to transmit drive to the clutch and transmission (see Chapter 2) but also drives the combined oil/water pump assembly from its forward end. On 75 models two balancer weights are incorporated in the shaft to cancel out the rocking couple produced by the motion of the two outer pistons and thus eliminate the only vibration source inherent in any 120° triple; on 100 models drive is actually transmitted via a large housing, with vanes protruding from its inner surface, through rubber blocks to damp out transmission shocks to a vaned shock absorber inner which is splined to the output shaft. The shaft rotates in a needle roller bearing at its forward end and a ball journal bearing at its rear end, both bearings being clamped to the underside of the main crankcase/cylinder block casting by the crankcase lower section, which also acts as the engine oil reservoir.

The fourth major engine casting is the bellhousing which is attached to the rear end of the crankcase and houses the clutch and alternator/starter motor drive components. An auxiliary drive shaft is driven via a 1.5 : 1 reduction ratio from the crankshaft gear, rotates in a needle bearing in the crankcase and a ball journal bearing set in the top of the bellhousing and has the drive flange of the alternator shock absorber bolted to its rear end. The electric starter motor drives via an idler shaft set in the bellhousing through a starter clutch mounted on the auxiliary drive shaft; a total reduction ratio of 27 : 1. Early UK only K100 and K100 RS models were fitted with a clutch containing three rollers locked by spring-loaded plungers, while later models are fitted with a sprag-type clutch containing fourteen locking elements.

Since the output/balancer shaft and the auxiliary drive shaft are gear-driven from the crankshaft they rotate in the opposite direction to it. Their combined mass, with that of the alternator and clutch, cancels out the lateral torque reaction which would otherwise be evident from the crankshaft of an engine of this layout.

2 Carrying out a compression test

1 A good idea of the internal state of the engine can be gained by testing its compression as follows.

2 The engine must be fully warmed up to normal operating temperature and the battery fully charged for the test results to be accurate.

3 Remove all the spark plugs. Noting the warnings concerning servicing the ignition system given in Chapter 6, lay the spark plugs on the cylinder head so that their metal bodies are securely earthed to the metal of the cylinder head (to prevent damage to the ignition system) and so that their electrodes are well clear of the spark plug orifices (to prevent the risk of sparks igniting any fuel/air mixture that is ejected). While one cylinder is being tested, place a wad of rag over each of the remaining spark plug apertures as additional protection.

4 Attach an accurate, good quality compression gauge (tester) to the cylinder head spark plug orifice, following its manufacturer's instructions. Open the throttle fully. Spin the engine over on the starter motor and note the readings recorded.

5 After one or two revolutions the pressure should build up to a maximum figure and then stabilise; note the reading and repeat the test on the remaining cylinders. There should be no discernible difference between any readings. The expected pressures are given in Specifications. If all pressures are the same and in the good or normal range then the engine is in good condition.

6 If there is a marked discrepancy between the readings, or if any is in the poor range, the appropriate cylinder must be checked carefully.

7 Note that during a normal compression test one would go on to temporarily seal the piston rings by pouring a quantity of oil into the barrel and then take a second set of readings. If the pressure increased noticeably it could then be assumed that the piston rings were worn

rather than the valves. Since it would be very difficult to get a full seal from such a method in a warm flat-cylinder engine there is little point in doing this; check the pistons and rings as well as the head gasket and valves when looking for the cause of compression loss.

3 Dismantling the engine unit: general

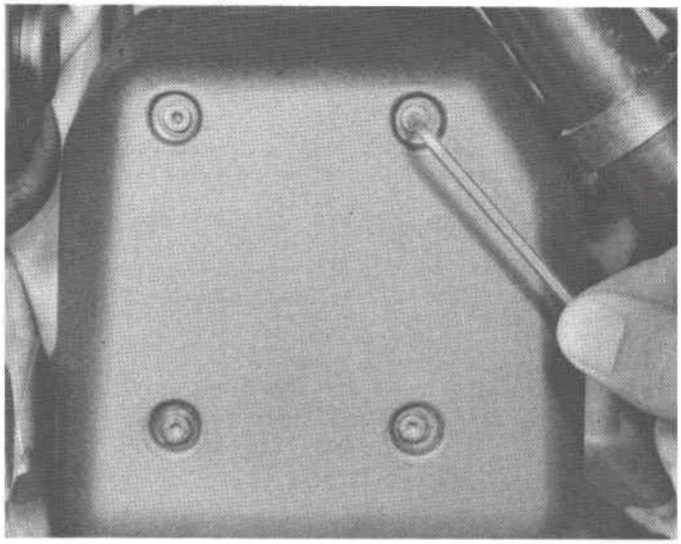
1 The engine unit is so designed that the only parts of it which cannot be removed easily while the main crankcase/cylinder block casting is in the frame are the auxiliary drive shaft, including the starter idler shaft and starter clutch, and the output/balancer shaft assemblies. If the bellhousing or the crankcase lower section are to be removed to reach any of these components, the gearbox and final drive must be removed first (see Chapter 3) so that the clutch can be withdrawn (see Chapter 2) to give access to the bellhousing. The engine and frame will require very careful supporting if this procedure is adopted. See Section 7.
2 All other components can be removed with the main crankcase/cylinder block casting and the bellhousing still in the frame. Usually, components can be easily removed leaving others intact. For example, to remove the crankshaft it is possible merely to drain the coolant, to remove the engine left-hand, right-hand and front engine covers and to disconnect the cam chain before removing the big-end and main bearing caps and withdrawing the crankshaft.
3 K75 model owners should note, however, that it is necessary on reassembly to align timing marks on the crankshaft and balancer shaft gears. Since these marks may not be easily visible from the crankshaft opening it is recommended that this task be undertaken only with the engine unit removed. The amount of preliminary dismantling necessary to remove the balancer shaft with the engine in the frame means that there is in practice very little extra work to remove the entire unit and gain much improved working conditions.
4 Owners of all models should note that if a major overhaul is to be undertaken, or if more than one component requires attention at any time, the engine unit should be removed from the frame. This is a basically simple procedure which permits excellent access to all components and allows the major castings to be cleaned so that the high standards required for successful rebuilding are maintained.
5 While notes on alternative procedures are provided where necessary, this Chapter is based on the assumption that the engine/transmission unit is to be removed from the frame, that the engine will be separated from the clutch and transmission and that it will be completely overhauled.

4 Removing the engine unit from the frame

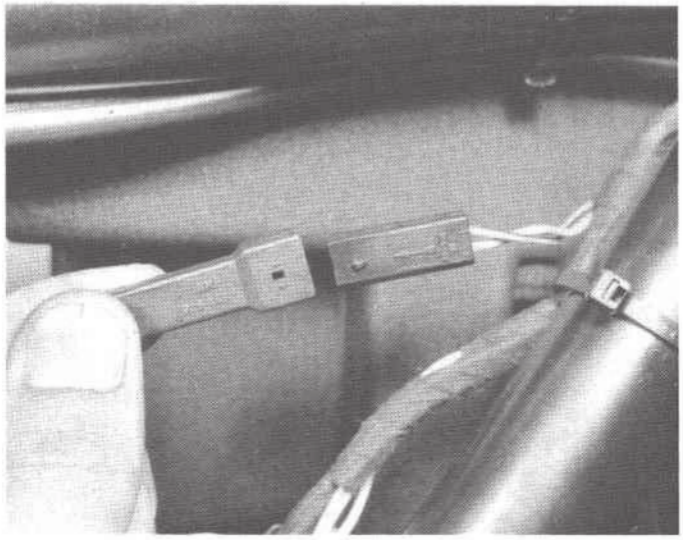
Note: *It is possible to separate the engine unit from the transmission at the bellhousing rear face and to remove the engine unit after the gearbox and final drive have first been withdrawn. (The engine cannot be removed on its own, leaving the gearbox and transmission attached to the frame, since this leads to an unacceptable risk of damage and a great deal of difficulty in aligning the clutch and gearbox input shaft and the engine mountings.)*

Since, however, the above method involves a great deal of care in aligning the gearbox input shaft and clutch release with the clutch and in supporting solidly the frame, engine and transmission components as they are separated, it is recommended that the engine and transmission are removed from the frame as a single unit and then separated; the following instructions are based on this procedure. Owners who do not wish to use the recommended method should note that procedures are similar until the final stages. Refer to Chapter 3 for more information.

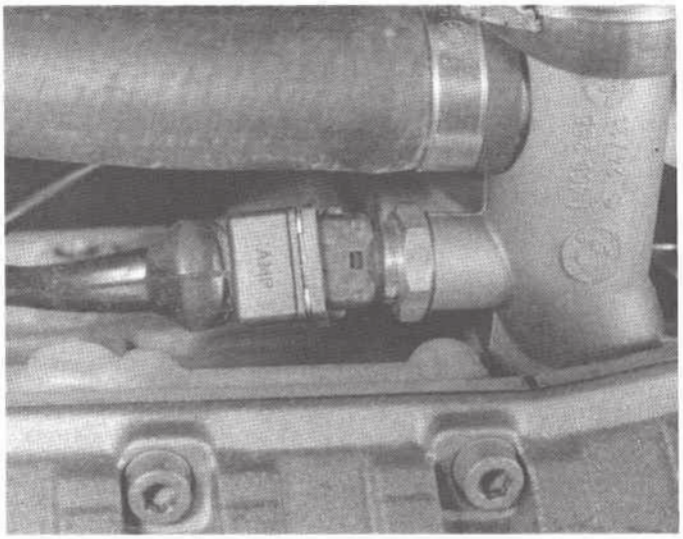
1 Place the machine firmly on its centre stand so that it is standing securely and there is no likelihood that it may fall over. This is extremely important as owing to the weight of the complete machine and the engine, any instability during dismantling will probably be uncontrollable. If possible, place the machine on a raised platform. This will improve accessibility and ease engine removal. Again, owing to the weight of the machine, ensure that the platform is sufficiently strong and well supported.
2 Drain the engine oil and remove the oil filter, as described in Routine Maintenance.
3 On K100 RS, K100 RT and K100 LT models it should suffice to remove only the fairing knee pads and lower sections (side panels and radiator cover); owners may, however, feel it preferable to eliminate any risk of damage by removing the entire fairing. On K75 S models it is best to remove the fairing. Where fitted, remove also the engine spoiler or belly fairing. Refer to Chapter 7.
4 On all models, lift the seat, remove both side panels, remove the radiator cover panels (where fitted), then remove the fuel tank as described in Chapter 5.
5 Note that whenever any component is moved, all mounting nuts, bolts, or screws should be refitted in their original locations with their respective washers and mounting rubbers and/or spacers.
6 Disconnect and remove the fuel injection control unit and storage tray, as described in Chapter 5.
7 Remove the battery as described in Routine Maintenance and tie the coolant expansion tank to the frame out of harm's way.
8 Remove the air intake hose.
9 Working as described in Chapter 4, drain the coolant, disconnect the radiator hoses (pull the bottom hose out of the crankcase cover) and remove the radiator.
10 Remove the exhaust system. See Chapter 5.
11 Remove the alternator cover, ignition HT coil cover, number plate bracket and the rear mudguard.
12 Working as described in Routine Maintenance, disconnect and remove clear of the engine/transmission the throttle, choke and clutch cables.
13 Working methodically round the machine, disconnect all electrical wires joining the engine/transmission unit to the frame. Trace each wire from the component concerned up to the connector joining it to the main wiring loom and separate the connector; noting where each is installed. Remove the clamps or cable ties securing the wire to the frame. These wires include the alternator connector plug, the starter motor cable, the ignition HT coil low-tension wires (make a written note of exactly what colour wire is fitted to which terminal), the frame earth connection (retained by a single nut and bolt to the left-hand side of the frame top tubes, at the rear of the steering head), the speedometer impulse transmitter, the stop lamp rear switch, the gear position indicator switch, the oil pressure switch, the ignition trigger assembly, the choke warning lamp switch and the engine wiring harness. Be very careful to check that all wires are released and are positioned so that they will not hinder the removal of the frame from the engine/transmission unit.
14 Slacken the two engine front mounting nuts and the bolts securing the bellhousing/frame joint and the two gearbox/frame joints; also the rear suspension bottom mounting nut. If any fastener is difficult to move, apply a good quantity of penetrating fluid and allow time for it to work before proceeding further. In the case of the front mounting bolts, slacken the nuts and attempt to break the bolts free by rotating them before attempting to tap them out. Make a final check that all components have been disconnected/or removed which might hinder the removal of the frame from the engine/transmission unit; the unit should now be held only by its six mountings.
15 Enlist the aid of two or three assistants to withdraw the frame; one to 'steer' the front forks, another to lift the back of the frame and a third to help with the engine/transmission unit.
16 Place blocks of wood or similar under the sump so that the engine is securely supported and cannot fall. Place another block of wood or similar support under the final drive case; the support should be tall enough to fit closely under the casing.
17 Remove the rear suspension unit from its bottom mounting and lower the final drive case on to its support; **do not** allow the swinging arm to move too far downwards or the gaiter at its front end may be torn and **never** allow it to drop or it may crack the casing.
18 With the assistants standing ready, unscrew and remove the bellhousing mounting bolt, the engine front mountings and the gearbox mounting bolts; note carefully the presence and number of any shims that may be found at any of the mountings. The engine/transmission unit should now be supported securely on its sump support, on the centre stand and on the rear wheel/final drive support.
19 Taking care not to scratch the paintwork or damage any component, carefully lift the frame at the rear and walk it forwards clear of the engine and transmission.
20 On K100 RS, K100 RT and K100 LT models check the engine front mounting rubber bushes for cracks, splits, perishing or compaction and renew them if they show any sign of deterioration or damage.



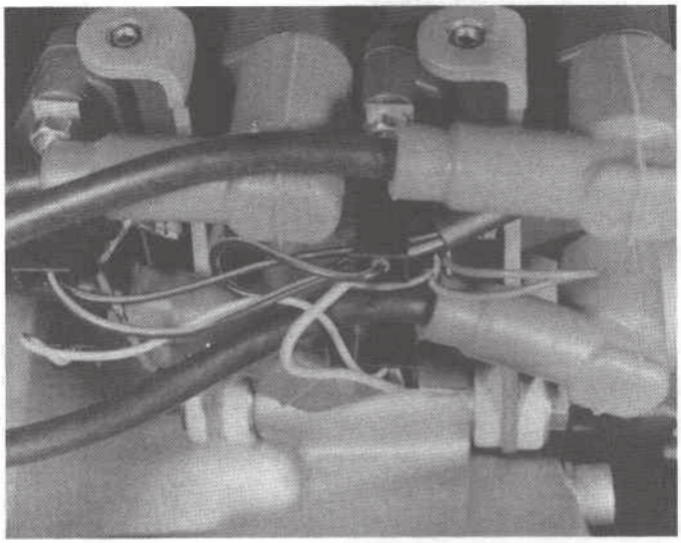
4.11 Ignition HT coil cover is retained by four Allen screws – 100 models



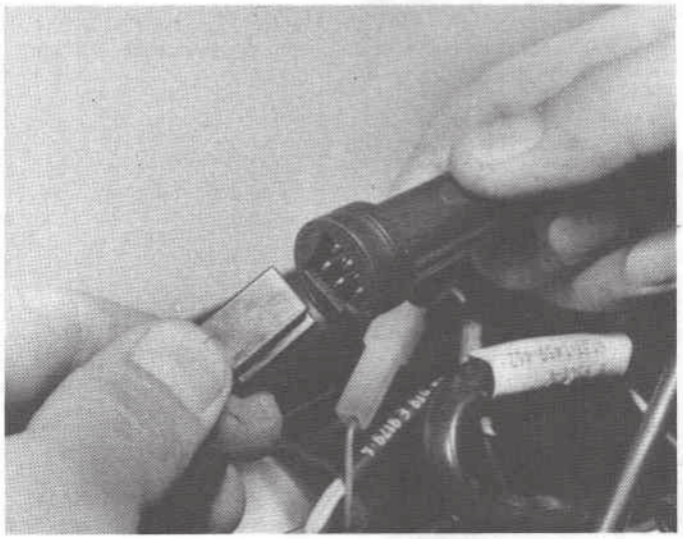
4.13b Check that all wires are disconnected between engine/transmission and frame – note speedometer impulse transmitter wires ...



4.13d Coolant temperature sensor connector is secured by a wire clip



4.13a Make a written note of connections before disconnecting ignition HT coil leads



4.13c ... and ignition trigger assembly wires

5 Dismantling the engine unit: preliminaries and general procedures

Preliminary dismantling

1 If the engine/transmission unit has been removed as a single unit withdraw the alternator and starter motor (see Chapter 10) and separate the gearbox and final drive (see Chapter 3) from the bellhousing, noting that it will be necessary to remove the stand assembly to reach the two lowest gearbox/bellhousing retaining screws. There is no need to separate the final drive from the gearbox. Dismantle the clutch as described in Chapter 2.

2 As described in Chapter 5, remove the top half of the air filter assembly with the engine wiring harness attached to it, disconnect the loom from all other electrical components. Withdraw the air filter element and the air cleaner bottom half, the fuel rail and injectors, the plenum chamber and crankcase breather, the throttle bodies and intake stubs and the EECS pressure relief valve and hoses (where fitted).

3 Remove the coolant hose stub. See Chapter 4.

4 Remove the ignition HT coils, noting carefully where the HT leads are connected, see Chapter 6. Remove the spark plugs and HT leads as described in Routine Maintenance.

5 If necessary, remove the sump (oil pan) and pump pick-up as

described in Chapter 5, and remove the oil/water pump assembly as described in Chapters 4 and 5.
6 Remove the ignition trigger assembly as described in Chapter 6.

General procedures
7 If any of the following operations are to be carried out with the main cylinder block still in the frame, ensure that the machine is supported firmly on the centre stand. It is less tiring if the machine can be raised off the ground on a strong, low, bench. Have blocks to hand for supporting the rear of the machine, especially if the rear wheel is to be removed.
8 Before commencing any work involving the electrical system, disconnect the battery negative (earth) lead at the terminal to prevent any risk of short circuits.
9 On K100 RS, K100 RT and K100 LT models it will usually be necessary to remove the fairing knee pads and lower sections (side panels and radiator cover) to gain adequate access to components, refer to Chapter 7 for full details. The complete fairing can be removed to eliminate any risk of damage, if required. Where fitted, remove the belly fairing or engine spoiler. See Chapter 7.
10 Before any dismantling work is undertaken, the external surfaces of the unit should be thoroughly cleaned and degreased. This will prevent the contamination of the engine internals, and will also make working a lot easier and cleaner. A high flash-point solvent, such as paraffin (kerosene) can be used, or better still, a proprietary engine degreaser such as Gunk. Use old paintbrushes and toothbrushes to work the solvent into the various recesses of the engine castings. Take care to exclude solvent or water from the electrical components and intake and exhaust ports. The use of petrol (gasoline) as a cleaning medium should be avoided, because the vapour is explosive and can be toxic if used in a confined space.
11 When clean and dry, arrange the unit on the workbench, leaving a suitable clear area for working. Gather a selection of small containers and plastic bags so that parts can be grouped together in an easily identifiable manner. Some paper and a pen should be on hand to permit notes to be made and labels attached where necessary. A supply of clean rag is also required.
12 Before commencing work, read through the appropriate section so that some idea of the necessary procedure can be gained. When removing the various engine components great force is seldom required, unless specified. In many cases, a component's reluctance to be removed is indicative of an incorrect approach or removal method. If in any doubt, re-check with the text.
13 **Note:** *All descriptions of locations ie left, right, front and rear refer to components as they would be if installed in the machine with the rider normally seated. Given the potential for confusion with this engine design the terms 'top end' and 'bottom end', referring respectively to the cylinder head and crankshaft assemblies, have been avoided if at all possible. However in some unavoidable cases, mention has been made of 'upper' or 'lower' components; these refer to the upper side, ie the intake side or top surface of the engine or to the lower side, ie the exhaust side or underneath (sump/oil pan) of the engine. Bear this in mind at all times, but particularly if the engine is supported in some unusual position on the workbench.*

6 Dismantling the engine unit: removing the outer covers

General
1 While specific instructions are given below for each cover, the following general notes apply to all.
2 Since all are well above the level of oil there is no need to drain the engine oil before removing any of these covers but be prepared to mop up or catch the small amount of oil that will be released as the cover is removed.
3 Wipe off all traces of dirt from around the cover before removing it, so that nothing drops into the engine.
4 Take care not to stretch or damage the rubber seals fitted to the cylinder head and crankcase covers; these can be re-used many times if they are undamaged.
5 Always slacken screws by a turn at a time, working in a diagonal sequence from the outside inwards. When all pressure is released, remove the screws, tap the cover lightly once or twice with a soft-faced mallet to break the seal and pull the cover away.

Cylinder head (engine left-hand) cover
6 On K100 RT and K100 LT models remove the fairing left-hand knee pad and lower side section. Where fitted, remove the belly fairing, or engine spoiler. See Chapter 7. Remove the spark plug cover (see Routine Maintenance) and pack the spark plug channel with rag or similar to prevent oil from flowing into it.
7 On early K100 and K100 RS models remove the two drain plugs screwed into the cover and place the machine on its side stand so that any oil remaining in the cover can drip out. On all other models be prepared to catch the residual oil as the cover is removed.
8 Remove the ten (75 models) or twelve (100 models) bolts securing the cover and withdraw it, noting the presence of the coil spring fitted to one of the camshaft bearing caps. Mop up any spilt oil; **do not** allow oil to flow into the spark plug channel.

Crankshaft (engine right-hand) cover
9 On K100 RS, K100 RT and K100 LT models remove the fairing right-hand knee pad, lower side section and radiator cover. Where fitted, remove the engine spoiler or belly fairing and the radiator cover panels. See Chapter 7.
10 Drain the coolant if not already done, then disconnect and remove the radiator bottom hose. See Chapter 4.
11 Remove the eight (75 models) or ten (100 models) bolts securing the cover and withdraw it.

Cam chain (engine front) cover
12 It is possible to remove this cover after merely slackening the crankshaft cover bolts and removing the two cylinder head cover front bolts; however this is not recommended as it is not possible to clean the sealing surfaces well enough to guarantee a leak-free joint on reassembly. Start by removing both engine side covers as described in paragraphs 6-11 above.
13 Remove the complete ignition trigger assembly as described in Chapter 6.
14 Disconnect the oil pressure switch wire and feed it downwards clear of the front cover, releasing the metal securing clips. Remove the horn (75 models only).
15 Remove the cover retaining screws and withdraw the cover noting the two gaskets, one along each mating surface, and the two locating dowels set in the top mating surface. Always renew the gaskets to prevent leaks.

7 Dismantling the engine unit: removing the bellhousing and auxiliary drive shaft components

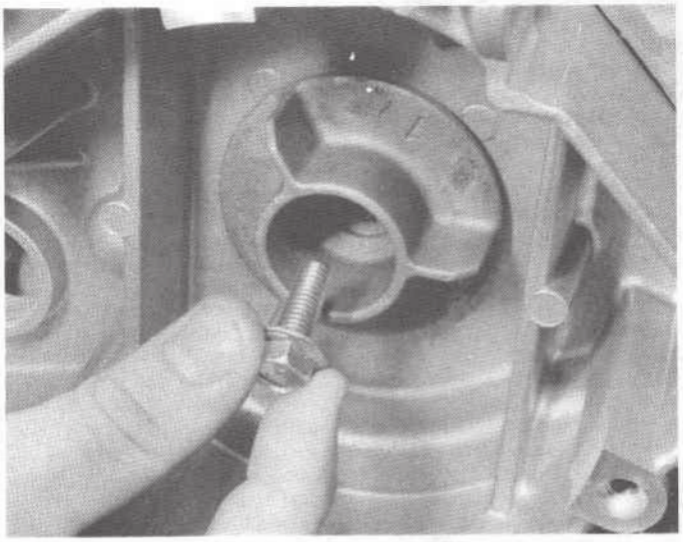
1 If the engine unit is in the frame, remove first the gearbox and final drive (Chapter 3), the alternator (Chapter 10) and the ignition HT coils (Chapter 6). Remove the clutch (see Chapter 2), but while the housing is locked to permit the retaining nut to be unscrewed, slacken also the bolt securing the alternator drive flange to the auxiliary shaft. Remove the crankshaft cover. See Section 6.
2 Owners will now have to devise some means of supporting securely the frame rear end and the engine at the same time. Note that when the frame/bellhousing mounting bolt is removed the engine will pivot, however slightly, on its two front mountings thus causing a risk of damage to other components and problems with alignment on reassembly. Only secure supports can prevent this.
3 If the frame rear end is hanging from an overhead support, as described in Chapter 6, great care must be taken not to jar the frame while the bellhousing is removed. Note that jacks should not be used to support heavy components for any length of time; they are for lifting only. Use car axle stands, blocks of wood or similar to hold the engine and frame securely at the required height.
4 When the machine is securely supported remove the bellhousing mounting bolt and any shims that may be fitted.
5 If the engine is removed from the frame temporarily refit the clutch housing and lock it as described in Chapter 2 to permit the alternator drive flange retaining bolt to be slackened. Remove the bolt and withdraw the drive flange, noting that the O-ring and thrust washer behind it may be dislodged.
6 While in practice the flange was found to be a fairly slack fit and was easily pulled away by hand, it may require a sharp tap from a

hammer and a soft metal drift or a wooden dowel (to avoid damaging the shaft) on the auxiliary shaft rear end to jar it free. BMW state that a two-legged puller, with an adaptor to protect the shaft end, is required to remove the flange; it will probably be necessary to grind down the puller claws so that they will fit between the flange and the bellhousing.

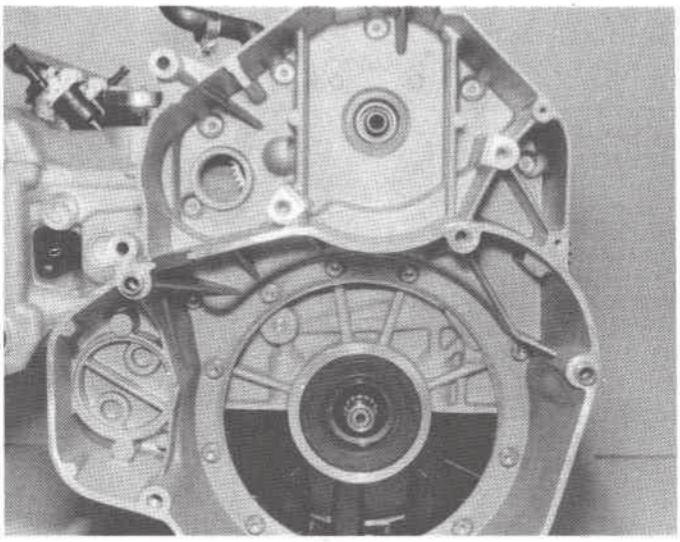
7 Remove the bellhousing/crankcase retaining screws. These are Torx screws, size T30, and will require the use of a suitable key to remove and refit them. Torx keys are available at most specialist tool shops and some auto accessory shops; it is useful to purchase a key that is attached to a socket so that a torque wrench can be used to fasten them.

8 When all the screws are removed, tap the bellhousing sharply with a soft-faced mallet to break the seal and withdraw it, noting the presence of the two locating dowels. Check carefully that the starter idler shaft and the auxiliary drive shaft are not dislodged with the bellhousing.

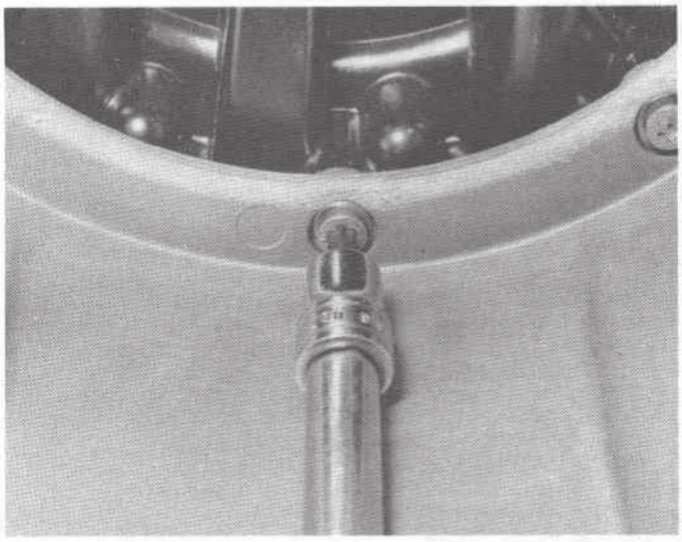
9 Carefully pull the starter idler shaft out of the crankcase and note exactly how the spring behind it (if fitted on early 100 models) is fitted before removing it. Withdraw the auxiliary drive shaft as a single unit.



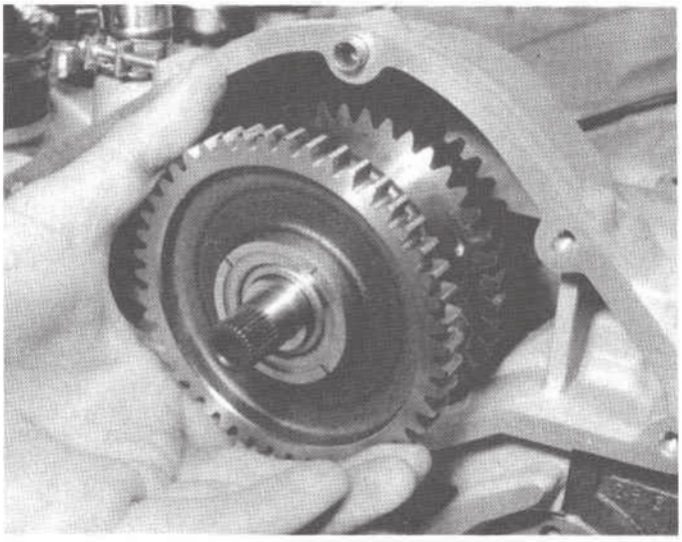
7.5 Lock crankshaft to permit removal of alternator drive flange retaining bolt



7.7a Bellhousing/crankcase retaining screws are of ...



7.7b ... Torx type – special key required for removal and refitting



7.9 Remove auxiliary drive shaft as a single unit

8 Dismantling the engine unit: removing the camshafts and cam chain

1 If the engine unit is in the frame, remove first the engine outer covers, as described in Section 6 of this Chapter. Remove the spark plugs, as described in Routine Maintenance.

2 Rotate the crankshaft by means of an Allen key placed in the ignition rotor retaining bolt until the camshafts are placed so that all valves are open as far as possible, ie so that there is the minimum pressure possible exerted on the camshafts by the valve springs. On 75 models this position is close to Number 3 cylinder being at TDC on the compression stroke.

3 Remove the chain tensioner. Some early 100 models are fitted with a chain tensioner which can be locked by turning a screw as far as possible clockwise; the tensioner mounting screws are then removed and the unit can be withdrawn. The screw is to be found in that face of the tensioner opposite to the plunger/tensioner blade assembly. On 75 models and later 100 models compress the tensioner by hand, remove the mounting screws and withdraw the unit; slowly allow it to extend until the spring pressure is released.

4 Remove their retaining clips or circlips, noting the washer behind each, and withdraw the cam chain tensioner blade and chain guide. Remove its retaining screws and withdraw the chain top guide rail from between the camshafts; these are Torx screws which BMW state are size T30 but were found on the machine featured in the accompanying photographs to be size T27. Owners should ensure that both sizes of key are available.

5 In some cases there may be sufficient slack in the chain, and sufficient clearance around the sprockets, to permit its removal at this stage but usually it will be necessary to withdraw the camshaft sprockets; use an open-ended spanner to hold the camshaft at the hexagon provided, remove the bolt and withdraw the large washer and the sprocket. While these components are the same for both intake and exhaust camshafts, it is good practice to mark them and to store them separately so that they can be refitted in their original locations. Withdraw the chain from the crankshaft sprocket.

6 If required, the ignition rotor flange and crankshaft sprocket can be withdrawn at this stage.

7 If the camshafts are to be removed, this can be done before or after the chain has been disconnected but in the former case some care will be required to avoid damaging or marking any components.

8 **Note:** Before removing the camshafts make a careful note (using a small sketch if required), of the exact location and fitted position of the bearing caps; these are clamped to the head and line-bored in a single process on manufacture and must **not** be refitted on any other bearing, nor reversed. The manufacturer has provided identification aids in the form of a number stamped into each bearing cap to match a number cast into the cylinder head next to the bearing pedestal; these numbers are stamped in the top of each cap above the threaded boss on the intake and below it on the exhaust and can only be read from the rear of the cylinder head looking forwards to help eliminate any possibility of their being reversed. Note that odd numbers are used for the intake and even numbers for the exhaust, except for the rear bearing on 100 models which is marked '0' indicating '10'. If necessary, make your own identifying marks, provided this does not involve scratching a cap or using a punch. It is useful to have ready some means of retaining the cam followers and shims. See paragraph 12.

9 To avoid tilting the camshafts, remove first the front or cam chain end (thrust) bearing caps. Unscrew the nuts alternately by a turn at a time so that each bearing is released evenly and remains square. Note the locating dowels fitted at each stud of these front bearing caps. Store the caps in separate, clearly marked containers.

10 With the front bearings removed, gradually and evenly slacken the nuts on the remaining bearing caps, working from the outside inwards until all valve spring pressure is released. Withdraw the caps and store them in separate clearly-marked containers. **Note:** take a great deal of time and trouble over this – if any bearing cap is cracked or damaged by careless workmanship it can only be replaced as part of a new cylinder head assembly.

11 Withdraw the camshafts. There is no need to mark them as the bearings are offset and the cams can be refitted only in the correct location.

12 If the camshafts are to be removed, it is worthwhile to cut two lengths of wooden dowel, of a diameter similar to that of the camshaft rear bearings, and to fasten these lightly in place using the bearing caps. This will avoid the loss of any components and the risk of the cam followers and shims falling out and getting mixed up.

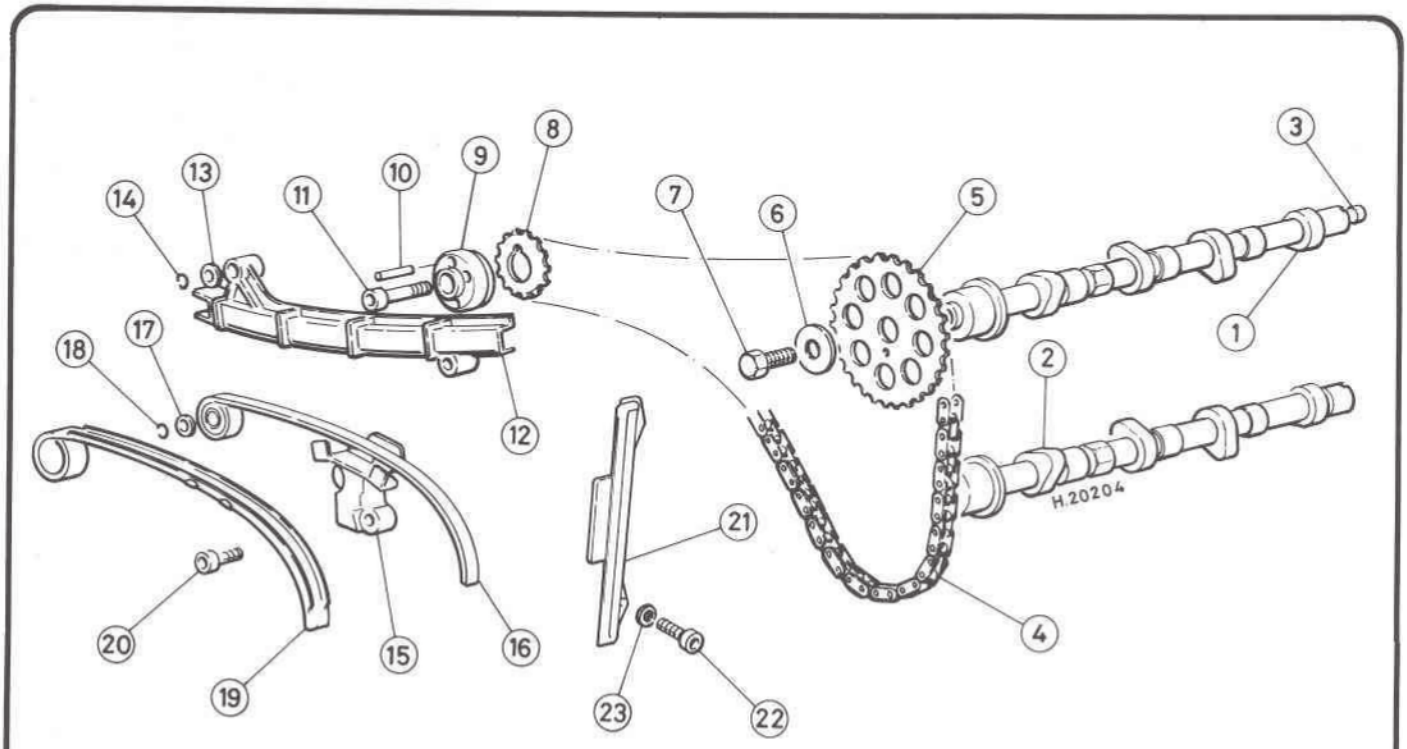
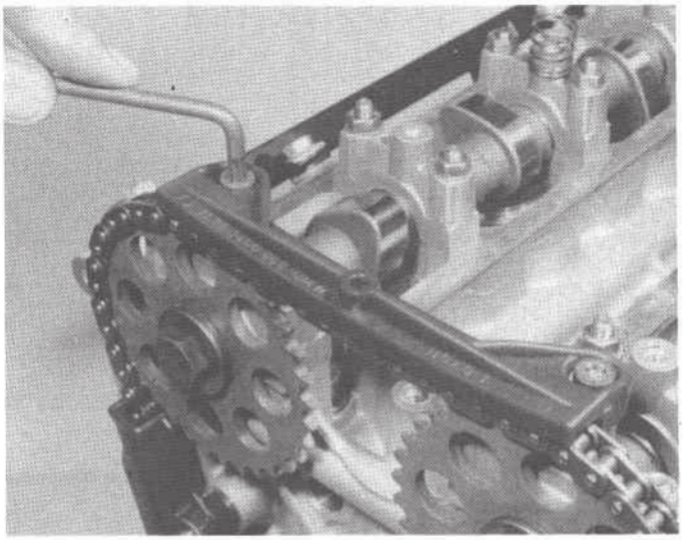
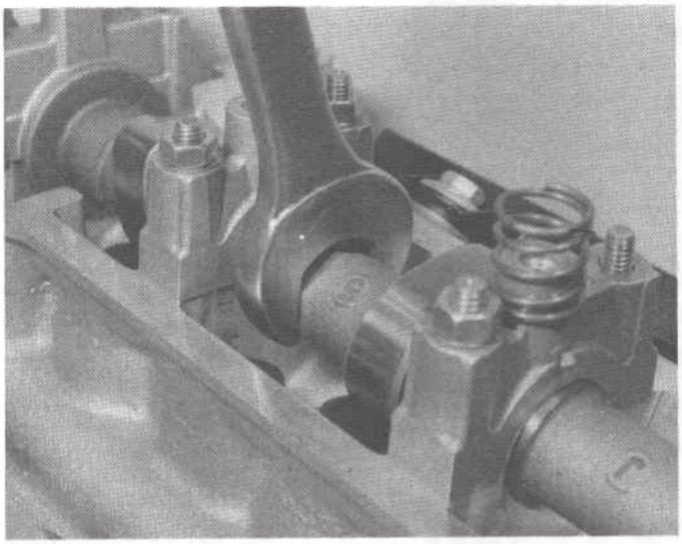


Fig. 1.1 Camshafts and cam chain

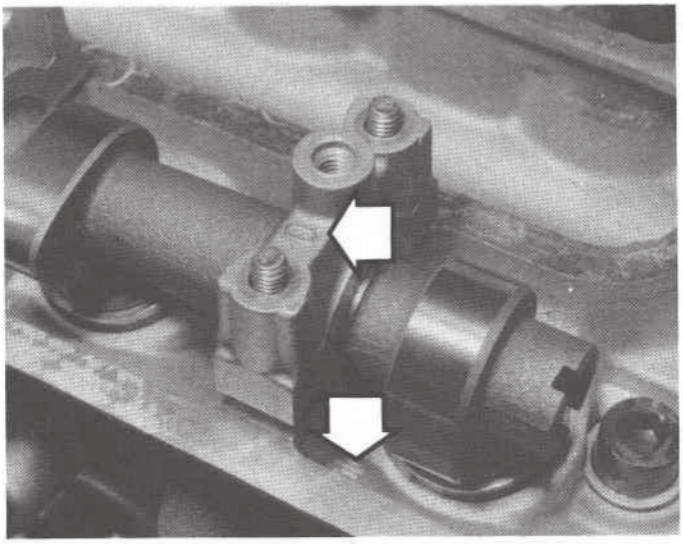
1 *Intake camshaft*
2 *Exhaust camshaft*
3 *Plug – 2 off*
4 *Cam chain*
5 *Sprocket – 2 off*
6 *Washer – 2 off*
7 *Bolt – 2 off*
8 *Sprocket*
9 *Rotor*
10 *Locating pin*
11 *Bolt*
12 *Chain guide*
13 *Washer*
14 *Circlip*
15 *Tensioner*
16 *Tensioner blade backing*
17 *Washer*
18 *Circlip*
19 *Tensioner blade plastic face*
20 *Screw*
21 *Chain top guide rail*
22 *Torx screw*
23 *Wave washer*



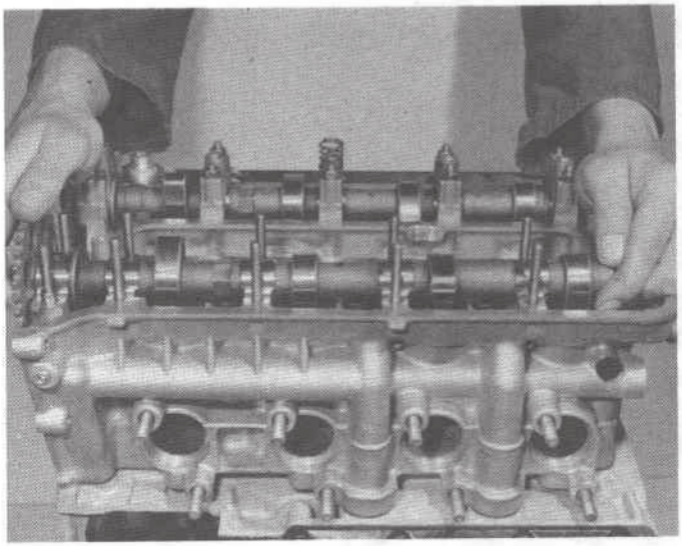
8.4 Cam chain top guide rail is retained by Torx screws – ensure correct size key is available



8.5 If sprockets are to be removed, hold camshaft as shown while retaining bolts are unscrewed



8.8 Identify camshaft bearing caps using marks provided (arrowed) before disturbing – make notes if required



8.11 Withdraw camshafts separately to avoid mixing components – camshaft bearings are offset, so cams themselves cannot be interchanged

9 Dismantling the engine unit: removing the cylinder head

1 If the engine is in the frame a large amount of preliminary dismantling is necessary before the head can be removed. Proceed as follows, referring to Section 4 of this Chapter for information on the full procedures:

2 On K100 RS, K100 RT and K100 LT models remove the fairing knee pads and lower side sections and radiator cover. On K75 S models, owners may wish to gain additional working space by removing the fairing. The engine spoiler or belly fairing and the radiator cover panels (where fitted) must be removed. Lift the seat, remove both side panels and disconnect the battery (negative terminal first) then remove the fuel tank and the exhaust system.

3 Remove the air intake hose, drain the cooling system and disconnect the radiator bottom hose. Remove the ignition HT coil cover and disconnect the throttle and choke cables.

4 Slacken the intake stub clips and the clips at the plenum chamber ends of the crankcase breather and air filter hoses. Disconnect the fuel rail hoses and the fuel injector wires, also all electrical leads from components on the throttle body assembly.

5 Noting that it may be necessary to gain extra working space by removing the air filter top and the element, carefully withdraw the plenum chamber/throttle body assembly, ensuring that all control cables and electrical leads are disconnected, also the fuel and vacuum hoses from the pressure regulator.

6 Disconnect the radiator top hose. The coolant and intake stubs and the fuel rail and injectors need only be removed, if required. Remove the HT leads and spark plugs.

7 Referring to Sections 6 and 8 of this Chapter, remove the engine outer covers and the camshafts and cam chain components.

8 Check that all components have been removed or disconnected which will prevent the lifting of the cylinder head, then remove the engine front left-hand mounting bolt and nut, noting the presence and number of any shims which might be fitted.

9 Working in a diagonal sequence from the outside inwards, progressively and evenly slacken the cylinder head bolts and then remove them with their washers; there are 8 bolts on 75 models, ten on 100 models.

10 Tap the head firmly at a suitably-reinforced point to break the seal without risking damage and withdraw it.

11 Peel off the gasket and discard it. Note the two locating dowels; unless firmly fixed in the cylinder block these should be removed and stored safely.

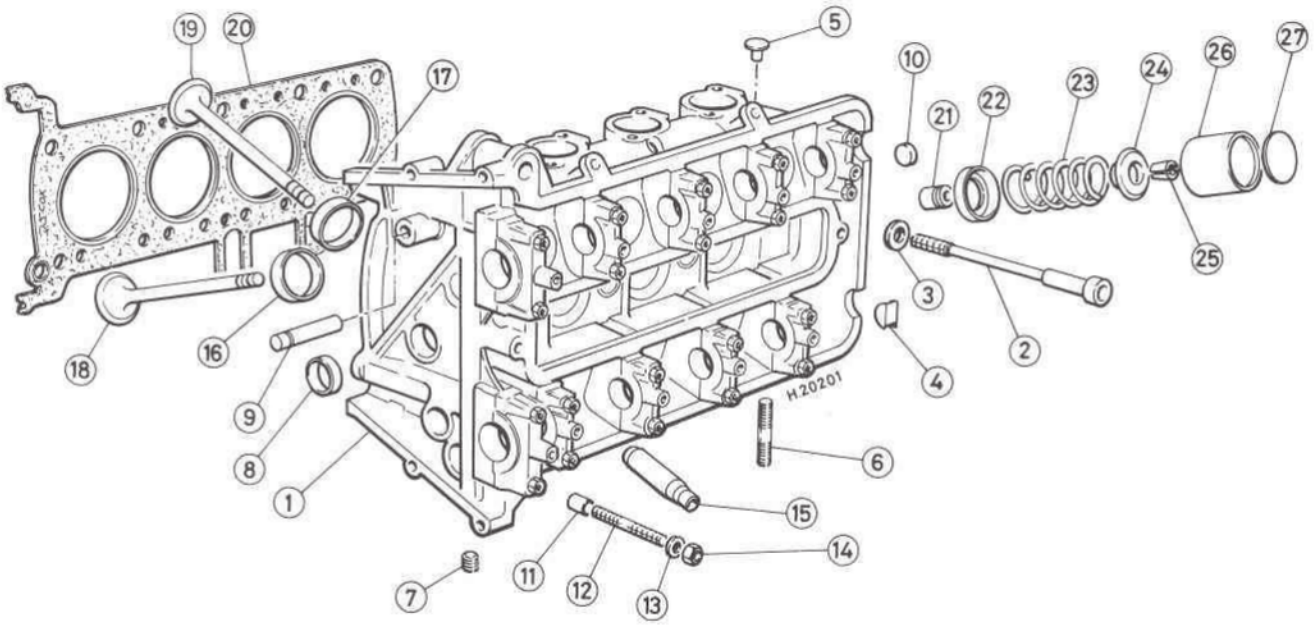


Fig. 1.2 Cylinder head and valves – 100 models (75 similar)

1 *Cylinder head*
2 *Bolt – 10 off*
3 *Washer – 10 off*
4 *Plug – 2 off*
5 *Plug – 2 off*
6 *Stud – 8 off*
7 *Threaded plug*
8 *Core plug – 2 off*
9 *Chain guide mounting pin*
10 *Core plug – 2 off*
11 *Dowel – 4 off*
12 *Stud – 20 off*
13 *Washer – 20 off*
14 *Nut – 20 off*
15 *Valve guide – 8 off*
16 *Intake valve seat – 4 off*
17 *Exhaust valve seat – 4 off*
18 *Intake valve – 4 off*
19 *Exhaust valve – 4 off*
20 *Head gasket*
21 *Valve guide oil seal – 8 off*
22 *Spring bottom seat – 8 off*
23 *Spring – 8 off*
24 *Top collar – 8 off*
25 *Split collet – 16 off*
26 *Cam follower – 8 off*
27 *Shim – as required*

10 Dismantling the engine unit: removing the pistons and connecting rods

1 If the engine is in the frame, the cylinder head must be removed first, with all the preliminary dismantling work that this entails. See Section 9.

2 Rotate the crankshaft by means of an Allen key applied to the ignition rotor flange retaining bolt. On 75 models one piston/connecting rod assembly will have to be dealt with at a time, with the crankshaft being rotated first to bottom dead centre (BDC) and then to top dead centre (TDC) as described for each assembly. On 100 models two piston/connecting rod assemblies can be removed or refitted at the same time, either the inner pair (2 and 3) or the outer pair (1 and 4).

3 **Note:** Before disturbing any component, make careful written notes of exactly how each component can be identified, also how its original fitted position can be indicated. Slowly rotate the crankshaft looking for paint spots, marks made by the manufacturer and any other identifying features; note all these and if necessary make your own. At the very least obtain three or four (as appropriate) containers in which the components of each piston/connecting rod assembly can be stored separately and clearly marked.

4 The component parts of the machine featured in the accompanying photographs were identified as follows. The pistons had larger valve cutaways on the intake side and an arrow stamped in the crown of each pointing towards the front (cam chain) of the engine. The big-end bearing caps all had red paint spots and the bearing shell lubricating channels/locating tangs were aligned against each other on the 'upper' intake side of the engine. The connecting rod small-end bearing oilway was also on the intake side and each connecting rod had a single spot of blue paint (indicating its weight group) on its rear face, ie towards the gearbox. Lastly, each rod and cap had a two-digit number etched into the flat-machined surface of its 'upper' intake side as follows: cylinder 1 marked 40, cylinder 2 marked 42, cylinder 3 marked 44, cylinder 4 marked 46. To be safe, a hammer and a small punch was used to mark the intake side of each rod and cap, making one mark on each for cylinder 1, two for 2 and so on. Check for similar marks on the machine being overhauled.

5 On 75 models position the crankshaft so that any piston is at the bottom of its stroke (BDC); on 100 models position the two middle pistons at BDC.

6 Working evenly, by one turn at a time, unscrew the two nuts securing each connecting rod big-end bearing cap and withdraw the cap; these will be very tight and will require a few taps from a soft-faced mallet to release them. When the caps have been removed, it is good practice to prevent the risk of the bolt threads marking any bearing surface by slipping a length of rubber or plastic tubing over each.

7 Rotate the crankshaft until the piston is at the top of its stroke and use a wooden dowel or similar to push the piston out of the cylinder

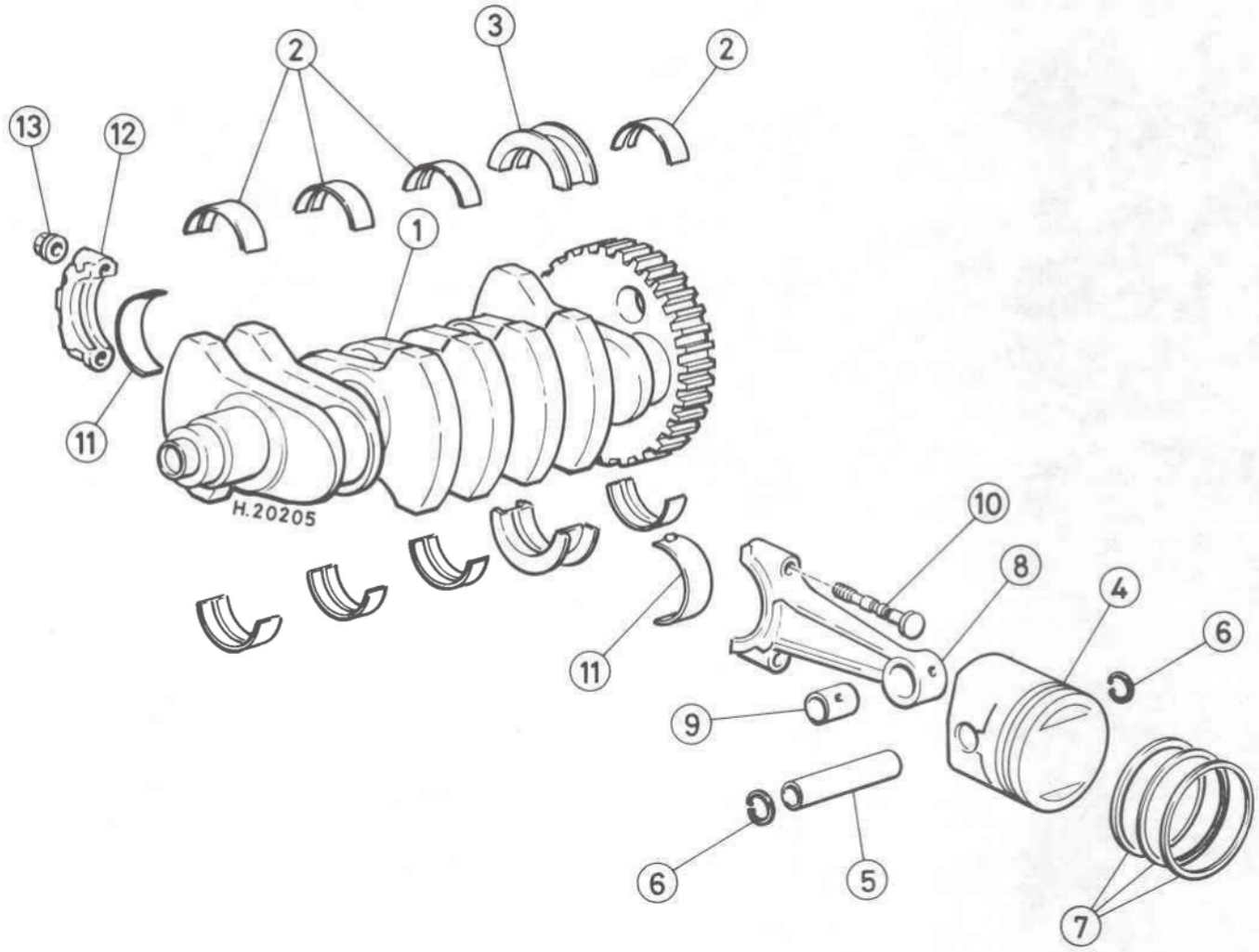


Fig. 1.3 Crankshaft, connecting rods and pistons – 100 models (75 similar)

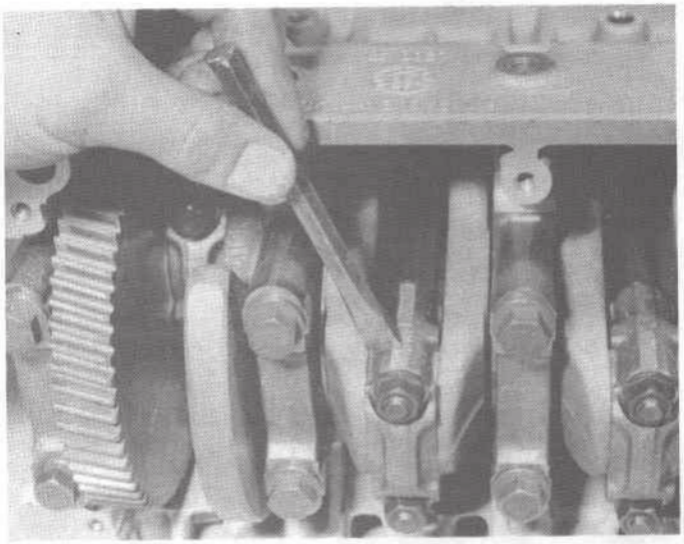
1 Crankshaft
2 Main bearing shell
3 Thrust bearing
4 Piston
5 Gudgeon pin
6 Circlip
7 Piston rings
8 Connecting rods
9 Small-end bearing
10 Bolt
11 Big-end bearing
12 Connecting rod cap
13 Nut

towards the cylinder head. Store all the components of each piston/rod assembly in a separate container and mark it with the cylinder number to avoid any risk of swapping components and promoting excessive wear by mis-matching part-worn components.

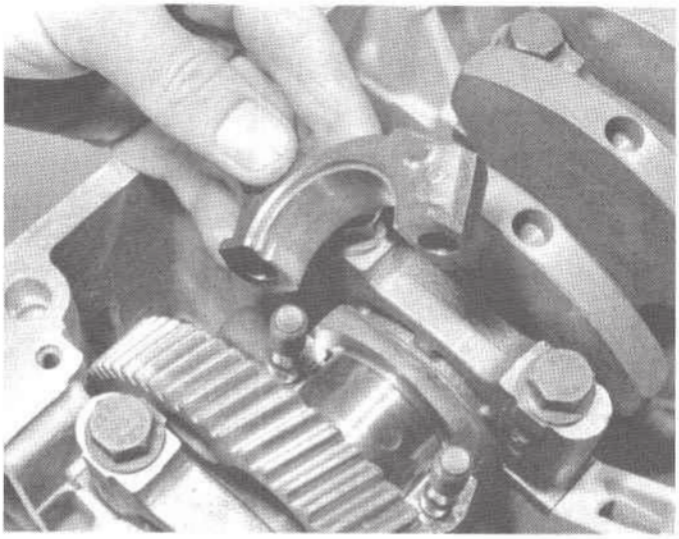
8 Repeat the procedure for the remaining assemblies.

9 Before separating a piston from its connecting rod, ensure that marks are made or identified which will ensure that they are correctly refitted. For example in the case given in paragraph 4 above, the arrow indicating the direction of piston installation was pointing 'away' from the blue paint spot on the connecting rod's rear face. Use a pointed implement to prise out the gudgeon pin retaining circlip, then press out the gudgeon pin and withdraw the piston. If the pin is a very tight fit, immerse the piston in boiling water (taking care to prevent any risk of personal injury when heating components or when handling them), thus causing the aluminium alloy piston to expand faster than the steel pin. Discard the circlip; these should never be re-used.

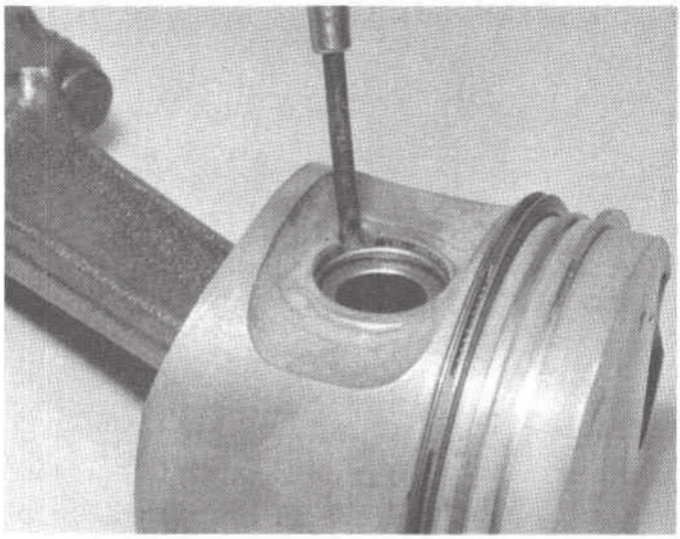
10 Remove the piston rings carefully, by expanding them sufficiently with the thumbs to pass over the piston. If necessary use three thin strips of metal to ease them from their grooves (see illustration). The rings are very brittle, and must not be handled roughly. Note which groove each ring came out of, and which way up on each piston. The two-piece oil scraper ring must be removed in two parts; first the outer section which is removed in the same way as the compression rings, and then the coil spring-type inner section.



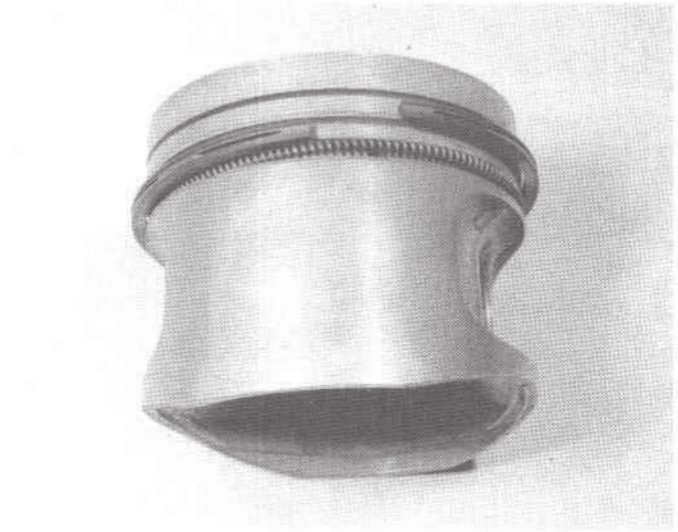
10.4 Mark connecting rods as described before removal, to ensure correct refitting



10.6 Unscrew nuts and remove big-end bearing caps, noting how shell locating tangs are positioned



10.9 Removing gudgeon pin circlips from piston – always renew disturbed circlips



10.10 Oil scraper ring is two-piece design – remove in stages, as shown



Fig. 1.4 Method of removing gummed piston rings

11 Dismantling the engine unit: removing the crankcase lower section and the output/balancer shaft

1 While these components can be removed with the main cylinder block casting still in the frame, this is not recommended. It will leave the engine unit supported precariously at its rear end and attached to the frame by two bolts (only one if the cylinder head is removed) and a few ancillary components; when one realises that the frame is supported only by the front wheel and its rear end, the potential for serious damage and personal injury may be appreciated.

2 Since the removal of the engine/transmission unit complete involves so little extra work and affords so much safer working conditions and improved access, it is the only recommended method of gaining access to these components.

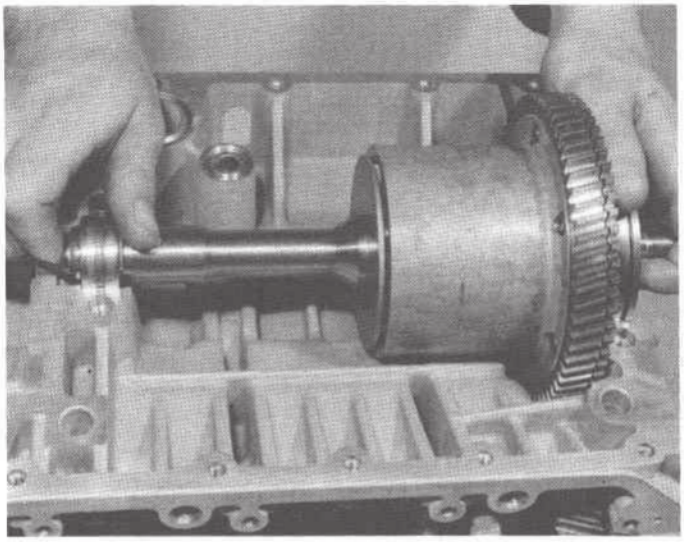
3 Owners who wish to carry out the work with the engine in the frame (against the above advice) should note that the gearbox and final drive must be removed (Chapters 3 and 8) the clutch must be withdrawn (Chapter 2) and the bellhousing removed (Section 7). Also the engine oil must be drained and the filter removed (see Routine Maintenance) and the sump and oil pump pick-up removed (Chapter 5). Finally the coolant must be drained and the oil/water pump assembly must be removed (Chapter 4 and 5).

4 Remove the Allen screws along the left- and right-hand mounting surfaces of the crankcase lower section, then remove the two hexagon-headed bolts from the inside rear and the two Allen-headed bolts or screws from the inside front. Tap the lower section with a soft-faced mallet to break the joint and withdraw the lower section noting the O-rings around the oil and coolant passages and the two locating dowels, one next to each output shaft bearing. Unless the dowels are firmly fixed in the crankcase/cylinder block, they should be removed.

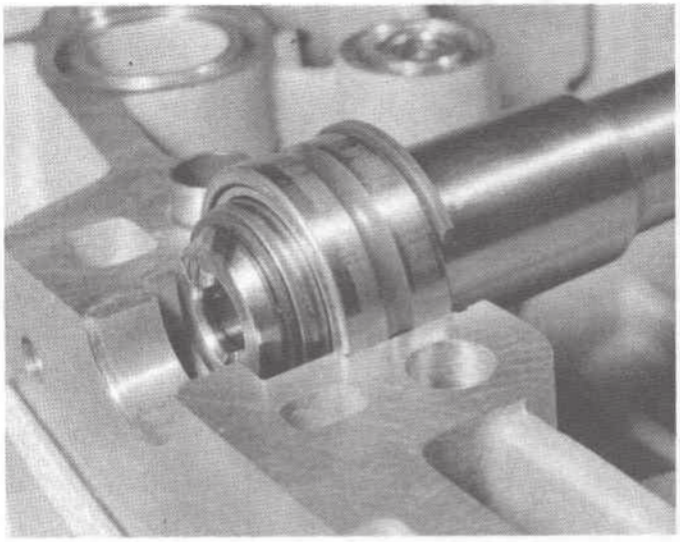
5 On 75 models, slowly rotate the crankshaft and balancer shaft until the timing marks can be seen. These should be in the form of a straight line on the crankshaft gear which aligns with either a dot or a V mark on the balancer gear. **Do not** disturb either shaft until the marks have been found and noted.

6 Withdraw the output/balancer shaft and its rear seal noting that its front needle roller bearing is loosely fixed and may drop clear.

7 On some early models whose output shafts are fitted with rear bearings which have a thin (1.75 mm/0.07 in thick) locating circlip at the forward end of the bearing outer race, the bearing may be glued in place with Loctite 273, Three Bond 1110 B or similar adhesive. If any difficulty is encountered in removing such a bearing, the adhesive should be heated (maximum of 300°C/572°F) to break it down and to release the bearing.



11.6a Remove crankcase lower section to release output shaft ...



11.6b ... noting that front bearing is loose and may drop clear

12 Dismantling the engine unit: removing the crankshaft

1 As mentioned in Section 3, the crankshaft can be removed whether or not the engine unit is in the frame. It is possible, if required, to remove the crankshaft by draining the coolant and removing the engine outer covers (Section 6), removing the cam chain from the crankshaft and camshafts (Section 8), and releasing the big-end caps from the crankshaft (Section 10). If their removal is not necessary, and provided that care is taken not to allow them to touch the valves, the pistons can be left in the bores while the crankshaft is removed and refitted. This avoids the need to remove the cylinder head.

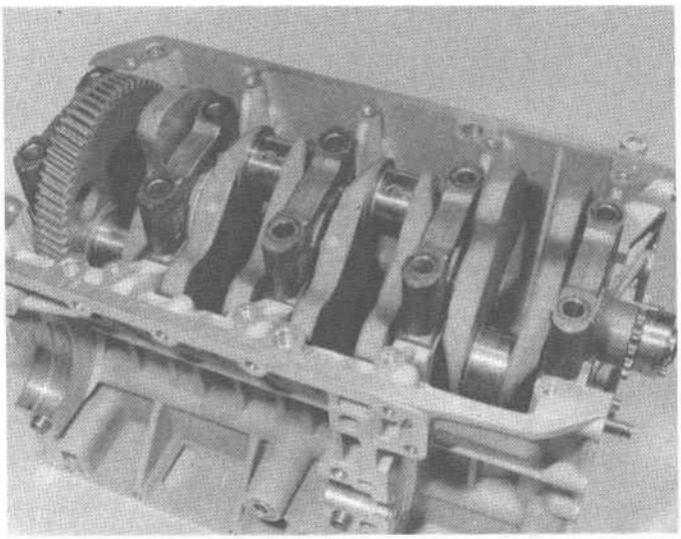
2 Owners of 75 models should check whether the crankshaft/balancer shaft marks are visible as soon as the crankshaft cover is removed. If these timing marks cannot be seen, the crankcase lower section and balancer shaft **must be removed** to permit the marks to be aligned on reassembly. See Section 11. If the cylinder head is to be removed, removing the entire engine/transmission unit involves so little extra work and produces so much better access and safer working conditions that it is strongly recommended.

3 With the preliminary dismantling operations that are described above carried out, inspect the main bearing caps, making careful written notes of how each cap can be identified and how its original fitted position can be indicated. Look for paint spots, manufacturer's stamped marks and any other identifying features; note all these and if necessary make your own.

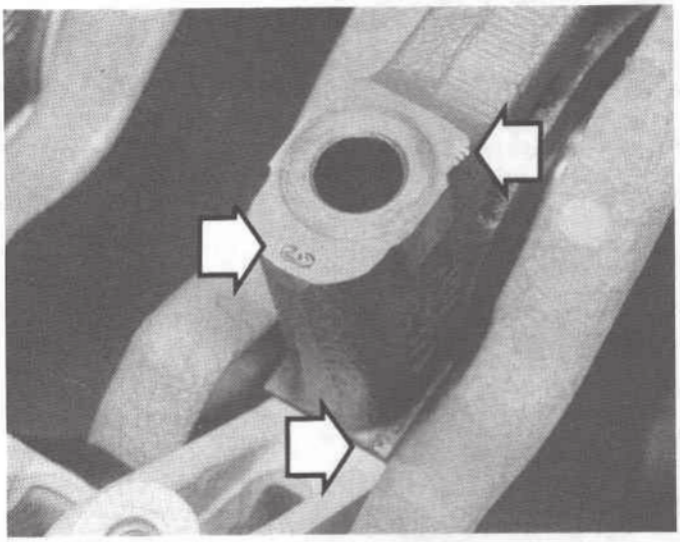
4 The component parts of the machine featured in the accompanying photographs were marked as follows, counting the main bearings consecutively from front to rear, number 1 being next to the cam chain; bearing caps number 1, 2 and 3 were stamped with the figure 1, 2 or 3 respectively on the 'lower' exhaust retaining bolt boss, also at the base of the cap 'lower' end. Number 4 bearing cap carried the thrust bearing and number 5 carried no identification at all; to be safe a hammer and a small punch were used to mark the sides of the 'lower' retaining bolt boss of each cap, making one mark for bearing number 1, two for 2 and so on. Check for similar marks on the machine being overhauled and note that on 75 models bearing caps numbers 1 and 2 are numbered, number 3 carries the thrust bearing and number 4 is unmarked. When the caps are removed, note that the bearing shell locating tang grooves/oilways of each cap and the crankcase are aligned against each other on the 'lower' side of each bearing.

5 Working evenly, by one turn at a time, unscrew the two bolts securing each main bearing cap, tap the cap firmly but gently with a soft-faced mallet to release it and withdraw it, noting which way round it is fitted. To ensure an even release of pressure first slacken all the bolts and then remove the caps in the following sequence: 75 models, rear bearing, front bearing (number 1), number 3, number 2 – 100 models, rear bearing (number 5), front bearing (number 1) , number 4, number 2, number 3.

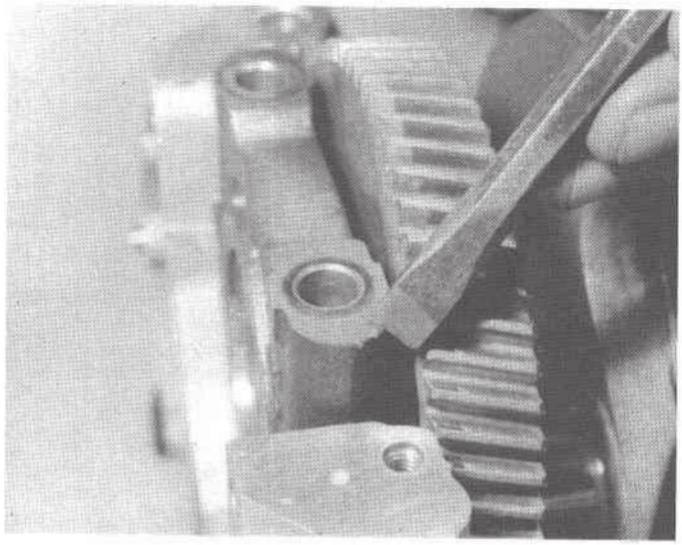
6 With all caps removed, lift out the crankshaft.



12.3 Before removing crankshaft main bearing caps ...



12.4a ... make notes of any marks identifying each cap's fitted position (arrows) ...



12.4b ... and if necessary make your own – see text

13 Dismantling the engine unit: removing bearings and oil seals

Note: *All oil seals should be renewed as a matter of course whenever they are disturbed, but bearings should be disturbed only if examination proves them to be worn or defective. Proceed as described below but note that where instructions are given requiringthe use of heat, castings must be heated evenly to the required temperature. This means using an oven, or placing the casting in a container and pouring boiling water over it (taking care to avoid splashes); do not use sources of fierce localised heat such as gas-powered torches.* **Always** *clean castings carefully and remove any components that might be damaged by heat before heat is applied, and always take precautions (wearing suitable protective clothing, gloves etc) to prevent the risk of damage or of personal injury when heating components or when handling them.*

1 The auxiliary driveshaft rotates on a needle roller bearing at the front, in the upper rear part of the main crankcase/cylinder block casting, and on a ball bearing in the bellhousing.

2 If the needle roller bearing is to be renewed, it can be extracted using a slide-hammer with the correct internally-expanding adaptor; BMW recommend that the crankcase casting is heated evenly, in an oven or similar, to 100–120°C (212–248°F) to permit the bearing to be removed. If these tools are not available, use a hammer and a small pin punch to drive in part of the bearing outer race so that it can be gripped with pliers and drawn out; be very careful not to damage the bearing housing and to collect all the pieces of the bearing if this method is used.

3 If the rear bearing is to be removed, withdraw the retainer plate (held by three Allen screws) noting the conical spring washer behind it, and carefully lever out the oil seal (see below) before withdrawing the locating circlip. The bearing can then be driven out using a tubular drift such as a socket spanner which bears only on the bearing outer race; note that BMW recommend the bellhousing is heated evenly, in an oven or similar, to 100–120°C (212–248°F) to permit the bearing to be removed. Clean all traces of Loctite from the threads of the retainer plate screws and their tapped holes.

4 The output shaft front bearing can be pulled off the shaft front end by hand while the rear bearing will require the use of a bearing puller to withdraw it from the shaft, after the retaining circlip has been released.

5 The starter clutch gear pinion rotates on two needle roller bearings. If these are to be removed they can be driven out using a hammer and a suitable drift; take care not to damage the pinion on any surface.

6 If the output shaft rear oil seal is to be removed without separating the crankcase lower and main sections it can be levered out, providing that great care is taken not to damage the shaft, the seal housing or the crankcase around it; use only a tool with well-rounded edges and pivot it against a block of wood placed on the crankcase. Alternatively, two self-tapping screws can be screwed into the seal (as close to its outside edge as possible without marking the seal housing) to provide points which can be gripped with two pairs of pliers or similar so that the seal can be pulled out; take care not to allow the screws to touch the bearing.

7 If the auxiliary drive shaft rear seal is to be renewed with the shaft removed it can be levered out. If the shaft is still in place, the seal can be pulled out using the second of the two methods described above.

8 If the crankshaft front oil seal is to be removed from the cam chain (engine front) cover while the cover is still in place, it can be extracted using two self-tapping screws as described above. However, this seal is a tight fit and owners may find it necessary to remove the cover in order to renew the seal to prevent any risk of damage; note that refitting will be difficult with the cover in place. If the cover is removed, the seal can be tapped out using a hammer and a socket spanner or similar as a tubular drift. In exceptional circumstances heat the cover by immersing it in boiling water to loosen the seal's grip.

9 If the oil level sight glass is leaking or damaged it can be removed as follows from the crankcase lower section. Drive a sharp-edged screwdriver or similar into the sight glass centre and lever out the glass and seal, then withdraw the metal cage; this will have to be levered out, distorting it in the process, so care must be taken not to damage the housing. Use blocks of wood as pivots for the levers so that the crankcase fins are undamaged.

14 Examination and renovation: general

1 Before any component is examined, it must be cleaned thoroughly. Being careful not to mark or damage the item in question, use a blunt-edged scraper (an old kitchen knife or a broken plastic ruler can be very useful) to remove any caked-on deposits of dirt or oil, followed by a good scrub with a soft wire brush (a brass wire brush of the type sold for cleaning suede shoes is best, with an assortment of bottle-cleaning brushes for ports, coolant passages etc). Take care not to remove any paint code marks from internal components.

2 Soak the component in a solvent to remove the bulk of the remaining dirt or oil. If one of the proprietary engine degreasers (such as Gunk or Jizer) is not available, a high flash-point solvent such as paraffin (kerosene) should be used. The use of petrol as a cleaning agent cannot be recommended because of the fire risk. With all of the above cleaning agents take great care to prevent any drops getting into the eyes and try to avoid, prolonged skin contact. To finish off the cleaning procedure wash each component in hot soapy water (as hot as your hands can bear); this will remove a surprising amount of dirt on its own and the residual heat usually dries the component very effectively. Carefully scrape away any remaining traces of old gasket material from all joint faces.

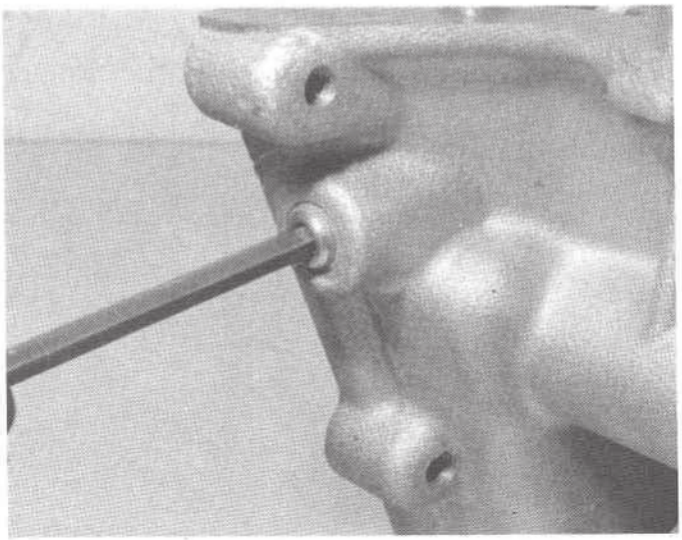
3 Check all coolant passages and oilways for blockages, using compressed air to clear them, or implements such as pipe cleaners. Note that many of the coolant passages are sealed by core plugs. These are removed by piercing the centre with a hammer and centre punch so that a screw thread can be tapped in and a slide-hammer applied; the plugs should **never** be disturbed unless absolutely necessary. A hexagon-headed blanking plug is screwed into the underside of the cylinder head to blank off the oilways; if camshaft wear reveals a possible lubrication fault, this plug should be removed so that the oilways can be blown clear with compressed air. If it is disturbed, tighten it securely on refitting, using a drop of Loctite 242 or similar thread-locking compound on its threads.

4 If there is the slightest doubt about the lubrication system, for example if a fault appears to have been caused by a failure of the oil supply, all components should be dismantled so that the oilways can be checked and cleared of any possible obstructions. Refer to Chapter 5 for details of the lubrication system. Always use clean, lint-free rag for cleaning and drying components to prevent the risk of small particles obstructing oilways.

5 Examine carefully each part to determine the extent of wear, checking with the tolerance figures listed in the Specifications section of this Chapter. If there is any doubt about the condition of a particular component, play safe and renew.

6 Various instruments for measuring wear are required, including a vernier gauge or external micrometer and a set of standard feeler gauges. The machine's manufacturer recommends the use of Plastigage for measuring radial clearance between working surfaces such as

shell bearings and their journals. Plastigage consists of a fine strand of plastic material manufactured to an accurate diameter. A short length of Plastigage is placed between the two surfaces, the clearance of which is to be measured. The surfaces are assembled in their normal working positions and the securing nuts or bolts fastened to the correct torque loading; the surfaces are then separated. The amount of compression to which the gauge material is subjected and the resultant spreading indicates the clearance. This is measured directly, across the width of the Plastigage, using a pre-marked indicator supplied with the Plastigage kit. If Plastigage is not available, both an internal and external micrometer will be required to check wear limits. Additionally, although not absolutely necessary, a dial gauge and mounting bracket is invaluable for accurate measurement of endfloat, and play between components of very low diameter bores – where a micrometer cannot reach. After some experience has been gained the state of wear of many components can be determined visually or by feel and thus a decision on their suitability for continued service can be made without resorting to direct measurement.



14.3 Remove blanking plug from cylinder head to clear oilways, if required

15 Examination and renovation: engine cases and covers

1 Small cracks or holes in aluminium castings may be repaired with an epoxy resin adhesive, such as Araldite, as a temporary expedient. Permanent repairs can be effected only by welding and a specialist will be able to advise on the availability of a proposed repair.
2 Damaged threads can be economically reclaimed by using a diamond section wire insert of the Helicoil type, which is easily fitted after drilling and re-tapping the affected thread. Most motorcycle dealers and small engineering firms offer a service of this kind.
3 Sheared studs or screws can usually be removed with screw extractors, which consist of tapered left-hand thread screws of very hard steel. These are inserted by screwing anticlockwise into a pre-drilled hole in the stud. If any problem arises which seems to be beyond your scope it is worthwhile consulting a professional engineering firm before condemning an otherwise sound casing; many such firms advertise in the motorcycle papers.
4 If gasket or other mating surfaces are marked or damaged in any way they can be reclaimed by rubbing them on a sheet of fine abrasive paper laid on an absolutely flat surface such as a sheet of plate glass. Use a gentle figure-of-eight pattern, maintaining light but even pressure on the casting. Note that if large amounts of material are to be removed, advice should be sought as to the viability of re-using the casting in question; the internal clearances are minimal in many cases between rotating or moving components and the castings. Stop work as soon as the entire mating surface is polished by the action of the paper.
5 Large surfaces such as the cylinder head or block gasket surface will have to be skimmed on a surface plate if warped. This is a task for a light engineering business only; be careful to warn them to remove only the minimum amount of metal necessary to true up the face. If excessive warpage is found, seek expert advice.
6 Note that the mating surface may become distorted outwards around the mounting screw holes, usually because these have been grossly overtightened. If such is the case, use a large drill bit or countersink to very lightly skim the raised lip from around the screw hole, then clean up the whole surface as described above.
7 Finally, check that all screw or bolt tapped holes are clean down to the bottom of each hole; serious damage can be caused by forcing a screw or bolt down a dirty thread and against an incorrect stop caused by the presence of dirt, oil, swarf or blobs of old jointing compound. At the very least the component concerned will be incorrectly fastened, at worst the casting could be cracked. The simplest way of cleaning such holes is to use a length of welding rod or similar to check that the hole is clean all the way to the bottom and to dig out any embedded foreign matter, then to give each hole a squirt of contact cleaner or similar solvent applied from an aerosol via the long plastic nozzle usually supplied. Be careful to wear suitable eye protection while doing this; the amount of dirt and debris that can be ejected from each hole is surprising.

16 Examination and renovation: bearings and oil seals

1 Ball bearings should be washed thoroughly to remove all traces of oil then tested as follows. Hold the outer race firmly and attempt to move the inner race up and down, then from side to side. Examine the bearing balls, cages and tracks, looking for signs of pitting or other damage. Finally spin the bearings hard; any roughness caused by wear or damage will be felt and heard immediately. If any free play, roughness or other damage is found the bearing must be removed.
2 Roller bearings are checked in much the same way, except that free play can be checked only in the up and down direction with the components concerned temporarily reassembled. Remember that if a roller bearing fails it may well mean having to replace, as well as the bearing itself, one or two components which form its inner and outer races. If in doubt about a roller bearing's condition, renew it.
3 Do not waste time checking oil seals; discard all seals and O-rings disturbed during dismantling work and fit new ones on reassembly. Considering their habit of leaking once disturbed, and the amount of time and trouble necessary to replace them, they are relatively cheap if renewed as a matter of course whenever they are disturbed.

17 Examination and renovation: camshafts and camshaft drive mechanism

1 Examine the camshaft lobes for signs of wear or scoring. Wear is normally evident in the form of visual flats worn on the peak of the lobes, and this may be checked by measuring each lobe at its widest point. If any lobe is worn by a significant amount the camshaft must be renewed. Scoring or similar damage can usually be attributed to a partial failure of the lubrication system, possibly due to the oil filter element not having been renewed at the specified mileage, causing unfiltered oil to be circulated by way of the bypass valve. Before fitting new camshafts, examine the bearing surfaces of the camshafts, and cylinder head, and rectify the cause of the failure.
2 If the camshaft bearing surfaces are scored or excessively worn, it is likely that renewal of both the cylinder head and the camshafts will be the only solution. This is because the camshaft runs directly in the cylinder head casting, using the alloy as a bearing surface. Assemble the bearing caps and measure the internal bore using a bore micrometer. If any internal diameter exceeds that specified, it will be necessary to renew the cylinder head and bearing caps. Note that it is not possible to renew the caps alone, because they are machined together with the cylinder head and are thus matched to it. It may be possible, however, for an expert to effect a repair; many machines suffer from top-end lubrication problems and several experts offer a repair service involving (usually) the fitting of shell or needle roller bearings to rectify this. It is possible that one of these may be prepared to undertake the repair of such a basically similar design.
3 Measure the camshaft bearing journals, using a micrometer. If any journals have worn to less than the specified outside diameter, the camshaft(s) should be renewed. The clearance between the camshafts and their bearing surfaces can be checked using Plastigage or by direct measurement. The clearance must not exceed the specified limit.
4 Camshaft runout can be checked by supporting each end of the

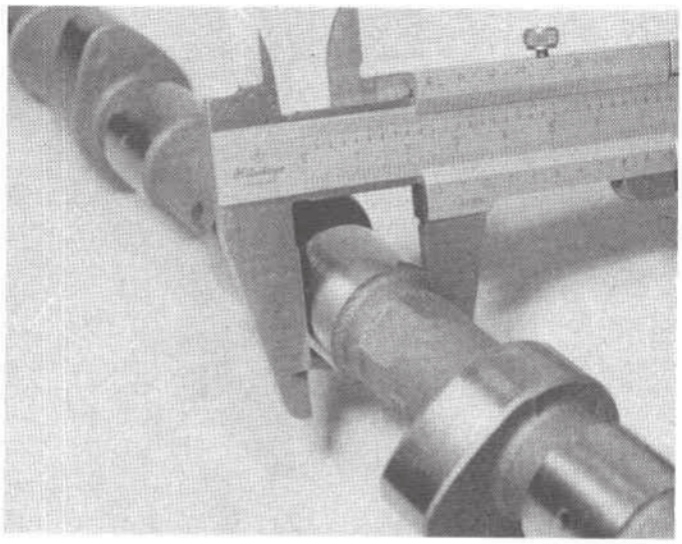
shaft on V-blocks, and measuring any runout using a dial test indicator running on the bearing journals. Since no service limits are specified, expert advice must be sought if runout appears excessive; the camshaft should be renewed, however, if warpage can be seen with the naked eye.

5 Excessive camshaft endfloat can produce a loud, regular, ticking noise noticeable mainly at idle speed. Each camshaft is located by a thrust flange which bears against a thrust face on the rear of the front bearing cap. Endfloat is measured by mounting a dial gauge on the cylinder head so that it is parallel to the camshaft, with its tip touching one end. Push the camshaft as far as possible away from the gauge, zero the gauge, then push the camshaft towards the gauge as far as possible and note the reading. Note that this will be very difficult if the valve gear is still in place; it should be removed if possible. If the reading taken appears excessive, expert advice should be sought. If excessive wear is found, it will be necessary to renew the camshaft or the cylinder head or both; repairs to reclaim such wear are extremely difficult and may be undertaken only by an engineering expert, if at all.

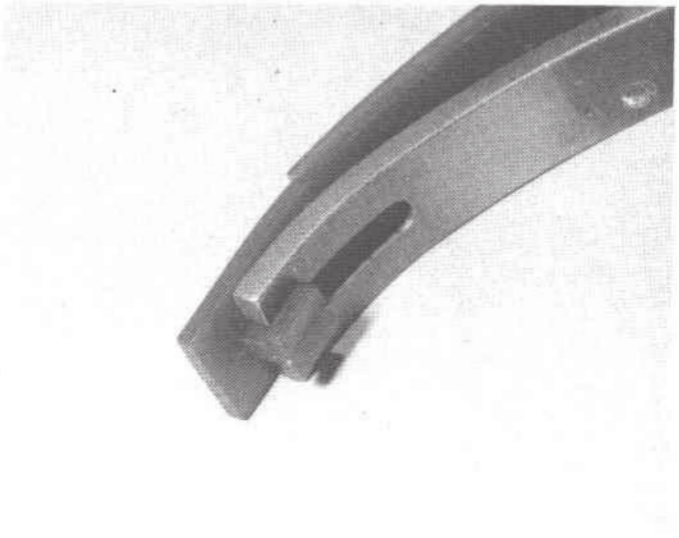
6 The camshaft drive chain should be checked for wear, particularly if the tensioner plunger was found to be fully extended, this latter condition being indicative that the chain is probably due for renewal. Check the chain at points all along its length, looking for cracked, broken or missing rollers or sideplates, or for any links which appear stiff or unduly sloppy; if any of these or other signs of wear or damage are found, the chain must be renewed. To check the chain for wear, lay it out on a flat surface, mark the pins at each end of a one-foot length and compress the chain endwise against a straightedge. Measure exactly the distance between the two pins, then anchor one end, draw the chain out taut and measure the stretched length between the two marked pins, repeat the test at points all along the chain's length. If the stretched measurement exceeds the compressed measurement by more than 1–2% (1/8 – 1/4 in per foot) at any point, the chain must be renewed.

7 The tensioner and guide blades and the tensioner assembly should be examined for wear or damage, which will normally be fairly obvious. Renew any parts which appear worn or are damaged, especially if a new chain is to be fitted. The same can be applied to the crankshaft sprocket and the two camshaft sprockets. The tensioner plunger must be smooth, unworn, free from dirt or corrosion and able to slide smoothly in the tensioner body. If the spring pressure is doubtful or if any other damage is found, the tensioner assembly must be renewed complete.

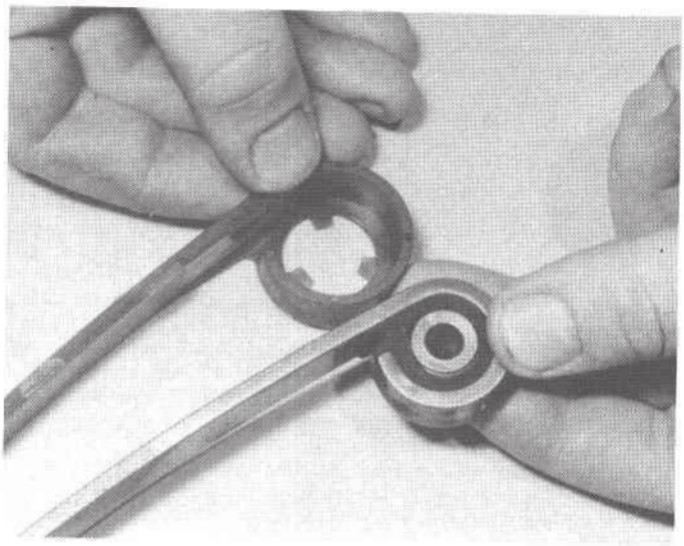
8 Note that the tensioner blade plastic face can be detached and renewed separately. The blade metal backing should be checked to ensure that the rubber bush at its bottom pivot is in good condition, also the rubber buffer which engages the tensioner plunger; otherwise it is not likely to suffer any wear. On refitting, slide the backing top fork over the locating lug on the rear of the plastic face, then insert the backing bottom end into that of the plastic face. Lastly, clip the plastic face centre to the metal backing at the tensioner plunger locating lugs.



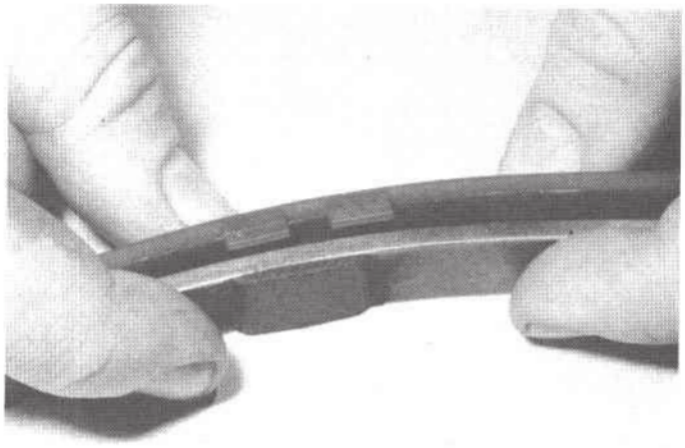
17.3 Measuring camshaft bearing journals



17.8a Fitting a new cam chain tensioner blade plastic face – slide metal fork over plastic locating lug ...



17.8b ... and insert bottom mounting eye into recess in plastic face ...



17.8c ... then clip plastic face to metal blade at centre lugs

18 Examination and renovation: cylinder head

1 Remove all traces of carbon from the cylinder head using a blunt ended scraper (the round end of an old steel rule will do). Finish by polishing with metal polish to give a smooth, shiny surface.
2 Check the condition of the spark plug threads. If the threads are worn or crossed they can be reclaimed by a Helicoil insert. Most motorcycle dealers operate this service which is very simple, cheap and effective.
3 Lay the cylinder head on a sheet of 1/4 inch plate glass to check for distortion. Aluminium alloy cylinder heads distort very easily, especially if the cylinder head bolts are tightened down unevenly. If the amount of distortion is only slight, it is permissible to rub the head down until it is flat once again by wrapping a sheet of very fine emery cloth around the plate glass base and rubbing with a rotary motion.
4 If the cylinder head is distorted badly (one way of determining this is if the cylinder head gasket has a tendency to keep blowing), the head will have to be machined by a competent engineer experienced in this type of work. This will, of course, raise the compression of the engine, and if too much is removed can adversely affect the performance of the engine as well as to cause the valves to strike the pistons. If there is risk of this happening, the only remedy is a new replacement cylinder head.
5 Refer to Sections 17 and 19 of this Chapter for details of work concerning the camshaft bearings and valve gear respectively.

19 Examination and renovation: valves, valve seats and valve guides

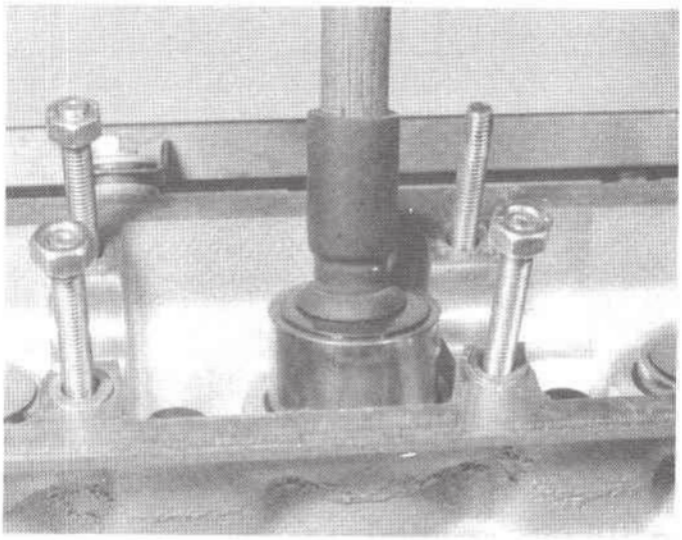
1 Obtain eight suitable containers and clearly mark each one with the type and cylinder number of the valve components that will be stored in it, eg Number 1 cylinder intake. Always keep components separate and in their marked containers so that all can be refitted in their original locations. As far as possible work on one valve assembly at a time so that there is no risk of swapping components.
2 Use a rubber sucker or a strong magnet to remove the shim and cam follower over each valve, then compress the valve spring, using a specially-modified valve spring compressor (see accompanying photograph) which will fit securely over the spring top retaining collar and yet reach down inside the bores in the cylinder head without marking their walls. Withdraw the two split collets using a slim magnetised rod (draw a permanent magnet several times down the shank of a slim screwdriver), release the compressor gradually and withdraw the top collar, the spring (noting carefully which way round it was fitted), the spring seat, the valve and the valve guide oil seal. The magnet will also be required to remove the spring seats. Store all components from each valve assembly together in their marked container.
3 **Note:** If any valve is difficult to remove through its guide check for any burrs or raised edges at the collet locating groove in the stem; use fine emery paper, if necessary, to polish away any that are found until the valve stem will slide easily through the guide. Be careful to wash away all particles of abrasive material.
4 Inspect the valves for wear, overheating or burning, and replace them as necessary. Normally, the exhaust valves will need renewal more often than the inlet valves, as the latter run at relatively low temperatures. If any of the valve seating faces are badly pitted, do not attempt to cure this by grinding them, as this will invariably cause the valve seats to become pocketed. it is permissible to have the valve(s) refaced by a motorcycle specialist or small engineering works. The valve must be renewed if the head thickness (the area between the edge of the seating surface and the top of the head) is reduced to the service limit specified, if its overall length is shorter than that specified, or if its stem is bent by more than the maximum specified runout, measured at the valve head.
5 Check the valve stems and guides for wear either by direct measurement or by inserting a valve and rocking it to and fro both along the direction of cam lobe thrust and at right angles to it; any wear will be most noticeable when the valve is at the maximum lift position. Compare the original valve with a new component to check if wear is excessive. If a small bore gauge and micrometer are available, the two components can be measured at three or four points along their bearing surfaces, both in the direction of cam lobe thrust and at right angles to it. Subtract the smallest stem diameter measurement obtained fom the largest guide bore diameter; if the stem/guide clearance figure thus calculated exceeds the specified service limit, one or both components must be renewed.
6 Valve guide renewal is not easy, and will require that the valve seats be recut after the guide has been fitted and reamed. It is also remarkably easy to damage the cylinder head unless great care is taken during these operations. It may, therefore, be considered better to entrust these jobs to a competent engineering company or to an authorised BMW dealer. For the more skilled and better equipped owner, the procedure is as follows:
7 Heat the cylinder head slowly and evenly, in an oven to prevent warpage, to 220 – 240°C (428 – 464°F). Using a stepped drift, tap the guide(s) lightly out of the head from the combustion chamber side, taking care not to burn yourself on the hot casting.
8 With the guide(s) removed, allow the head to cool and measure the guide bore in the cylinder head. If worn beyond the specified limits, the bore must be reamed out to the next oversize and the correspondingly oversized guide fitted.
9 To fit a valve guide, heat the cylinder head as described above and use the stepped drift to drive the guide into place from the camshaft side until it seats on the locating circlip.
10 After a new guide has been fitted it must be reamed to 7.0 mm (0.28 in) using a BMW reamer, and the seat must be recut to centre it on the new guide.
11 If a valve guide has been renewed, or if a valve seat face is worn or badly pitted, it must be recut to ensure efficient sealing. This process requires the use of the necessary cutters, with their adaptors, pilots and other equipment. It also requires some skill and experience if the cylinder head is not to be severely damaged. Accordingly, owners are strongly recommended to take the cylinder head to an authorised BMW dealer or similar expert for this sort of work to be done.
12 For those who have access to the necessary equipment and the experience, proceed as follows. Fit the appropriate cutter to the pilot bar and insert the pilot bar into the guide until the cutter makes contact with the valve seat. Using firm hand pressure, rotate the cutter through one or two full turns to clean the seat then withdraw the cutter and examine the seat. If the seat is continuous and free from pitting, proceed to the next step, but if pitting is still evident, refit the cutter and repeat the procedure until all pitting has been removed.
13 Be very careful to remove only the bare minimum of material necessary to achieve a clean surface. If valve seats become pocketed (sunk into the head) through excessive re-cutting, new valve seats must be fitted. While BMW supply separate replacement valve seats in standard size and one oversize, the removal and refitting of these seats is quite definitely a task for the expert alone who has the necessary skill, experience and equipment.
14 With the seat face cleaned up check that it is 1.5 mm (0.06 in) wide at the contact area with the valve face. If it is too wide it must be narrowed, using the appropriate cutter to remove material either from the combustion chamber side or from the port side. Again, remove only the barest minimum of material.
15 The valves should be ground in, using ordinary oil-bound grinding paste, to remove any light pitting or to finish off a newly cut seat. Note that it is not normally essential to resort to using the coarse grade of paste which is supplied in dual-grade containers. Valve grinding is a simple task. Commence by smearing a trace of fine valve grinding compound (carborundum paste) on the valve seat and apply a suction tool to the head of the valve. Oil the valve stem and insert the valve in the guide so that the two surfaces to be ground in make contact with one another. With a semi-rotary motion, grind in the valve head to the seat, using a backward and forward motion. Lift the valve occasionally so that the grinding compound is distributed evenly. Repeat the application until an unbroken ring of light grey matt finish is obtained on both valve and seat. This denotes the grinding operation is now complete. Before passing to the next valve, make sure that all traces of the valve grinding compound have been removed from both the valve and its seat and that none has entered the valve guide. If this precaution is not observed, rapid wear will take place due to the highly abrasive nature of the carborundum paste.
16 If the necessary equipment is available, measure the diameter of each cam follower at several points, also the inside diameter of each respective cylinder head well. If necessary, renew any component that is found to be damaged, scored or excessively worn.
17 Examine the spring retaining collars and split collets, renewing any that are marked, worn, or damaged in any way. Measure the free length

of each valve spring. If any spring has settled to a length significantly less than the nominal length specified, or if any one varies in length (check particularly the exhaust valve springs against the intakes) by a significant amount, it should be renewed. Note that while it is possible to buy the springs individually, it is considered good practice to renew them all as a set, and that many mechanics renew the springs as a matter of course to ensure good engine performance.

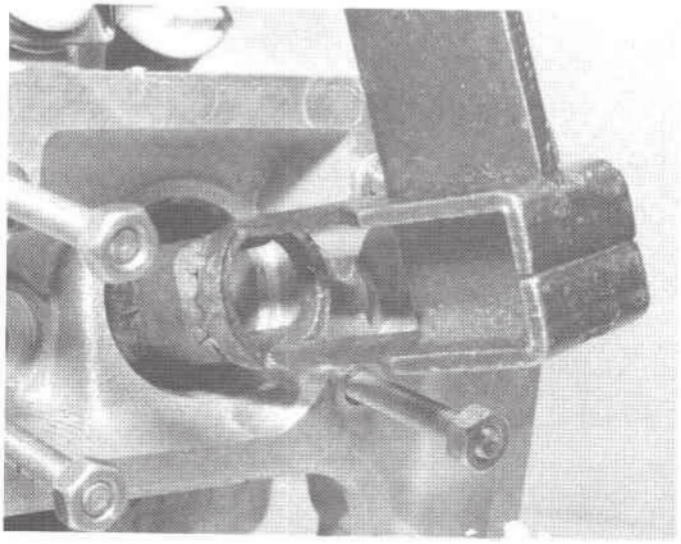
18 Place the spring seats over the guides and press new oil seals into place on each guide upper end. Liberally oil the guide bore and valve stem before refitting the valves. The springs are fitted next; while new springs, being linear-wound, have no particular direction of installation, the original springs (if re-used) must be fitted as they were found. On the machine featured in the accompanying photographs the spring lower end was marked by a dab of blue paint; similar markings may be found on other machines.

19 Refit the retaining collars, ensuring that the springs are correctly seated, compress the springs and refit the split collets. Give the end of each valve stem a light tap with a hammer to ensure that the collets have located correctly.

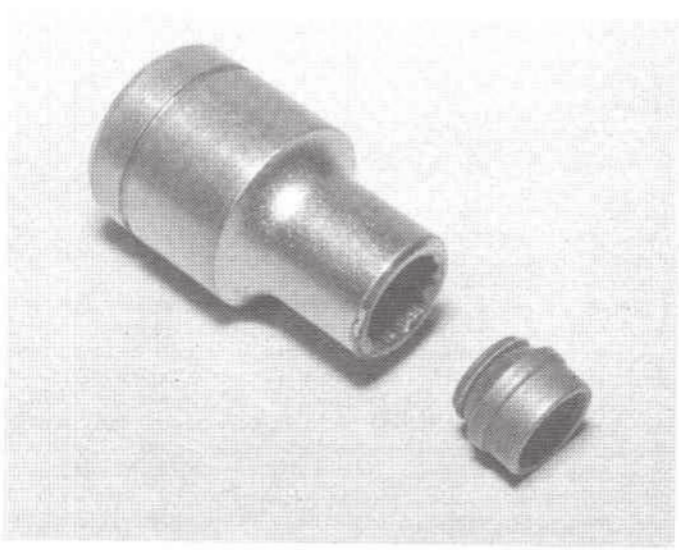
20 Refit the shims to their follower recesses, ensuring that the marked surface is downwards and using a smear of grease to retain each shim as the cam follower is oiled and refitted. Be careful to keep the followers absolutely square in their housings; the slightest tilt will jam them and make removal very difficult. Refit the dowels (if used) to retain the followers.



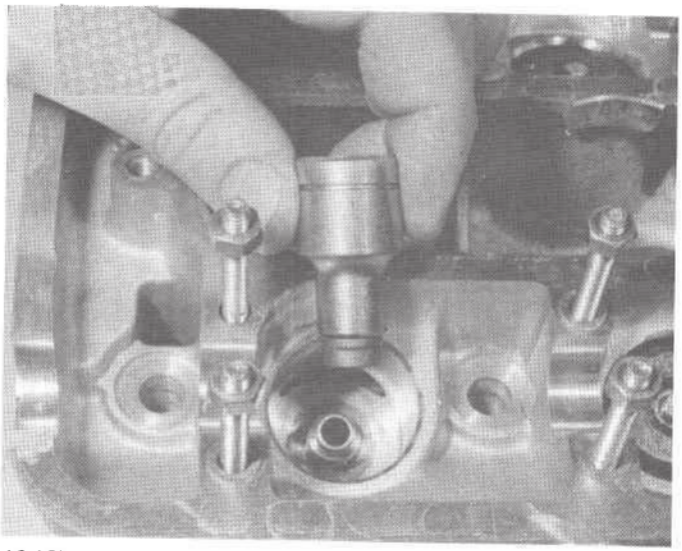
19.2a Use rubber sucker or strong magnet to extract shim and cam follower – store carefully and do not interchange



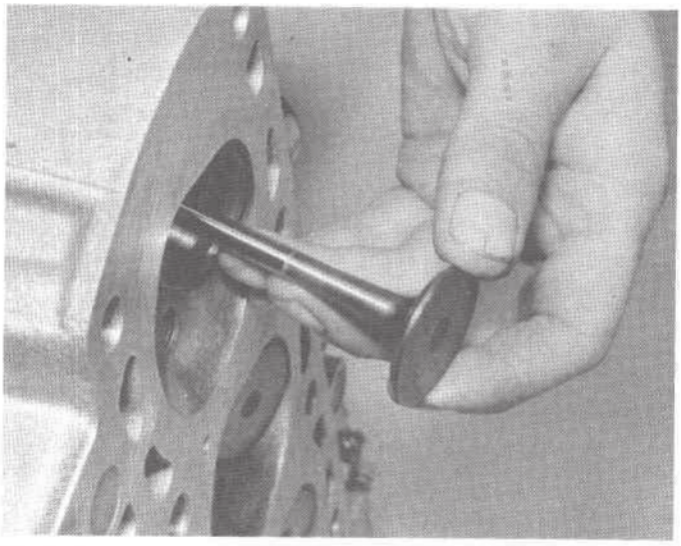
19.2b Valve spring compressor must be modified as shown to reach inside cam follower bores



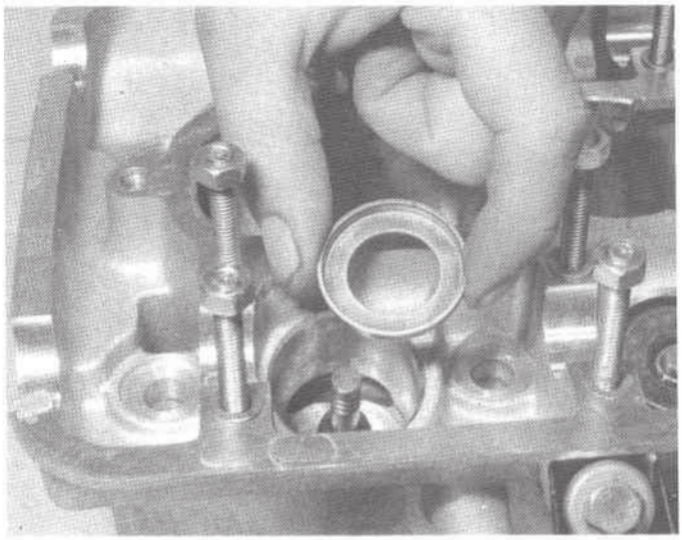
19.18a Valve guide oil seals must be fitted to a suitable tool ...



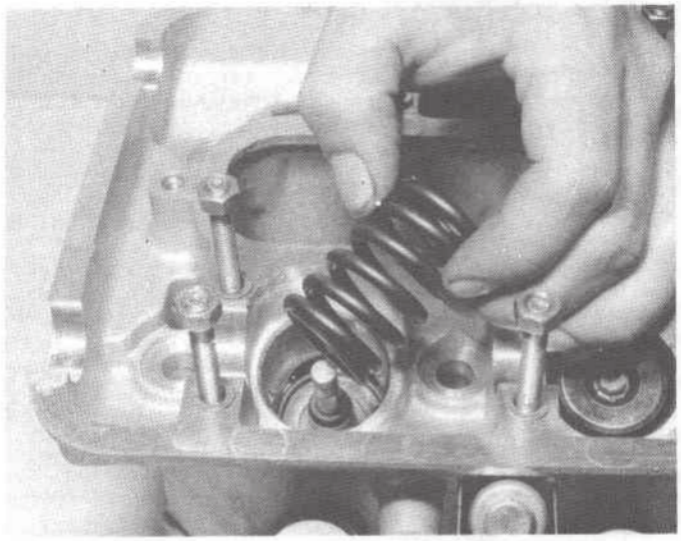
19.18b ... so that they can be pressed correctly on to guide ends



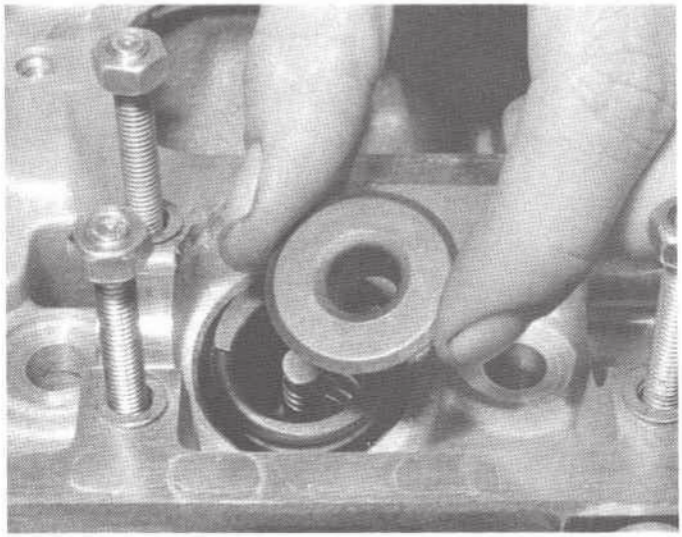
19.18c Oil valve stems and guides liberally on reassembly



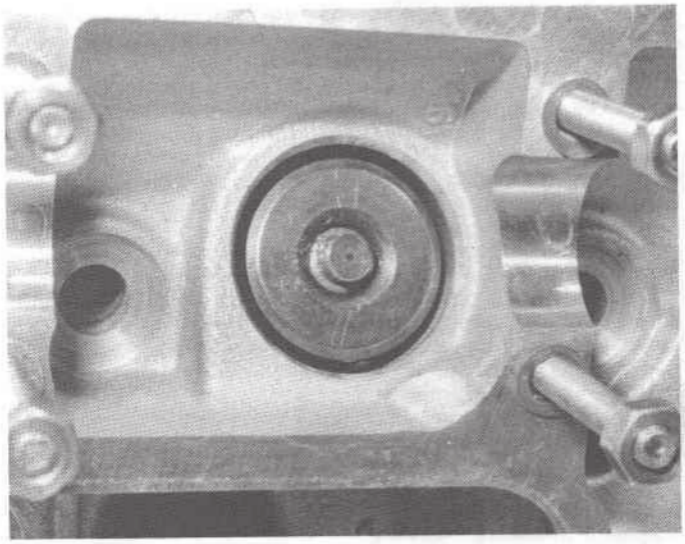
19.18d Do not forget to refit spring seat as shown ...



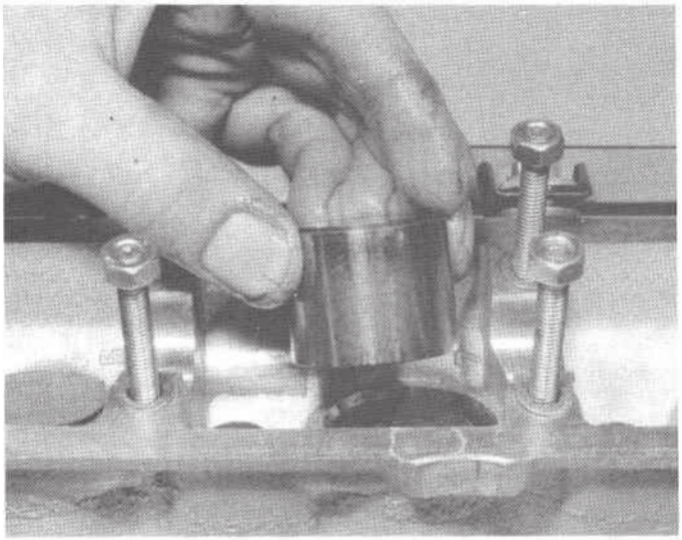
19.18e ... before inserting spring. Re-used springs must be refitted as found



19.19a Fit spring retaining collar and compress spring ...



19.19b ... so that split collets can be refitted to secure assembly



19.20 Be very careful to ensure that cam followers are square in bores on refitting

20 Examination and renovation: cylinder block

1 The usual indication of badly worn cylinder bores and pistons is excessive smoking from the exhausts. This usually takes the form of blue haze tending to develop into a white haze as the wear becomes more pronounced. However this must not be confused with the smoke cloud which these machines all seem to produce on starting, especially when hot or when the machine has been resting on its side stand. All K-series models do this in varying degrees and assuming that oil consumption is negligible, there is nothing that owners can do about it except remember to use the centre stand.

2 The other indication is piston slap, a form of metallic rattle which occurs when there is little load on the engine. If the cylinder head end of each bore is examined carefully, it will be found that there is a ridge on the thrust side, the depth of which will vary according to the rate of wear which has taken place. This marks the limit of travel of the top piston ring.

3 Measure the bore diameter just below the ridge both along the gudgeon pin axis and at right angles to it using an internal micrometer or a bore gauge. Take similar measurements at the middle and bottom of each bore. Although no service liimits are specified for taper and ovality, these dimensions should not differ significantly from each

other. Take the largest of these measurements to be the bore inside diameter.

4 Subtract the piston skirt diameter (see Section 21) from the bore diameter to calculate the piston/cylinder clearance; if this exceeds the specified service limit, either the pistons or the cylinder block must be renewed. Only very careful measurement can reveal whether this is necessary; in view of the expense of this solution owners are strongly advised to have their findings confirmed by an authorised BMW dealer before taking further action.

5 If sufficiently accurate measuring equipment is not available, an approximate idea of the degree of bore wear can be obtained by inserting a new piston (less rings) so that it is appropriately 3/4 inch from the top of the bore. Use feeler gauges to measure the clearance between the piston skirt and the bore at the point of greatest wear. It must be stressed that this is only approximate, to be regarded purely as a quick check before taking the cylinder block and pistons to an expert for accurate measurement.

21 Examination and renovation: pistons and piston rings

1 Remove all traces of carbon from the piston crowns, using a blunt ended scraper to avoid scratching the surface. Finish off by polishing the crowns of each piston with metal polish, so that carbon will not adhere so rapidly in the future. Never use emery cloth on the soft aluminium.

2 Piston wear usually occurs at the skirt or lower end of the piston and takes the form of vertical streaks or score marks on the thrust side of the piston. Damage of this nature will necessitate renewal and is checked by measuring the piston outside diameters at a point 12.0 mm (0.47 in) above the base of the skirt on KS pistons; on Mahle pistons the measuring points are 7.6 mm (0.30 in) on 75 models and 8.6 mm (0.34 in) on 100 models. In all cases the measurement is made at right angles to the gudgeon pin axis and the reading obtained is compared with that specified. Stamped marks in the piston crown will show the manufacturer and the size group code letter.

3 Actual piston wear limits are not given, therefore unless any piston is found to be worn to significantly less than the specified tolerances, the only way of calculating wear is to subtract the piston diameter from its respective bore's measurement (see Section 20) to calculate the piston/cylinder clearance. If this exceeds the specified service limit either the pistons or the cylinder block, or both must be renewed; only careful measurement, preferably by an authorised BMW dealer or similar expert, will indicate which.

4 Note that if any of the pistons is renewed at any time it must be of the same make and size code as the original, and must also be of the same weight group as the other pistons, ie all must carry the same weight group marking (+ or – stamped in the piston crown).

5 Check the fit of the gudgeon pin in the piston bosses; it should be a tight sliding fit with no sign of free play when installed and no trace of scoring or wear on any bearing surface. If the necessary equipment is available, the components can be checked by direct measurement. The piston and gudgeon pin should be treated as a matched pair and never interchanged.

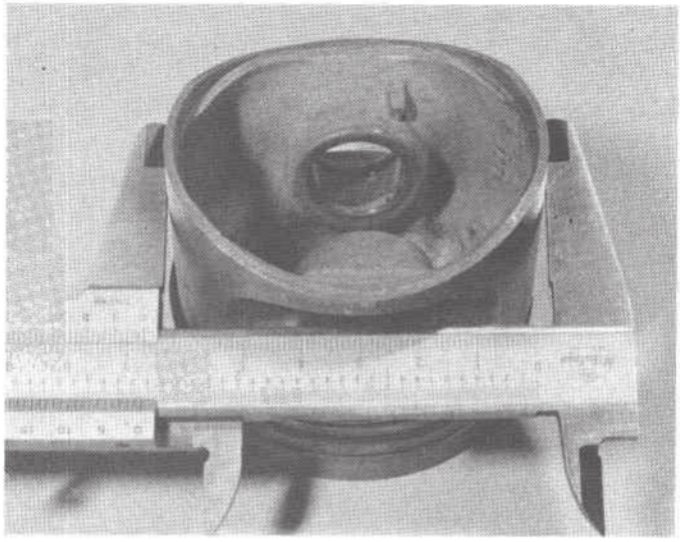
6 Discard any gudgeon pin retaining circlips that were disturbed on dismantling and obtain new ones for refitting; these circlips should never be re-used.

7 After the engine has covered a high mileage, it is possible that the ring grooves may have become enlarged. To check this, measure the clearance between the ring and groove with a feeler gauge. A clearance in excess of the limits given will mean that the piston or rings must be renewed.

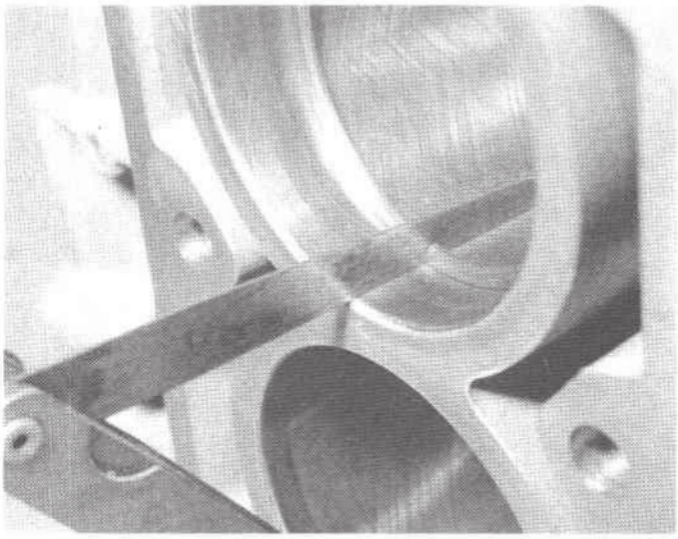
8 To measure the end gap, insert each piston ring into its cylinder bore, using the crown of the bare piston to locate it about 1 inch from the cylinder head end of the bore. Make sure it is square in the bore and insert a feeler gauge in the end gap of the ring. If the end gap exceeds the limits given, the ring must be renewed.

9 When fitting new piston rings, it is also necessary to check the end gap. If there is insufficient clearance, the rings will break up in the bore whilst the engine is running and cause extensive damage. The ring gap may be increased by filing the ends of the rings with a fine file.

10 The ring should be supported on the end as much as possible to avoid breakage when filing, and should be filed square with the end. Remove only a small amount of metal at a time and keep rechecking the clearance in the bore.



21.2 Measuring piston outside diameter – see text for measuring points



21.8 Measuring piston ring installed end gap

22 Examination and renovation: connecting rods and big-end bearings

1 Examine the connecting rods for signs of cracking or distortion, renewing any rod which is not in perfect condition. Check the connecting rod side clearance, using feeler gauges. If the clearance exceeds the limit specified it will be necessary to renew the connecting rod or the crankshaft assembly. Connecting rod distortion, both bending and twisting, can only be measured using a great deal of special equipment and should therefore be checked only by an expert; otherwise the rods should be renewed if there is any doubt about their condition.

2 If the necessary equipment is available, the condition of the small-end assemblies can be checked by direct measurement, referring to the tolerances given in the Specifications Section of this Chapter. If the equipment is not available, it will suffice to ensure that the bearing surfaces in the connecting rod small-end bearing, in the piston bosses and over the entire gudgeon pin are smooth and unmarked by wear. The gudgeon pin should be a tight press fit in both connecting rod and piston, and there should be no free play discernible when the components are temporarily reassembled. If any wear is found, the component concerned should be renewed.

3 If the small-end bearing is to be renewed, it must be pressed out

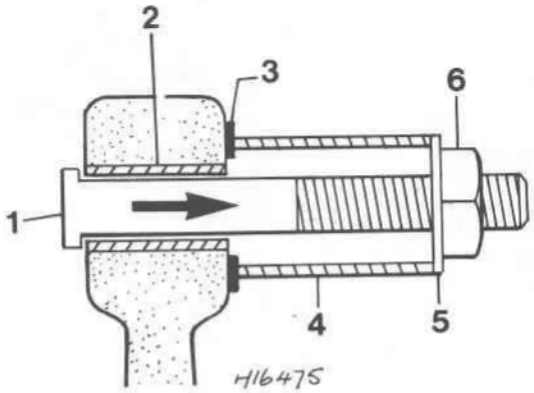


Fig. 1.5 Fabricated small-end bush drawbolt tool

1 Drawbolt
2 Bush
3 Rubber washer
4 Tube
5 Washer
6 Nut

using a drawbolt assembly, as shown in the accompanying illustration. On fitting the new bush, align its split joint at 60° to the left or right of the connecting rod centre line and drill and deburr a new oil hole through the bush, using the connecting rod oilway as a guide to the position and size. Finally, ream the new bush to the specified size.

4 If a connecting rod is renewed at any time, it is essential that it is of the correct weight group to minimise vibration. Rods are supplied in seven weight groups each being identified by having one, two or three spots of yellow, white or blue paint. All rods must have the same paint marking, if this has been erased on all rods they must be individually weighed (less bearing shells but complete with cap, bolts and nuts) so that the weight group can be identified by an authorised BMW dealer when a new rod is ordered. The weight groups vary by 7-8 grams.

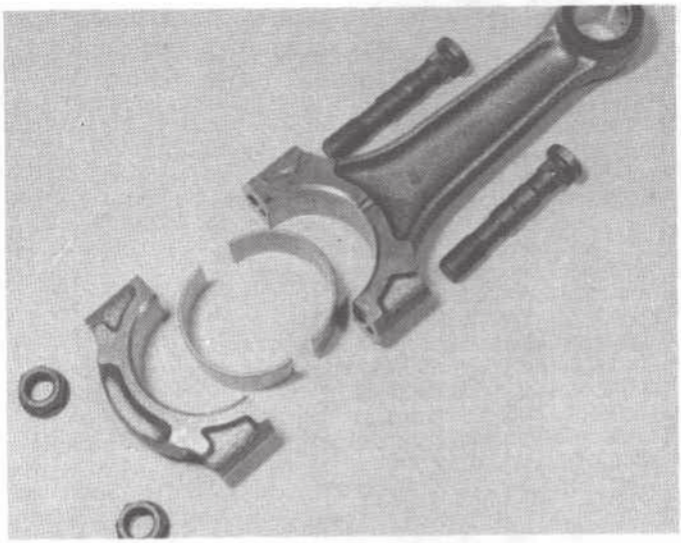
5 The big-end bearing cap retaining bolts and nuts should be renewed whenever they are disturbed. The bolts are of the expansion type which are permanently stretched on tightening and must **never** be re-used. They are an extremely tight fit in the connecting rods, however, and great care will be required to avoid marking the rods when tapping out the old bolts and fitting new ones. If a rod is clamped in a vice for support, be careful to fit the vice with padded jaws to avoid any risk of marking the rod surfaces.

6 Examine closely the big-end bearing shells. The bearing surface should be smooth and of even texture, with no sign of scoring or streaking on its surface. If any shell is in less than perfect condition the complete set should be renewed. In practice, it is advisable to renew the bearing shells during a major overhaul as a precautionary measure. They are relatively cheap and it is false economy to re-use part worn components.

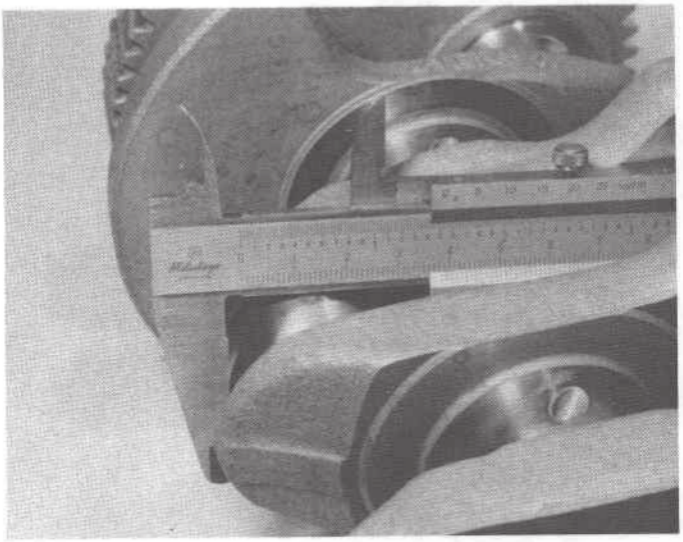
7 The crankshaft journals should be given a close visual examination, paying particular attention where damaged bearing shells were discovered. If the journals are scored or pitted in any way, seek the advice of a good authorised BMW dealer. While undersize shells are listed, making it possible in theory to reclaim wear or damage by regrinding the crankshaft, BMW give very little information to assist the repairer and state that since the crankshaft is surface hardened it cannot be reground by normal methods.

8 To select new shells, use the manufacturer's size code system. The standard crankpin outside diameter is divided into three size groups, to allow for manufacturing tolerances. The size group of each crankpin is indicated by a dab of white, green or yellow paint on the crankshaft webs immediately adjacent to the crankpin; if the equipment is available, these marks can be checked by direct measurement. Given that the connecting rod big-end eye diameter does not vary significantly in service, the shells, which are identified by a similar colour coding, are selected to match the crankshaft paint mark, ie a green paint mark on the crankshaft means green-ended bearing shells for that crankpin.

9 If the existing inserts are to be checked for wear with a view to re-using them, use Plastigage to check the clearance as described in Section 14. If the clearance measured is within the specified limits, the existing shells can be re-used. If the clearance is excessive, even with new shells (of the correct size code), the crankpin is worn and expert advice must be obtained.



22.1 Connecting rod assembly – retaining bolts and nuts must be renewed whenever they are disturbed



22.8 Measuring crankpin diameter

23 Examination and renovation: crankshaft and main bearings

1 The crankshaft should be cleaned. Be very careful to check that all oilways are completely free from dirt and other foreign matter.

2 If required, the ignition rotor flange and cam chain drive sprocket can be withdrawn. Unscrew the rotor retaining bolt and pull the flange and sprocket off the shaft end; a puller may be required to withdraw the flange. Note that the sprocket will fit either way round and that the locating pin set in the rotor flange passes through the sprocket to locate the two components by engaging a crankshaft keyway.

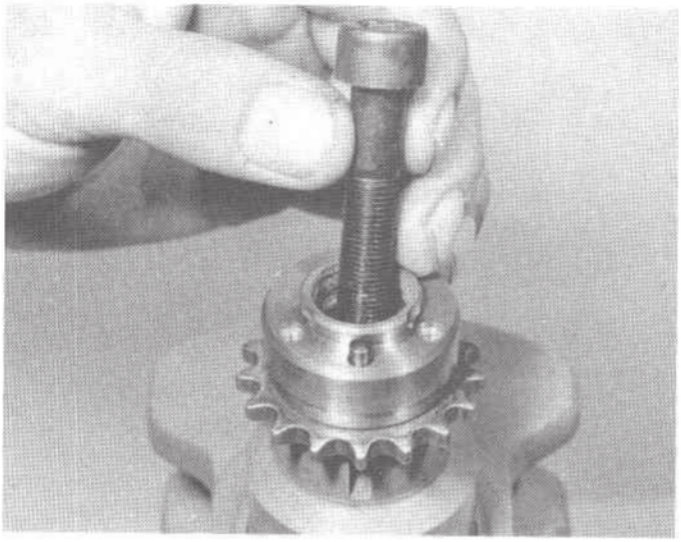
3 On reassembly, place the sprocket on the crankshaft end and refit the rotor, ensuring that both components are correctly located by the pin. Refit the retaining bolt and tighten it to the specified torque setting.

4 Examine the crankshaft closely. Any obvious signs of damage such as marked bearing surfaces, damaged threads, worn tapers and damaged gear teeth will mean that it must be renewed. There are, however, light engineering firms advertising in the motorcycle press who can undertake major crankshaft repairs; in view of the expense of

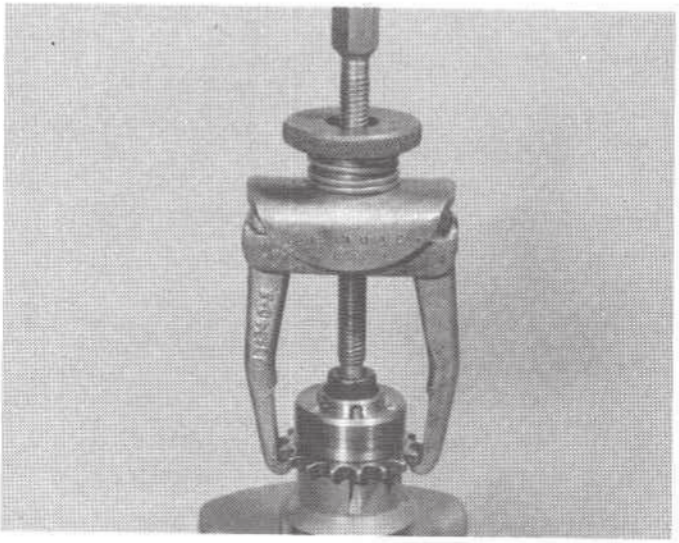
a new component it is worth trying such firms provided they are competent.

5 Refit temporarily the crankshaft and use feeler gauges to measure the clearance between the crankcase bearing pedestals and their respective adjacent webs. Alternatively, a dial gauge can be mounted parallel to the crankshaft, and with its tip touching one end. Push the crankshaft fully away from the gauge, zero the gauge, push the crankshaft fully towards the gauge again and note the reading obtained. If the crankshaft endfloat exceeds the specified limit, the thrust bearings must be renewed. Crankshaft runout is measured using a dial gauge with the crankshaft mounted on V-blocks at each outer main bearing journal; runout, measured at the centre main bearing journals, must not be excessive. If any doubt arises about the amount of runout measured, seek expert advice.

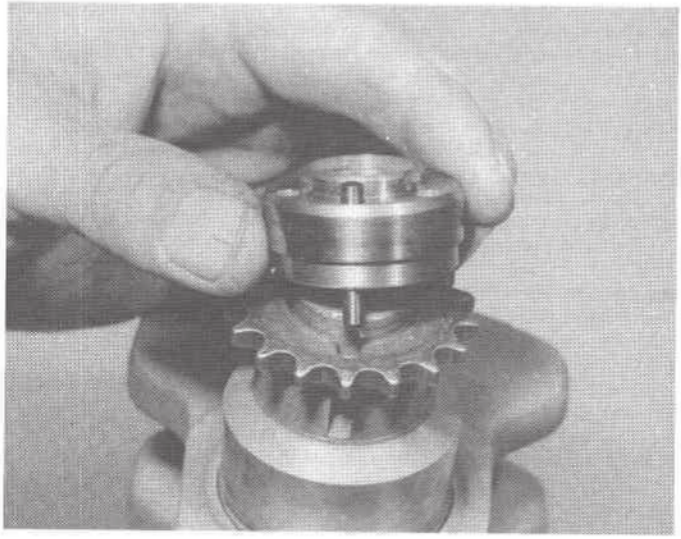
6 The procedures for examining the bearing inserts and journals, measuring the diameters of the crankshaft journals, and measuring the amount of wear on existing bearing inserts are the same as for the big-end bearings. Refer to paragraphs 6–9 of Section 22 of this Chapter. It will of course be necessary to reassemble temporarily the main bearing caps, tightening all securing bolts to the correct torque setting, when using Plastigage to check the bearing radial clearances.



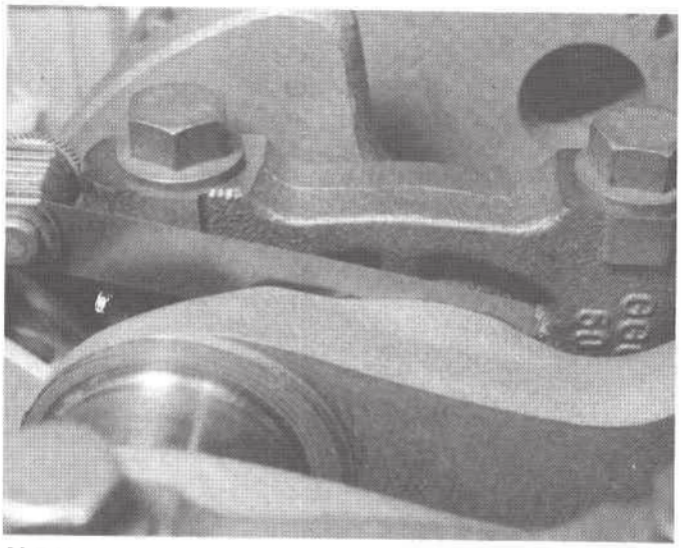
23.2a If required, unscrew retaining bolt to release ignition rotor and sprocket from crankshaft front end ...



23.2b ... noting that a puller may be required – note temporarily refitted bolt to protect crankshaft end



23.3 Note that locating pin locates both sprocket and rotor with crankshaft keyway



23.5 Measuring crankshaft endfloat

24 Examination and renovation: output/balancer shaft

1 To dismantle the output shaft assembly, remove the retaining circlip from its front end and withdraw the needle roller bearing inner sleeve. On 75 models, mark the drive gear front face at the point where it mates with the shaft itself, so that the shaft and drive gear can be refitted in exactly their original positions.

2 Hold the drive gear/ball bearing assembly in one hand and use a soft-faced mallet to tap the shaft out of the drive gear; do not allow the shaft to drop clear, but allow it to rest on a wadded rag or similarly soft surface.

3 On 100 models withdraw the damper rubbers from inside the shock absorber body and tap the shock absorber inner and end cover off the shaft. Note the thrust washer.

4 To dismantle the drive gear assembly, clamp the gear in a vice with soft jaw covers to prevent damage to its teeth, then remove the large retaining circlip. Obtain a bearing puller of sufficient size and an adaptor that will bear against the drive gear boss so that the puller can exert pressure (see accompanying photograph).

5 Draw off the bearing noting the diaphragm spring (early models) or the shim (late models) behind it. Discard the diaphragm spring (where fitted); this should not be re-used.

6 The anti-backlash gear should be removed using BMW tool 12 4

600 whose protruding lugs engage in the gear holes and permit it to be rotated slightly clockwise and lifted up to disengage the spring at the same time. If this tool is not available, check that the anti-backlash gear teeth are clear of the vice jaws and cover the gear with a thick layer of rag. Slip a thin-bladed knife between the two gears and gradually work the two apart until a screwdriver blade or similar can be inserted to lift the gear up and disengage it from the spring; use the thick rag to prevent any risk of personal injury caused by the gear jumping off. With the spring disengaged, withdraw the anti-backlash gear and use a pair of circlip pliers to remove the spring.

7 Check the output/balancer shaft components for any sign of wear or damage and renew any components necessary. Check particularly the gear teeth and all bearing surfaces. On 100 models renew the shock absorber rubbers if they are at all compacted or if they show any signs of wear or deterioration; always renew all five together, even if only one is faulty.

8 On reassembly, owners should note the following two modifications. The first was introduced on machines produced late in the 1985 model year (ie 100 models only) and consisted of a rear bearing with a thick shoulder (3.52 mm/0.14 in) integral with the bearing outer race at its rear end instead of the previous bearing which had a thin (1.75 mm/0.07 in) locating circlip around its outer edge. This was to improve the axial location of the output shaft. Earlier 100 models cannot be converted to the later type; their bearings must now be glued in place to ensure correct bearing location.

9 While the modified bearing was fitted to 100 models from late 1985 (model year) on and to all 75 models, a follow-up modification consisting of a retaining circlip with a conical spring cross-section was not fitted until early in the 1986 model year. The new-type circlip can be identified easily by the large square tangs protruding from it, which press firmly against the bearing inner race to ensure improved axial location of the drive gear assembly.

10 At about the same time as this subsidiary modification, the anti-backlash gear was changed and, on 100 models only the tension spring. Also the previously-fitted diaphragm spring was replaced on all models by shims to provide better anti-backlash gear retention. All these modified components can be installed in earlier machines.

11 It will be clear from the above that machines built in the late 1985 and early 1986 model years will have any one of a number of modified components. Owners of such machines should refer closely to the following text and to the accompanying illustrations; the photographs are of a late-1986 K100 RS and therefore show the fully modified assembly.

12 Clamp the drive gear in a vice with padded jaws to avoid damaging its gear teeth and fit the spring, using a pair of circlip pliers; ensure the spring fits around the drive gear boss and that its locating pin engages in the hole provided. Refit the anti-backlash gear.

13 On 75 models it is necessary to use the special tool 12 4 600 to refit the gear unless a suitable substitute can be fabricated. Place the gear over the drive gear assembly and engage its protruding pin with the hole in the free end of the spring. Lock the tool's lugs into the holes in the gear and rotate the tool clockwise while pressing down until the anti-backlash gear centre fits over the drive gear boss and its protruding pin fits through the hole in the spring free end into the hole in the drive gear; check that the anti-backlash gear is free to move against spring pressure.

14 On 100 models the tool is not necessary but care must be taken. The spring free end has a bent-over lug which can be pressed into the large hole in the drive gear (see accompanying photograph) so that the spring is effectively anchored at both ends. Take care that the spring does not fly off; keep a thick wad of rag over it at all times, during reassembly. Fit the anti-backlash gear, aligning its centre with the drive gear boss and engaging its protruding pin with the inner hole in the spring free end.

15 On early or unmodified models, fit a new diaphragm spring with its convex surface outwards, ie its outer edge in contact with the anti-backlash gear. On later models measure the height of the drive gear bearing locating boss above the anti-backlash gear rear face and fit shims as required to eliminate the clearance that will exist between the anti-backlash gear and the bearing (maximum remaining clearance 0.01 – 0.15 mm/0.0004 – 0.0059 in on 100 models). Shims are available in thicknesses of 1.00, 1.15, 1.30 and 1.45 mm (0.0394, 0.0453, 0.0512 and 0.0571 in) on 75 models and 1.60, 1.75, 1.90 and 2.05 mm (0.0630, 0.0689, 0.0748 and 0.0807 in) on 100 models.

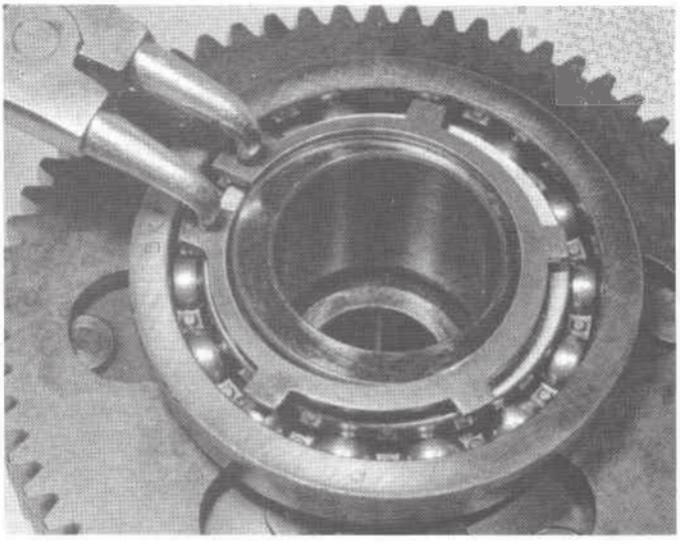
16 Thoroughly wash all oil from the bearing and heat it to approximately 80 – 100°C (176 – 212°F). Using suitable protective clothing drop the bearing over the drive gear boss with its thin locating circlip (early models only) towards the front (ie next to the gear) or with its thick shoulder (later models only) away from the gear (ie to the rear). Check that the diaphragm spring or shims (as applicable) are seated correctly around the drive gear boss and use a hammer and a tubular drift such as a socket spanner which bears only on the bearing inner race to drive the bearing fully on to the drive gear boss. Refit the circlip.

17 On all models **it is essential** that the circlip is seated absolutely correctly in its groove to take the high axial loads; on early models clearance between the groove and the bearing is minimal, therefore great care is required to ensure that the circlip is seated correctly. On later models with the square tang type of circlip, fit the circlip with its convex surface outwards, ie so that the square tangs around its outer edge are firmly in contact with the bearing inner race. Allow the bearing to cool, then lubricate it thoroughly.

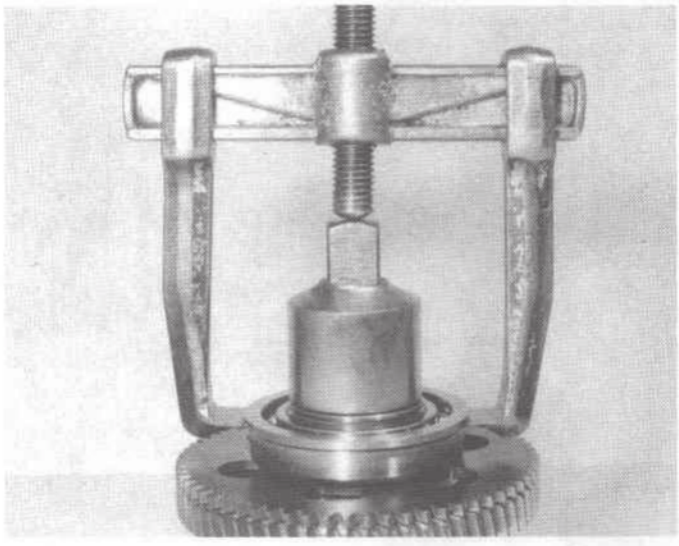
18 On 75 models align the marks made on dismantling when refitting the shaft to the drive gear, so that the balancer weights are correctly timed. Tap the gear assembly firmly on to the shaft locating tangs.

19 On 100 models fit the end cover and shock absorber inner to the shaft, lubricate the shock absorber rubbers and refit them to the body. Do not forget the thrust washer when refitting the shaft assembly to the shock absorber body/drive gear.

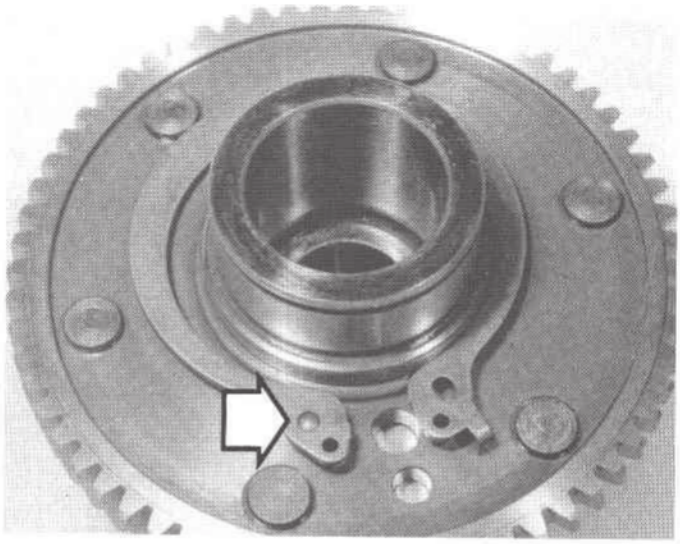
20 On all models fit the bearing inner sleeve and its locating circlip.



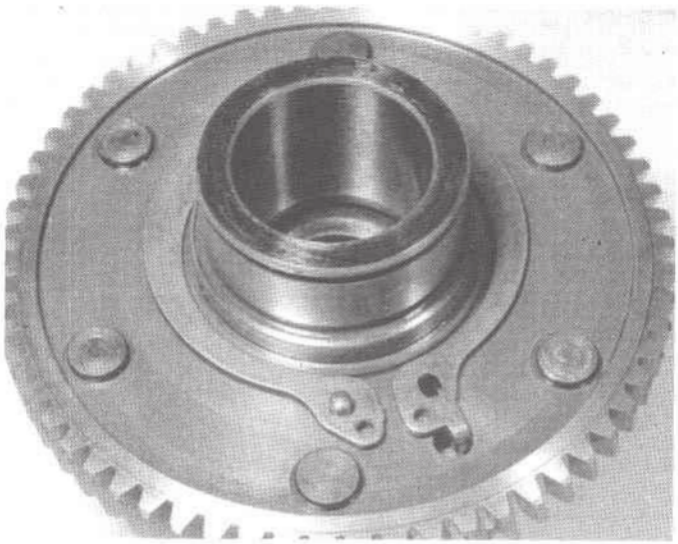
24.4a Use suitable pliers to remove retaining circlip ...



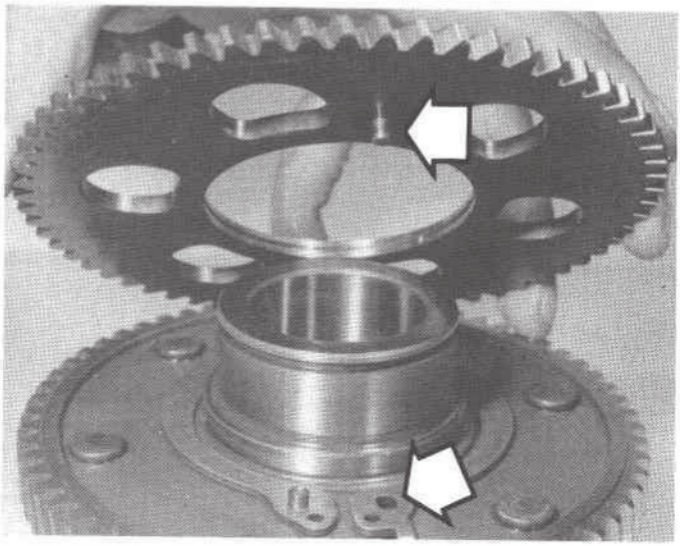
24.4b ... before using puller as shown to draw off output shaft rear bearing



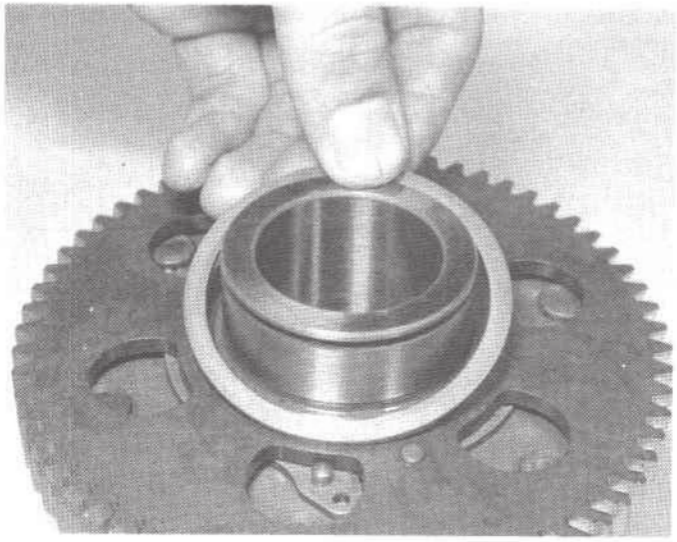
24.12 When refitting anti-backlash spring, anchor fixed end on locating pin (arrowed)



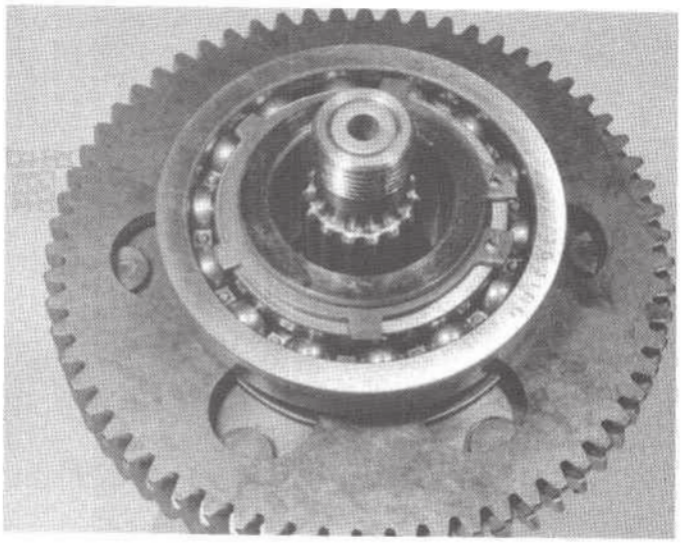
24.14a Refitting anti-backlash gear, 100 models – press spring free end into drive gear hole ...



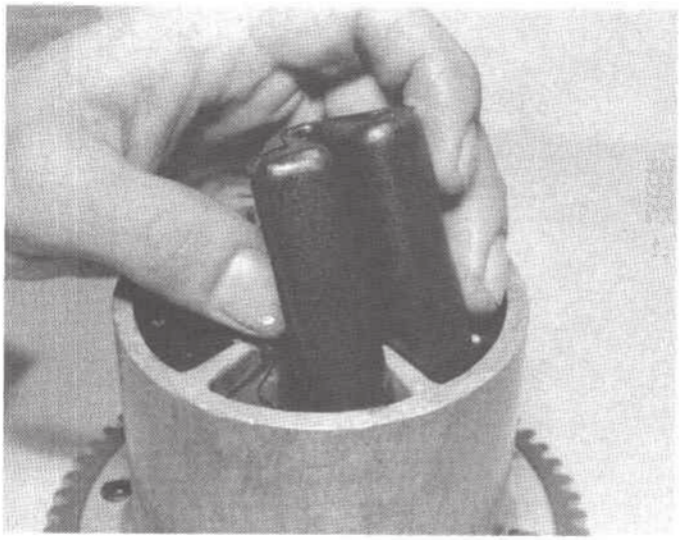
24.14b ... then fit gear so that its locating pin engages with hole in spring free end (arrows)



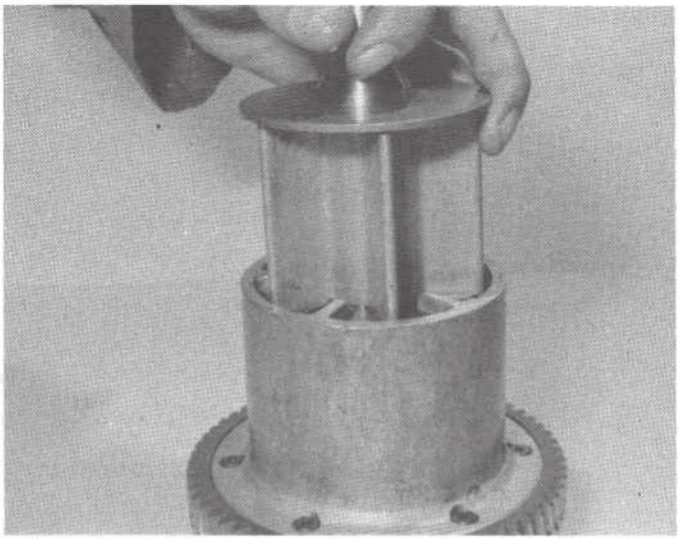
24.15 Fit diaphragm spring (early models) or shim, as shown (later models) around drive gear boss



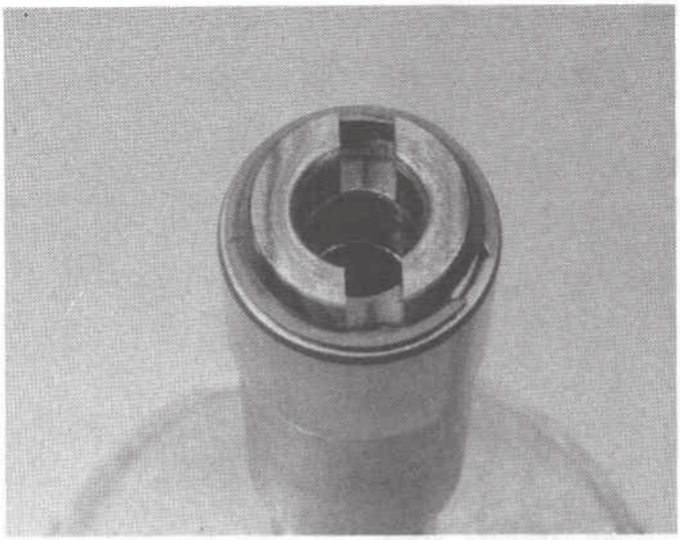
24.17 Rear bearing retaining circlip must be seated correctly – check carefully



24.19a 100 models only – lubricate shock absorber rubbers to aid reassembly ...



24.19b ... insert output shaft and shock absorber inner into shock absorber body, as shown



24.20 Do not omit front bearing inner sleeve and circlip from output shaft end

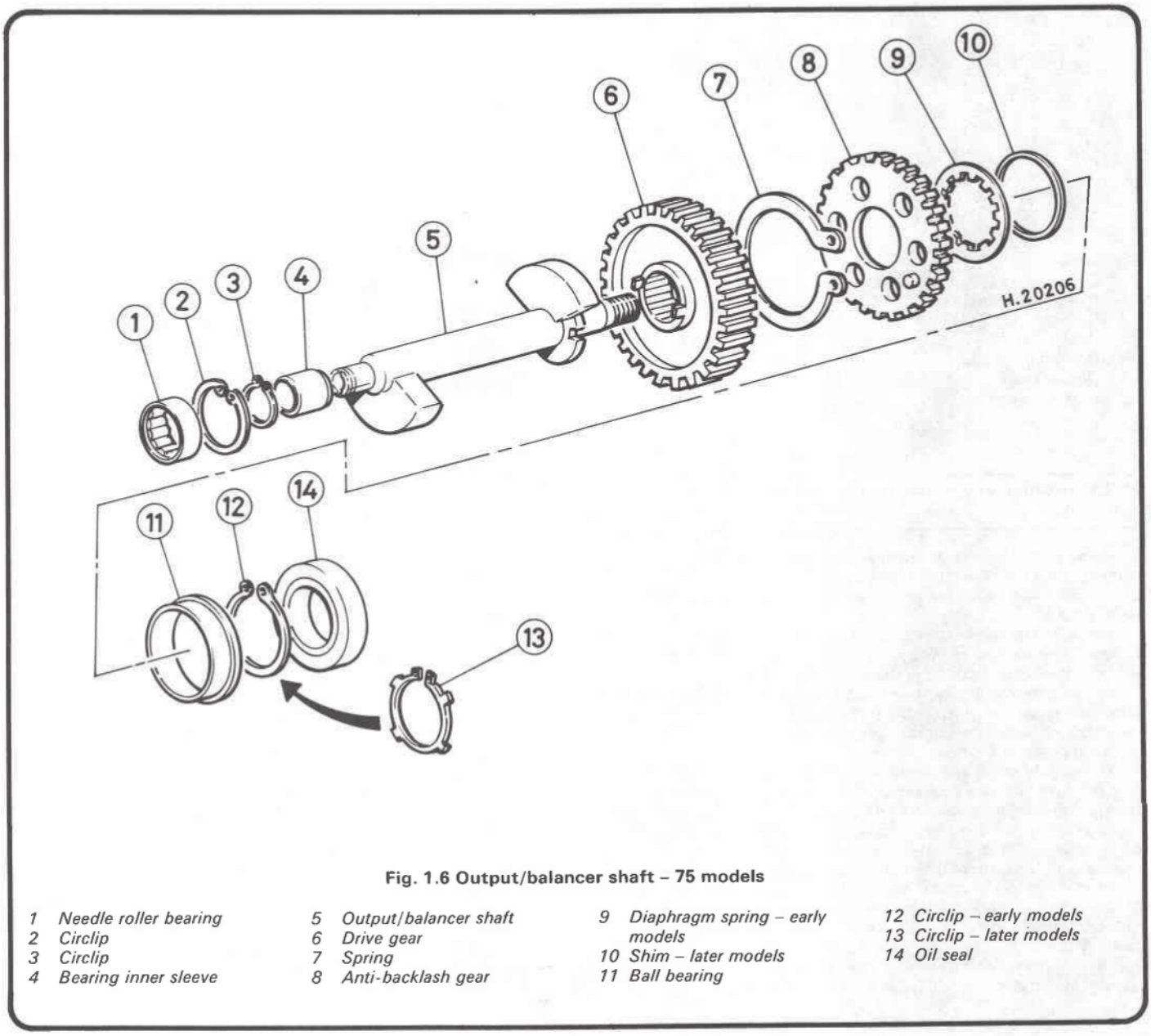


Fig. 1.6 Output/balancer shaft – 75 models

1 Needle roller bearing
2 Circlip
3 Circlip
4 Bearing inner sleeve
5 Output/balancer shaft
6 Drive gear
7 Spring
8 Anti-backlash gear
9 Diaphragm spring – early models
10 Shim – later models
11 Ball bearing
12 Circlip – early models
13 Circlip – later models
14 Oil seal

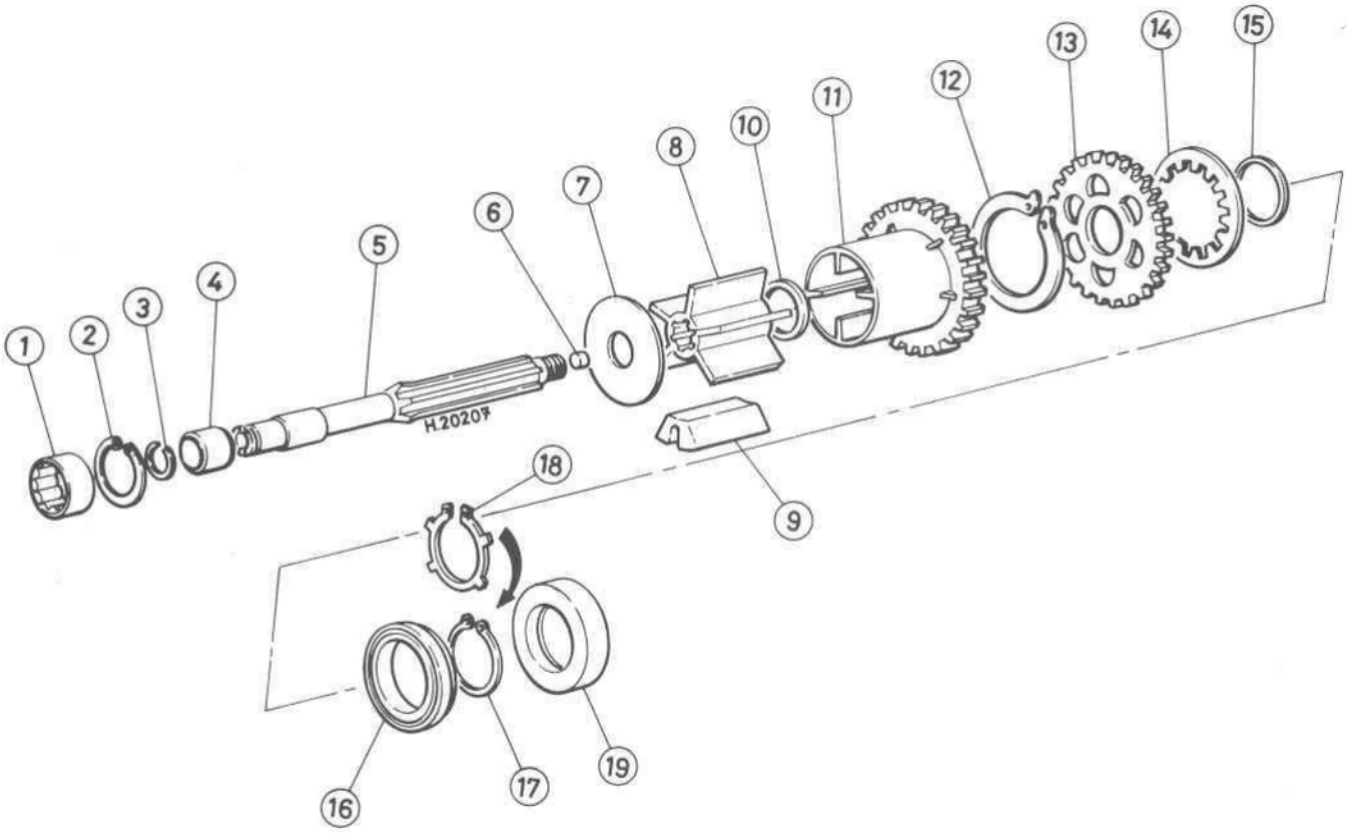


Fig. 1.7 Output shaft – 100 models

1 *Needle roller bearing*
2 *Circlip*
3 *Circlip*
4 *Bearing inner sleeve*
5 *Output shaft*
6 *Locking plug*
7 *Shock absorber end cover*
8 *Shock absorber inner*
9 *Shock absorber rubber – 5 off*
10 *Thrust washer*
11 *Drive gear/shock absorber body*
12 *Spring*
13 *Anti-backlash gear*
14 *Diaphragm spring – early models*
15 *Shim – later models*
16 *Ball bearing*
17 *Circlip – early type*
18 *Circlip – later type*
19 *Oil seal*

25 Examination and renovation: auxiliary drive shaft and starter clutch

1 Remove the O-ring and thrust washer from the auxiliary drive shaft rear end, then hold the main assembly and twist the starter clutch gear pinion clockwise to release it from the locking elements so that it can be withdrawn.

2 On early 100 models remove the three rollers and the spring and plunger from behind each. Unscrew the three retaining screws and separate the clutch body from the auxiliary drive shaft.

3 On all later models remove the six bolts and withdraw the end cover, the sprag clutch assembly (noting which way round it is fitted) the clutch body and the conical spring washer. Note which way round the spring washer is fitted.

4 Thoroughly clean and degrease all components, then check each item for signs of wear or damage, looking for chipped or damaged gear teeth, worn bearing surfaces or locking elements (rollers or sprags). If any sign of wear or damage is found, the components concerned must be renewed. On the early roller-type clutch check the rollers themselves are free from pits, flats or other signs of wear and that the plungers move easily against spring pressure in the clutch body. If in doubt about the condition of the springs, they should be renewed; they can be checked only by comparison with new components. The sprag-type clutch fitted to all later models should be checked similarly and renewed as a complete assembly if worn or damaged. On both types of clutch check carefully for wear of the starter clutch gear pinion boss.

5 **Above all** be careful to wash thoroughly all components in a high-flash point solvent. Most problems with these components are caused by the locking elements slipping on deposits of oily sludge which build up inside the clutch assembly. Even new components must be thoroughly degreased before reassembly to remove the preservative applied at the factory.

6 Modifications to the clutch assembly are as follows: Early 100 models were fitted with a roller-type clutch. This was replaced in early 1984 by a fourteen-element sprag-type clutch. At the same time a conical spring washer 1.15 mm (0.05 in) high was fitted inside the clutch assembly to control the gear pinion endfloat and the idler shaft assembly was narrowed so that a spring could be installed, also to control endfloat. Note that the idler shaft is now 21.3 – 21.5 mm (0.84 – 0.85 in) wide, measured across the outer faces of its pinions; if a new component is any wider than this the spring must be omitted.

7 In early 1985, components of the sprag-type clutch were modified to improve the flow of oil through the unit and reduce the build-up of sludge which could otherwise render the clutch inoperative. The most important of these was the starter clutch body which had three 4 mm (0.16 in) holes drilled in it radially, at 120° intervals, to permit sludge deposits to be thrown out under centrifugal force; this should have been fitted to any machine whose owner encountered the starter clutch problem. Also modified were the clutch assembly (two flats machined in its outer diameter to improve oil flow and its components nitrided to harden them) and the conical spring washer (now 1.40 mm/0.06 in high); these latter two components need only be fitted when the originals require renewal.

8 On reassembly, thoroughly clean and degrease all components using only clean engine oil as a lubricant during rebuilding. Check that

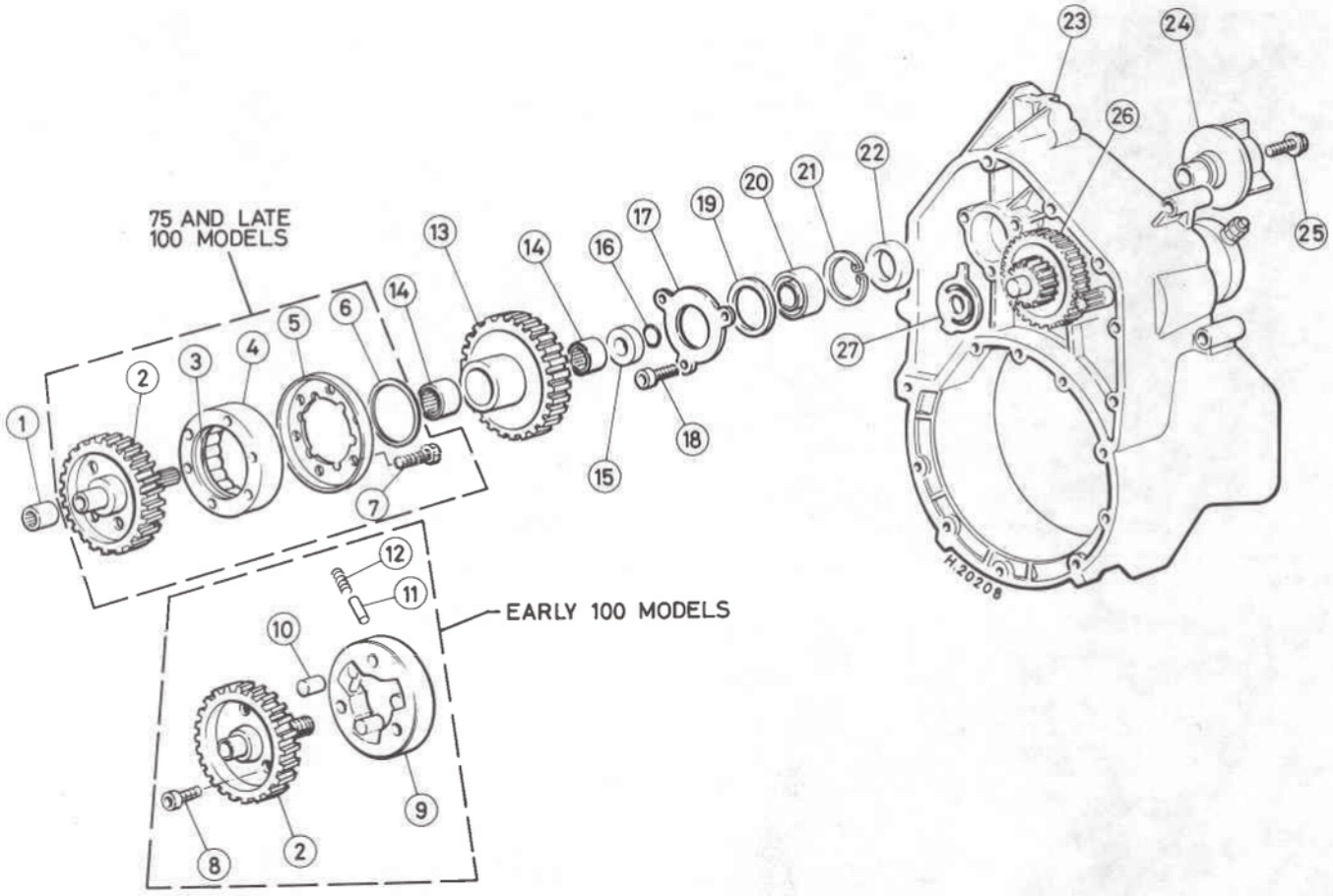


Fig. 1.8 Auxiliary drive shaft and starter clutch components

1 *Bearing*
2 *Auxiliary drive shaft*
3 *Cage*
4 *Sprag-type starter clutch*
5 *End cover*
6 *Conical spring washer*
7 *Bolt – 6 off*
8 *Screw – 3 off*
9 *Roller-type starter clutch*
10 *Roller – 3 off*
11 *Plunger – 3 off*
12 *Spring – 3 off*
13 *Starter clutch gear pinion*
14 *Bearing – 2 off*
15 *Thrust washer*
16 *O-ring*
17 *Retainer plate*
18 *Allen bolt – 3 off*
19 *Conical spring washer*
20 *Bearing*
21 *Circlip*
22 *Oil seal*
23 *Bellhousing*
24 *Alternator drive flange*
25 *Bolt*
26 *Starter idler shaft*
27 *Spring**

** note that this may not be fitted on early models*

the modified components (where applicable) are available if any are to be renewed.

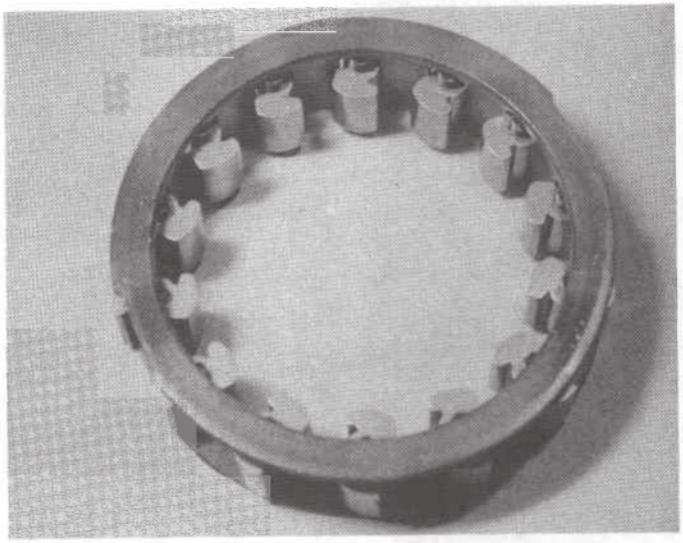
9 On the roller-type clutch fit the body to the auxiliary drive shaft, apply a few drops of Loctite 273 FL or similar thread-locking compound to their threads and refit the three retaining screws tightening them evenly to the specified torque setting.

10 Fit the springs and plungers together, insert each assembly into its respective bore in the clutch body and use a shim screwdriver or similar to compress the plunger into its bore while the roller is refitted.

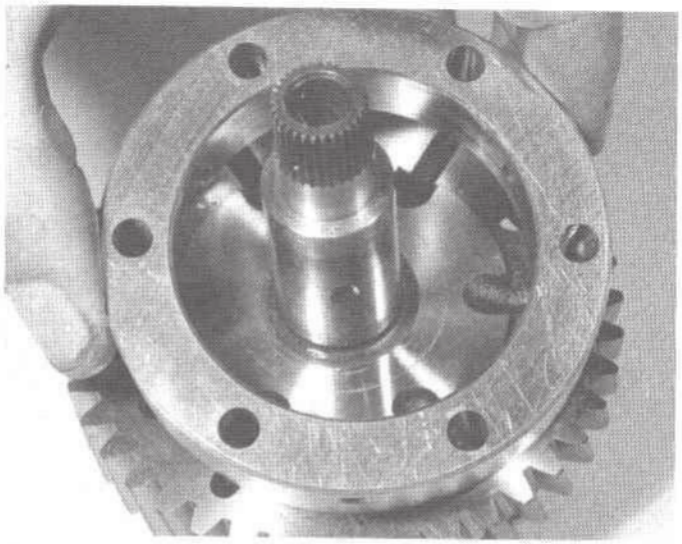
11 On the sprag-type clutch place the clutch body on the auxiliary drive shaft and insert the conical spring washer with its convex face to the rear, ie so that its outer edge rests against the drive shaft and its raised inner edge projects rearwards, towards the starter clutch gear pinion. Fit the sprag clutch assembly with the coil springs towards the rear, followed by the end cover. Apply a few drops of Loctite 273 FL thread-locking compound or similar to their threads and refit the six retaining bolts, tightening them to their specified torque setting.

12 On both types of clutch hold still the main assembly and insert the starter clutch gear pinion with a clockwise twist to help it enter the locking elements. Refit the thrust washer and O-ring.

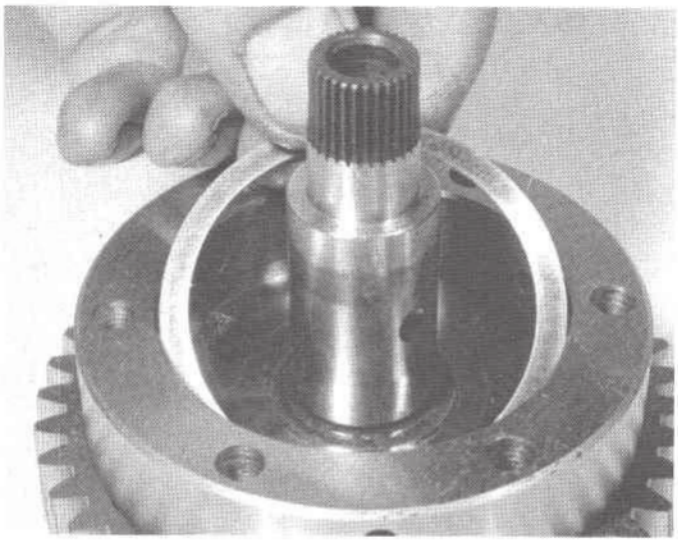
13 To check the operation of the clutch, hold the body and drive shaft while rotating the starter clutch gear pinion; seen from the rear, the pinion should be locked when rotated anticlockwise and should be free to turn when rotated clockwise.



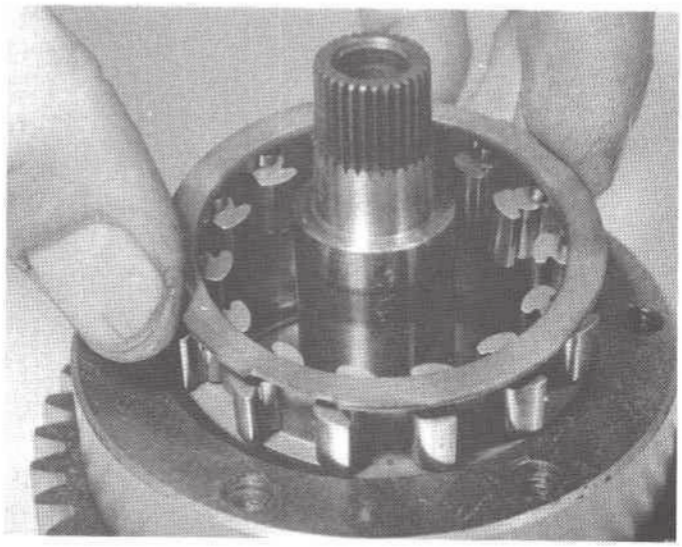
25.5 Starter clutch components must be thoroughly cleaned whenever possible



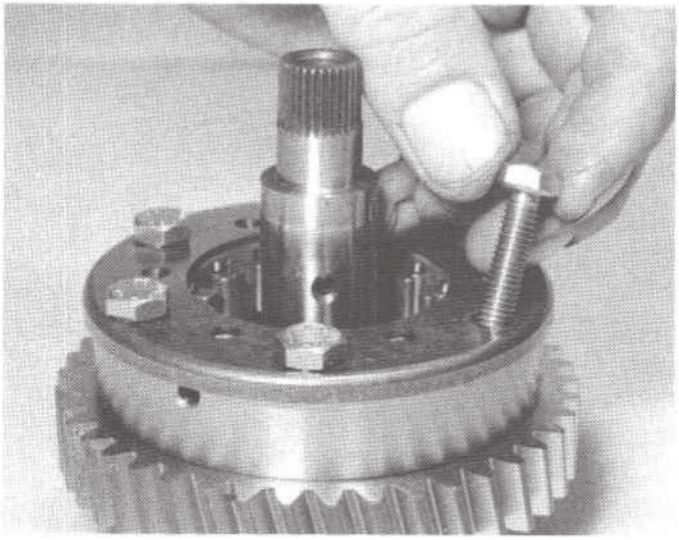
25.11a Reassembling sprag-type starter clutch – refit clutch body to drive shaft ...



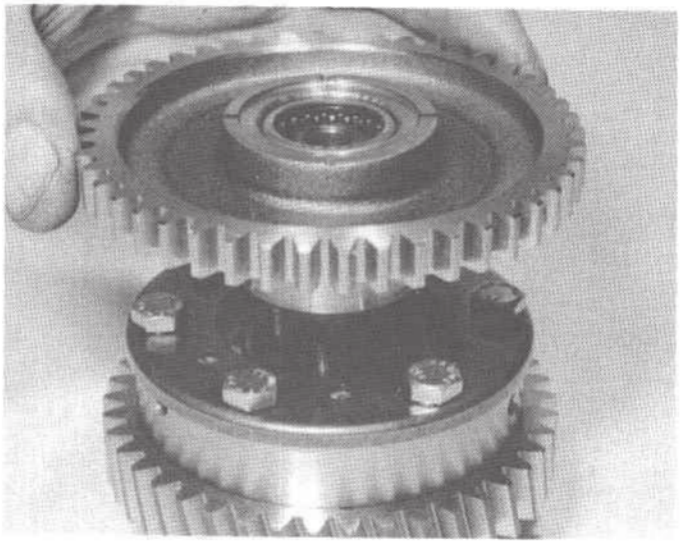
25.11b ... and refit conical spring washer – convex face rearwards



25.11c Sprag clutch assembly is fitted with coil springs to the rear – note notches in outer cage showing modified type of clutch



25.11d Refit end cover and bolts – secure bolts as described in text



25.12 Twist clutch gear pinion clockwise to refit to clutch assembly

26 Reassembling the engine unit: general

1 Before reassembly of the engine unit is commenced, the various component parts should be cleaned thoroughly and placed on a sheet of clean paper, close to the working area.

2 Make sure all traces of old gaskets have been removed and that the mating surfaces are clean and undamaged. Great care should be taken when removing old gasket compound not to damage the mating surface. Most gasket compounds can be softened using a suitable solvent such as methylated spirits, acetone or cellulose thinner. The type of solvent required will depend on the type of compound used. Gasket compound of the non-hardening type can be removed using a soft brass-wire brush of the type used for cleaning suede shoes. A considerable amount of scrubbing can take place without fear of harming the mating surfaces. Some difficulty may be encountered when attempting to remove gaskets of the self-vulcanising type, the use of which is becoming widespread, particularly as cylinder head and base gaskets. The gasket should be pared from the mating surface using a scalpel or a small chisel with a finely honed edge. Do not, however, resort to scraping with a sharp instrument unless necessary.

3 Gather together all the necessary tools and have available an oil can filled with clean engine oil. Make sure that all new gaskets and oil seals

are to hand, also all replacement parts required. Nothing is more frustrating than having to stop in the middle of a reassembly sequence because a vital gasket or replacement has been overlooked. As a general rule each moving engine component should be lubricated thoroughly as it is fitted into position.

4 Make sure that the reassembly area is clean and that there is adequate working space. Refer to the torque and clearance setting wherever they are given. Many of the small bolts are easily sheared if overtightened.

5 BMW now recommend the use of Three Bond 1207 B silicone sealant (formerly Loctite 574) for all mating surfaces which require the use of jointing compound and emphasize that careful work is necessary to prevent oil leaks. All mating surfaces must be cleaned of all traces of old gaskets or of old jointing compound and must be absolutely flat and unmarked. Using a clean, fluff-free cloth soaked in fresh high flash-point solvent wipe over the mating surfaces to remove all traces of old oil or grease. Apply a thin, continuous coat of sealant to the mating surfaces and assemble the parts immediately; tighten the retaining nuts, bolts or screws evenly and progressively to the specified torque settings, where available. Allow the sealant to harden for one hour before running the engine and peel off any surplus sealant from the outside of the joint.

6 Remember that if the mating surfaces are in good condition there should be no need for a thick film of sealant; the thinnest smear will usually prove sufficient to seal a joint. Sealant is wasted that is pushed out to form a bead on each side of the joint; note that while the bead on the outside is merely annoying and unsightly, proclaiming amateurish work, the bead on the inside is free to break off and block oilways or cause other similar problems.

27 Reassembling the engine unit: refitting bearings and oil seals

Note: *The refitting of bearings usually involves the use of heat. Refer to the general instructions at the beginning of Section 13.*

1 To refit the auxiliary drive shaft front bearing a stepped drift must be obtained or fabricated which fits closely inside the bearing rollers (ie of the same diameter as the shaft or 20.5 mm/0.81 in), and has a wider section of the same diameter as the bearing outer race so that the bearing is fully supported as it is driven into place. It must be fitted with the manufacturer's marks or numbers facing outwards, ie to the rear and must be driven in until it is flush with the crankcase, which must be heated to 100 – 120°C (212 – 248°F).

2 To refit the needle roller bearings to the starter clutch gear pinion a drawbolt assembly must be used. This is made up from a thick steel washer which is large enough to fit over the end of the bearing and the pinion, a smaller thick washer which is of the same outside diameter as the bearings (ie approximately 26 mm/1.02 in) so that it will fit closely inside the pinion's bearing bore, and a nut and bolt (of as large a diameter as possible) that will fit inside the washers, the pinion and one bearing.

3 Place the first bearing against the gear pinion so that it is absolutely square to the housing with the manufacturer's marks or numbers facing outwards. Place the smaller washer against the bearing and the larger washer against the opposite end of the pinion. Pass the bolt through the assembly, refit the nut and tighten it lightly. Check that the bearing is perfectly square to its housing and that the small washer is fully seated against the bearing, then tighten the nut gradually to draw the bearing into place until it is seated at a depth of 0.4 ± 0.2 mm (0.016 ± 0.008 in) inside the pinion (measured from the pinion end face to the outside edge of the bearing outer race). Dismantle the drawbolt, check that the bearing rollers are free to rotate smoothly and easily, then lubricate the bearing. Repeat for the remaining bearing.

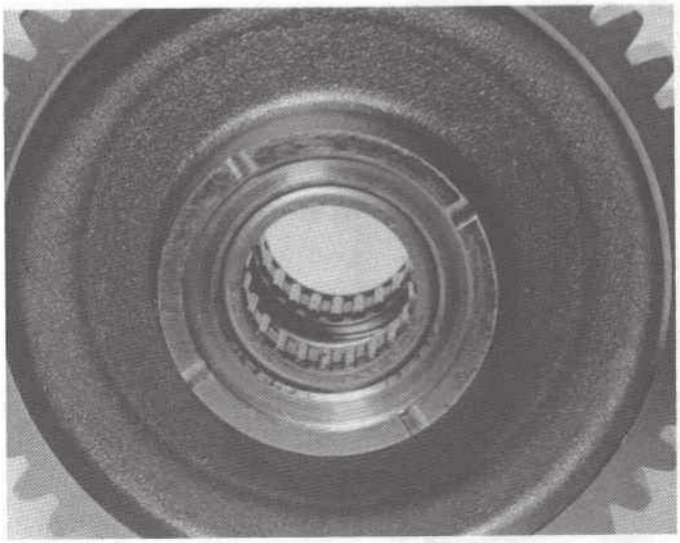
4 To refit the auxiliary shaft rear bearing, heat the bellhousing to approximately 100°C (212°F) and refit the locating circlip. Place the bearing squarely on its housing and tap it into place against the circlip using a hammer and a tubular drift such as a socket spanner which bears only on the bearing outer race. Install the conical spring washer so that its convex side is outwards (ie its outer edge must rest against the bearing, leaving the inner edge raised away from it). Refit the retainer plate and its retaining screws applying a few drops of Loctite 242 or similar thread-locking compound to the threads of each, tighten the screws evenly and securely, using the specified torque wrench setting, where given. Fit a new oil seal (see below).

5 The output shaft rear bearing must be heated before it can be tapped into place and the retaining circlip refitted in its groove. The front bearing is refitted during the rebuilding procedure.

6 The output shaft rear oil seal fitting procedure is described in Section 29.

7 The auxiliary drive shaft rear seal and the crankshaft front seal are fitted to their respective housings in the same way. Polish away any burrs or raised edges, grease the seal inner lips and outer edge and place the seal on its housing with the manufacturer's marks or letters facing outwards, ie with the seal spring-loaded centre lips towards the fluid being retained. Using a hammer and a tubular drift such as a socket spanner which bears only on the seal hard outer edge, tap the seal into place until it is flush with its surrounding housing; note that in the case of the crankshaft seal, it must be flush with the housing rear, or inside, face.

8 The oil level sight glass must be refitted, as described above, with great care. It helps to coat the outside of the sight glass with engine oil prior to installation.



27.2 Starter clutch gear pinion bearings must be fitted to a precise depth in pinion bore

28 Reassembling the engine unit: refitting the crankshaft

1 Check that all components are completely clean and dry. Ensuring that the correct shells are used, refit the shells to their respective recesses ensuring that the locating tangs (except thrust bearings) engage correctly in their grooves.

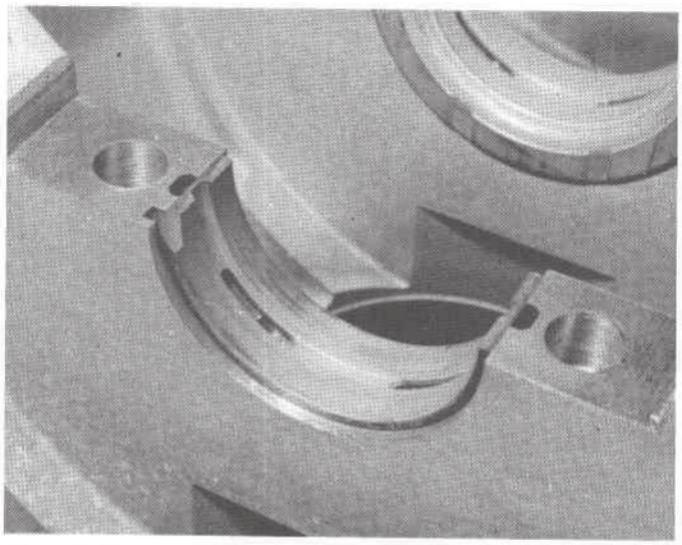
2 Lubricate the crankshaft bearing journals and the bearing shells liberally with clean engine oil.

3 Lower the crankshaft carefully into place, aligning the timing marks (if possible) on 75 models, and refit the main bearing caps using the marks or notes made on dismantling to ensure that each is refitted the correct way round and on its original bearing. Note particularly that the bearing shell locating grooves are next to each other on the 'lower' side of each bearing.

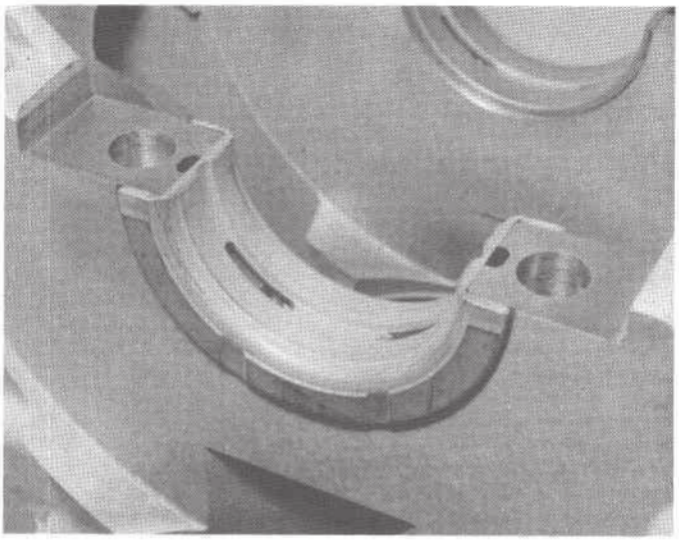
4 Tighten the bearing cap retaining bolts evenly and progressively to the specified torque setting. To apply pressure evenly work in the following sequence to tighten the caps (bearings numbered consecutively from front to rear, number 1 being at the front/cam chain end): on 75 models tighten first number 2, followed by numbers 3, 1 and 4 – on 100 models tighten first number 3, followed by numbers 2, 4, 1 and 5.

5 Check after each cap is tightened that the crankshaft is able to rotate freely and with reasonable ease; some stiffness will be inevitable, especially if new shells have been fitted.

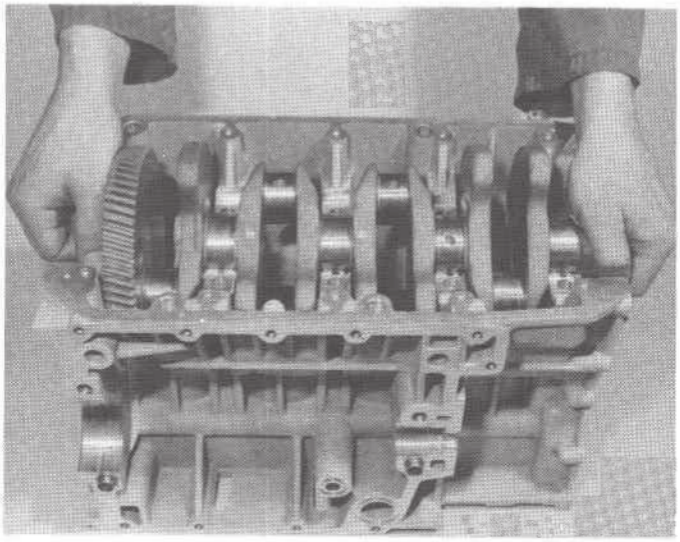
6 On 75 models, if the balancer shaft is now to be refitted, rotate the crankshaft to the position where the timing marks will align, as noted on removal.



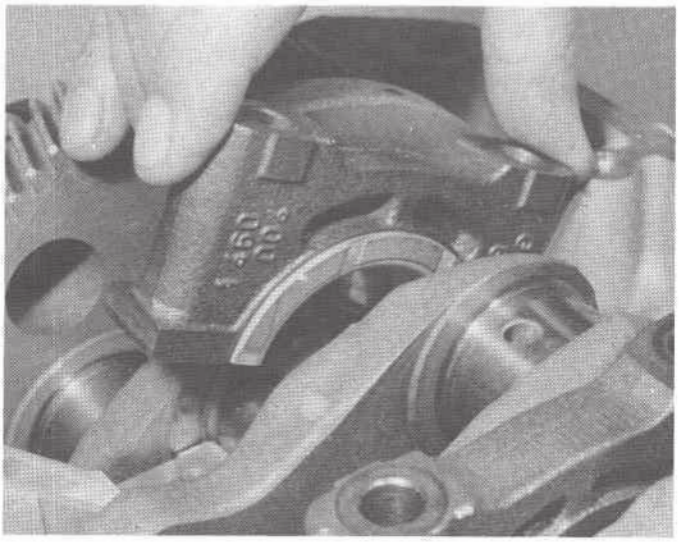
28.1a Check correct shells are refitted on reassembly – ensure locating tangs engage fully ...



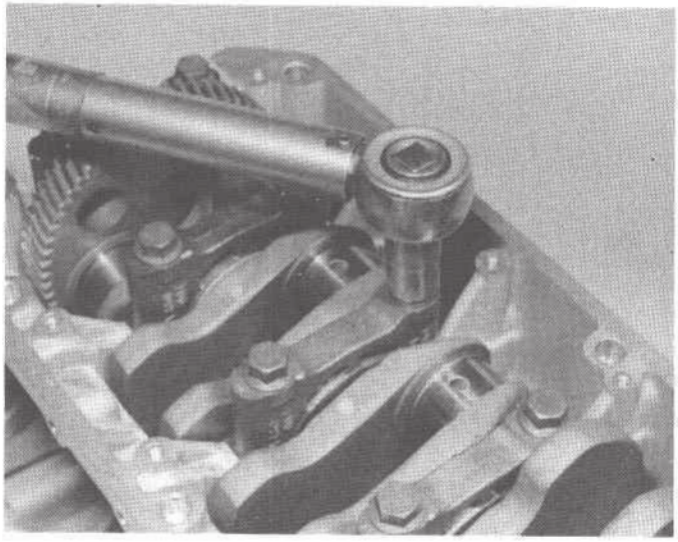
28.1b ... except for thrust bearings



28.3a Oil all bearing surfaces liberally before refitting crankshaft



28.3b Use identifying marks noted or made on removal to replace bearing caps correctly



28.4 Tighten main bearing cap bolts evenly and in correct sequence – see text

29 Reassembling the engine unit: refitting the output/balancer shaft and the crankcase lower section

1 Check that the front bearing inner sleeve is secured in place by its circlip and fit the larger circlip, followed by the needle bearing over it. Lubricate both bearings.

2 On 75 models fit the balancer shaft to its bearing recesses ensuring that the dot or V mark aligns exactly with the straight line on the crankshaft gear, as noted on removal, and that the marks remain in alignment as the balancer shaft bearings are pressed into place. Ensure that the rear bearing shoulder fits fully into its groove and that the front bearing locating circlip fits into its groove with its open end aligned on each side of the crankcase mating surface (ie so that the circlip compresses easily as the castings are clamped together).

3 On early 100 models – identified by the rear bearing having a thin (1.75 mm/0.07 in) locating circlip – thoroughly clean and degrease the rear bearing circlip and outside edge and the bearing recess, especially the circlip groove. Apply a thin coat of Loctite 273 or Three Bond 1110 B adhesive to the groove and refit the shaft. Press both bearings and circlips into their respective housings and grooves, ensuring that the circlip open ends are aligned on each side of the crankcase mating surface (ie so that the circlip compresses easily as the castings are clamped together).

4 On late 100 models – identified by the rear bearing having a thick (3.52 mm/0.14 in) locating shoulder at the outer race rear end – install the output shaft as described in paragraph 2 above, except that there are no timing marks to set.
5 On all models, check that the output/balancer shaft bearings are fully seated and check that it is free to rotate with the crankshaft. On 75 models check the timing marks again after one or two revolutions.
6 Install the two locating dowels in their recesses next to each bearing and place two new O-rings in the grooves around the oil and coolant passages.
7 Lubricate the output/balancer shaft bearings and gear teeth, check that the mating surfaces are absolutely clean, undamaged and degreased (wipe them over with a rag soaked in a suitable high flash-point solvent) and apply a thin coat of Loctite 574 or Three Bond 1207 B jointing compound following the manufacturer's instructions.
8 Fit the crankcase lower section and its retaining bolts or screws. At first tighten evenly the four 'inside' bolts by hand until the lower section is seated securely, then tighten first the rear two hexagon-headed bolts to their specified torque setting, followed by the front two Allen-headed bolts or screws to their (lower) torque setting. Finally refit and tighten evenly the 'outside' Allen bolts or screws to their specified torque setting.
9 Check again that the output/balancer shaft is free to rotate easily with no traces of stiffness.
10 Once the crankcase lower section is secured the output shaft rear seal may be refitted. Clean the seal outer edge, the shaft and its housing then apply a thin smear of grease to the housing, the seal outer edge and its sealing lips. Position the seal so that it is absolutely square to the housing and tap it in, until it is flush with the housing, using a hammer and a tubular drift such as a socket spanner which bears only on the seal's hard outer edge.

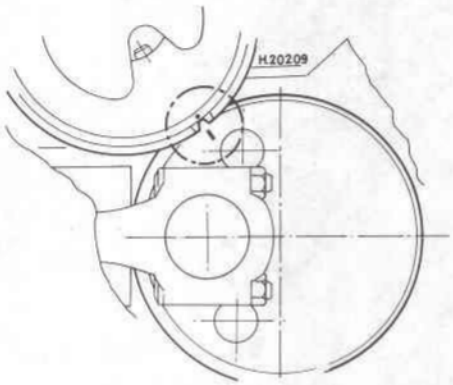
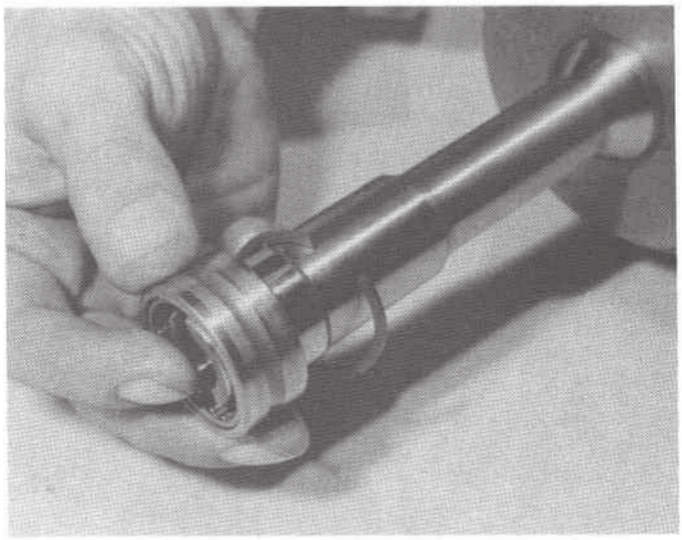
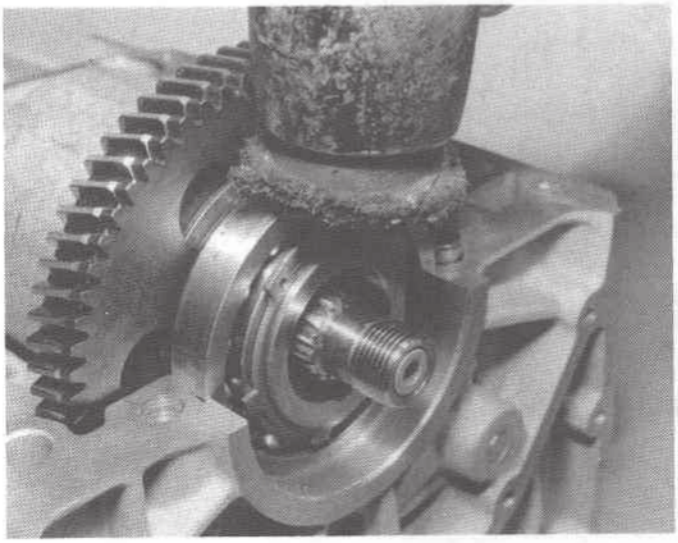


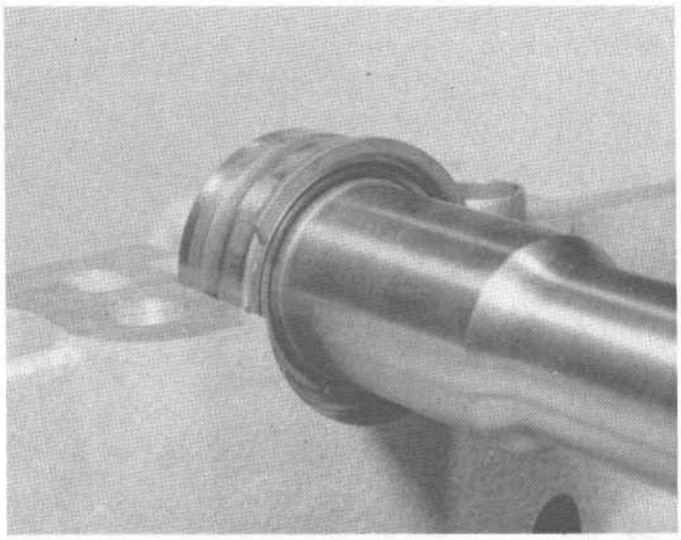
Fig. 1.9 Crankshaft/balancer shaft timing marks – 75 models



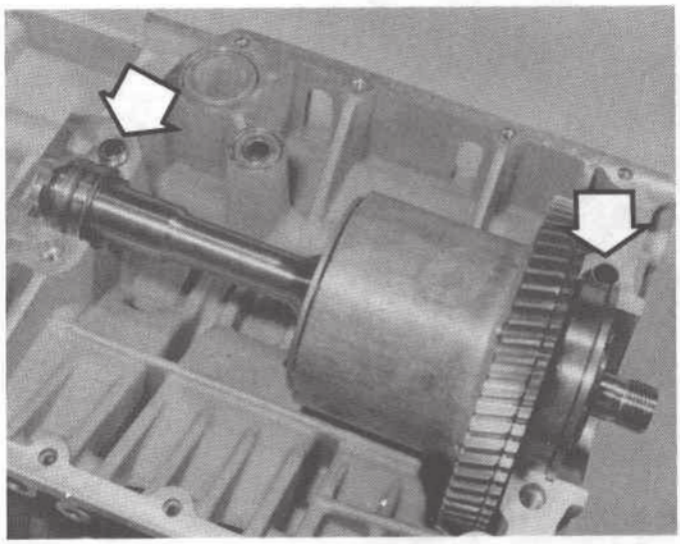
29.1 Fit larger circlip and bearing to output shaft front end



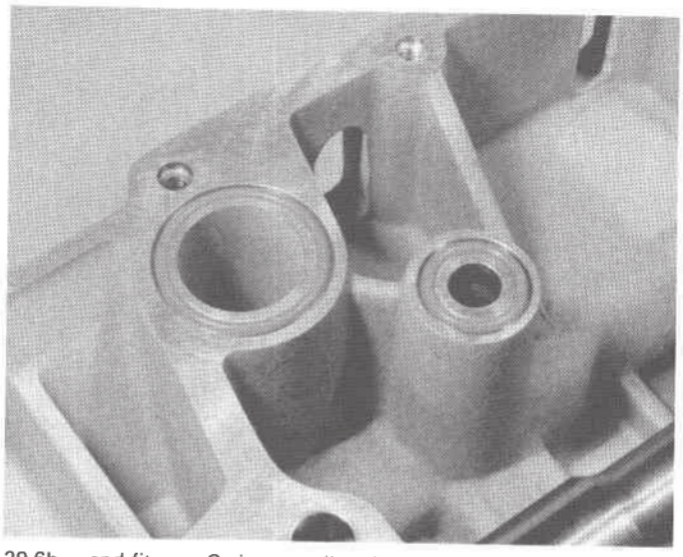
29.4a Ensure output shaft rear bearing is settled securely in its locating groove



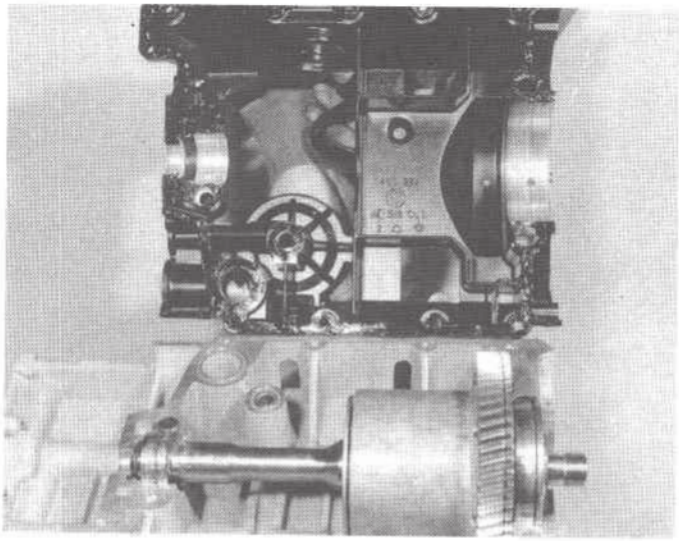
29.4b Position open end of front bearing locating circlip on each side of mating surface, as shown



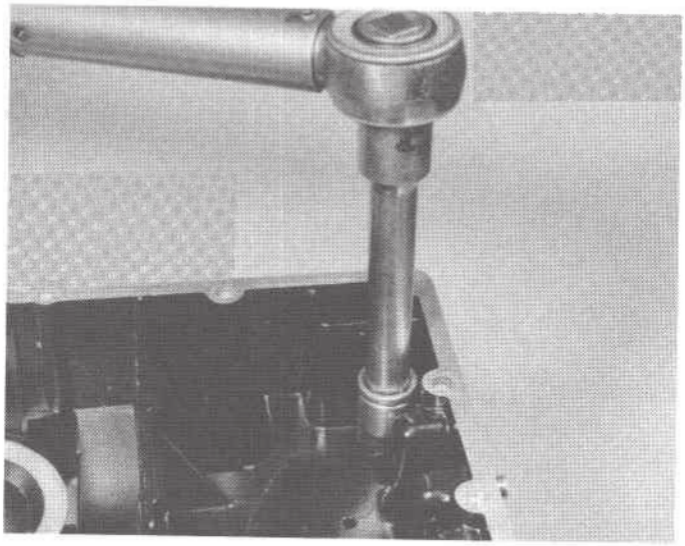
29.6a Check two locating dowels (arrowed) are pressed into locations next to bearings ...



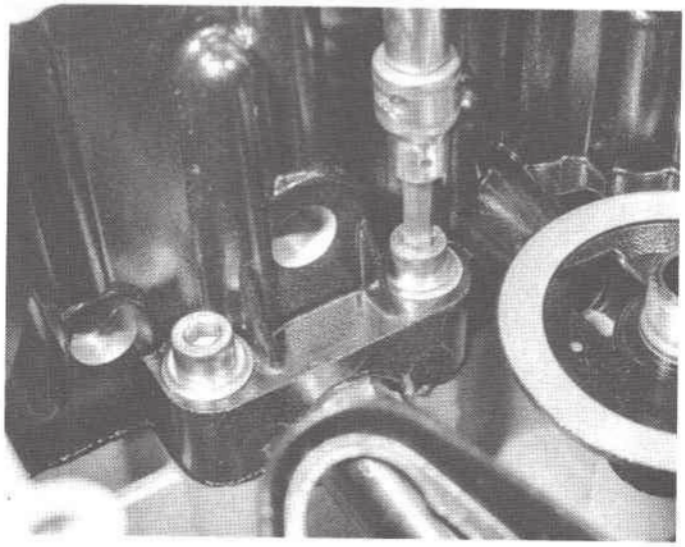
29.6b ... and fit new O-rings to oil and coolant passages



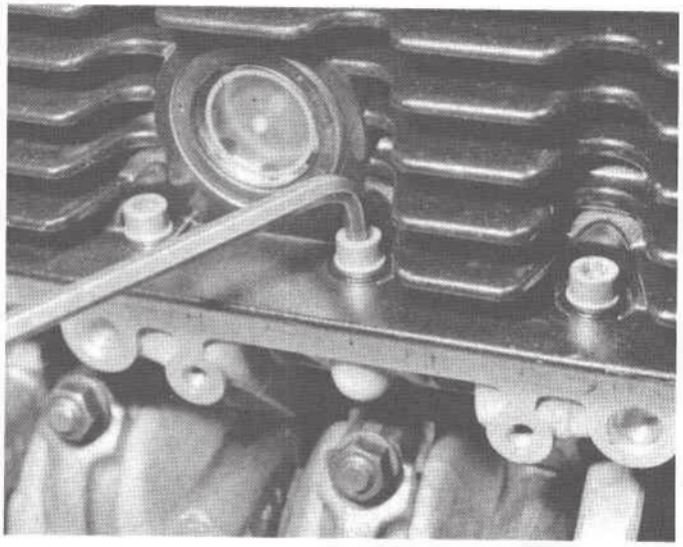
29.7 Apply a thin coat of sealant to mating surface as described in text



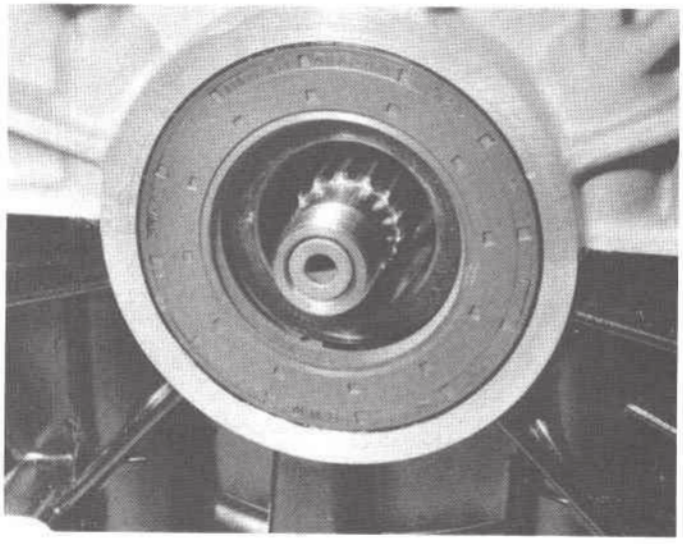
29.8a Tighten to specified torque wrench settings, the output shaft rear bolts ...



29.8b ... followed by front bolts or screws ...



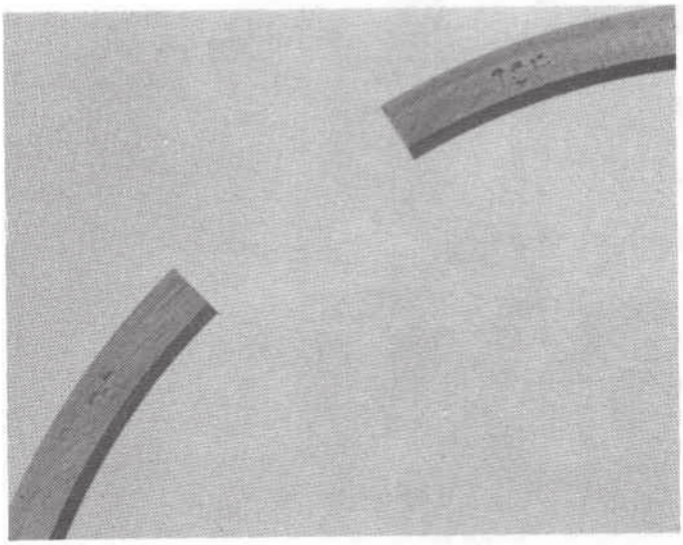
29.8c ... and bolts or screws around mating surface edge



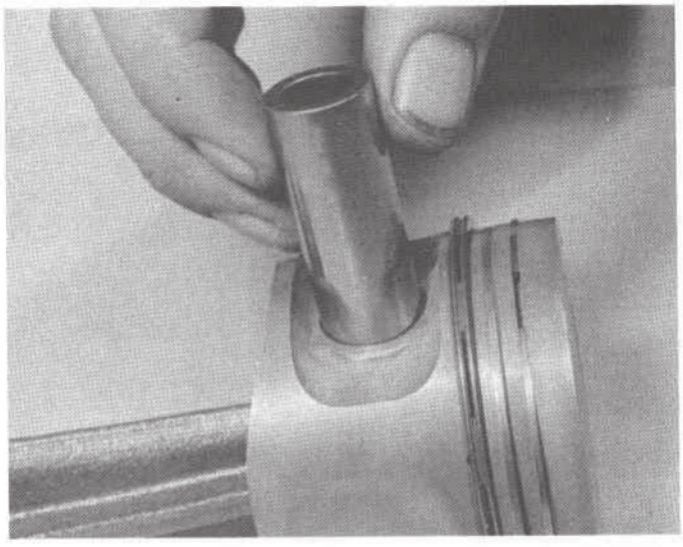
29.10 Fit output shaft rear seal as described in text

30 Reassembling the engine unit: refitting the pistons and connecting rods

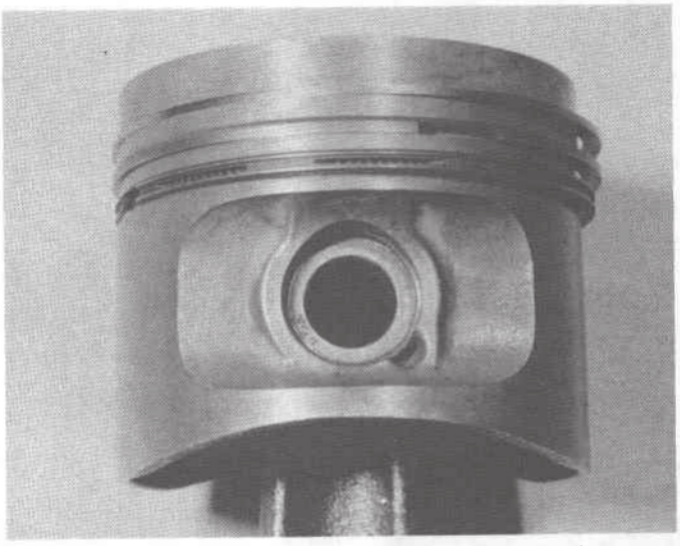
1 Fit the oil scraper ring inner section to its groove in each of the pistons followed by the outer section; their end gaps should be 180° apart. The second (lower) compression ring has a tapered inner edge on its top surface; this surface may also have the word TOP etched in it. The top compresssion ring is a plain rectangular cross-section which has the word TOP etched into its top surface and was found to be chrome-plated. Fit the two compression rings as indicated by their markings and identified by their cross-sections, space their end gaps at 120° from the scraper ring outer section end gap and from each other.
2 Fit each piston to its connecting rod and refit the gudgeon pin, warming the piston if necessary to permit this. Fit new gudgeon pin circlip(s) ensuring that they are settled fully in their grooves with the open ends well away from the slot provided for removal. Use the marks or notes made on dismantling (see Section 10) to ensure that the piston is positioned correctly on the rod; if a new rod is being fitted note that it's 'upper' or intake surface is indicated by the slots for the bearing shell locating tangs or oilways. From this can be found the connecting rod's front (cam chain) face which is to be aligned with the arrow in the piston crown.
3 Fit the bearing shells to the connecting rod and cap ensuring that each shell is pressed firmly into place with its locating tang fitted into the slot in the rod or cap. Try to avoid touching the bearing surface, and lubricate the shells and crankpins liberally with clean oil, then liberally oil the cylinder bore, piston and rings.
4 Position the crankshaft at BDC for the assembly being refitted and slip the lengths of protective tubing over the threads of the connecting rod bolts. Fit a piston ring compressor (use any suitably-sized car-type compressor available from most auto accessory shops) to the piston, checking first that the rings are correctly arranged as described above. Checking that the piston/rod assembly is the correct one for that cylinder and that it is refitted the correct way round – arrow stamped in the piston crown facing towards the front (cam chain) end of the engine, connecting rod bearing shell locating tangs/oilways upwards (intake side) – insert the assembly into the bore from the cylinder head side.
5 Carefully insert the piston into the bore until the ring compressor is seated, then tap the piston gently but firmly through the compressor until it is fully in the bore. At the same time, guide the connecting rod big-end over the crankpin.
6 Again lubricate the bearing surfaces, remove the tubing from the bolts, then refit the big-end bearing cap ensuring that its shell is correctly seated and that the locating tang/oilway is uppermost. Tighten the cap retaining nuts evenly until the cap is seated, then tighten them to the specified amount.
7 The big-end bearing cap retaining nuts are tightened in two stages. The first, to preload the bearing shells, is carried out using an ordinary torque wrench set to the specified pressure. The second stage is carried out using a method not yet in common use in the motorcycle world, ie to tighten the nuts by rotating them further through a specified angle. To measure this either use a degree disc (see accompanying photograph), or cut a circular piece of cardboard, pierce a hole in its centre and mark a heavy zero line from the centre to the edge along the true radius, then use a protractor to mark exactly the required angle anticlockwise from the zero line. Fit the disc to the tightening tool as shown and align the zero line with any convenient fixed point on the engine unit, then tighten the nut until the 80° mark aligns with the fixed point. Hold the engine unit steady (an assistant would be useful) and be very careful not to move the card on the tool during tightening or the angle measurement will be lost. **Note:** This method is very precise and effective in tightening fasteners but must be used with great care and accuracy if the nuts are to be correctly tightened; the pressures involved are quite high and the permissible tolerances minimal.
8 Repeat this procedure to refit the remaining assemblies. Check for free crankshaft rotation at each stage; some stiffness will be inevitable, especially if the bearing shells have been renewed, but the crankshaft should be able to rotate with reasonable ease.
9 Refit the cylinder head as described in the following Section.



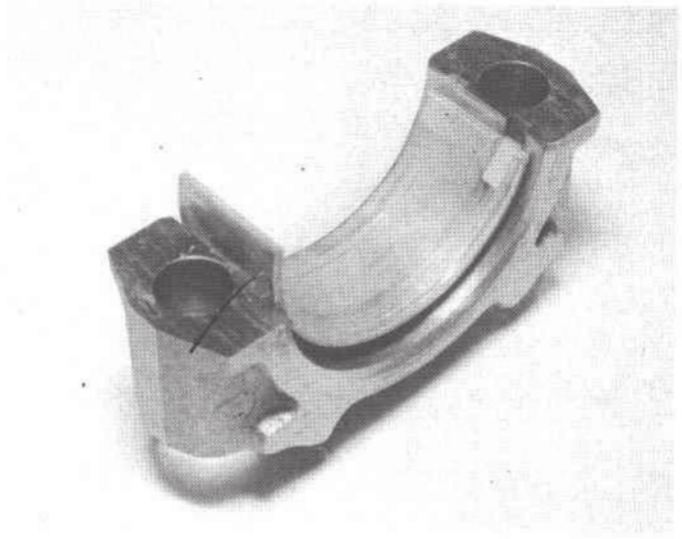
30.1 Compression ring top surfaces can be identified by markings and by cross-sections, see text



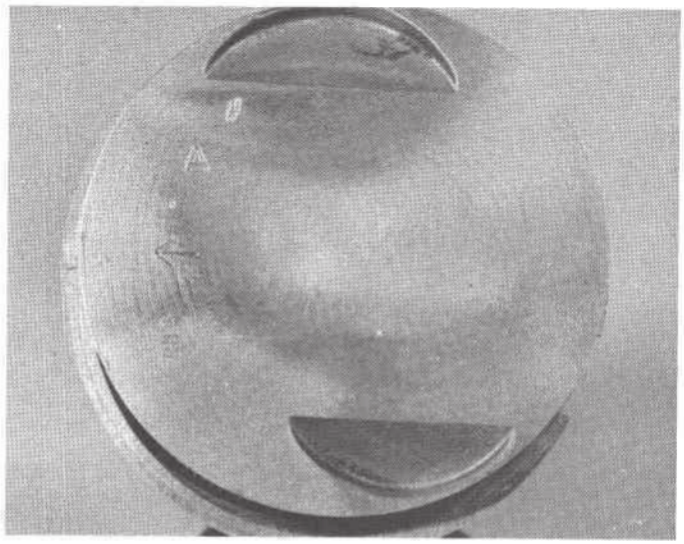
30.2a Ensure correct piston is refitted to each connecting rod – piston may require heating to permit refitting



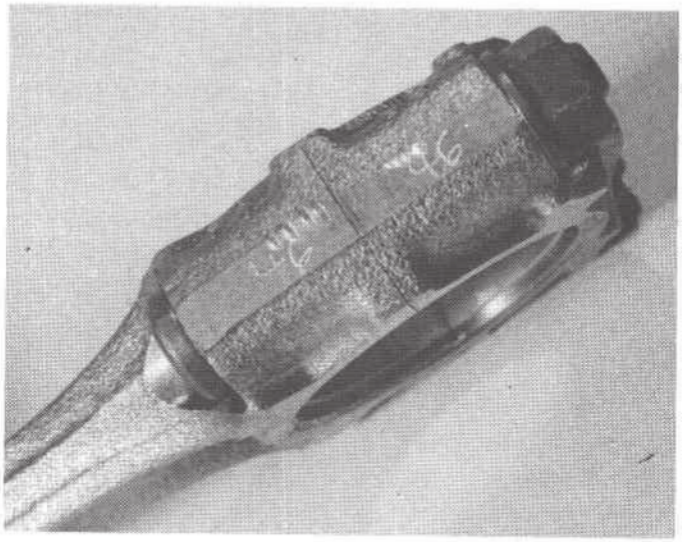
30.2b Ensure retaining circlips are correctly positioned, as shown



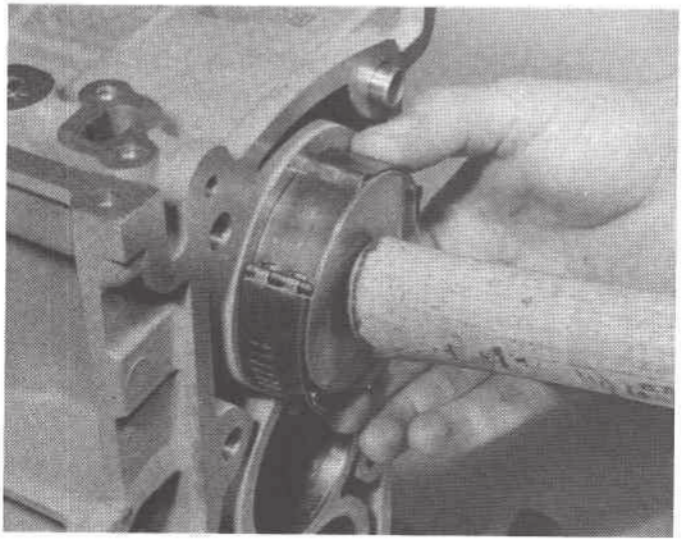
30.3 Bearing shell locating tangs must engage with cap or rod grooves – oil liberally



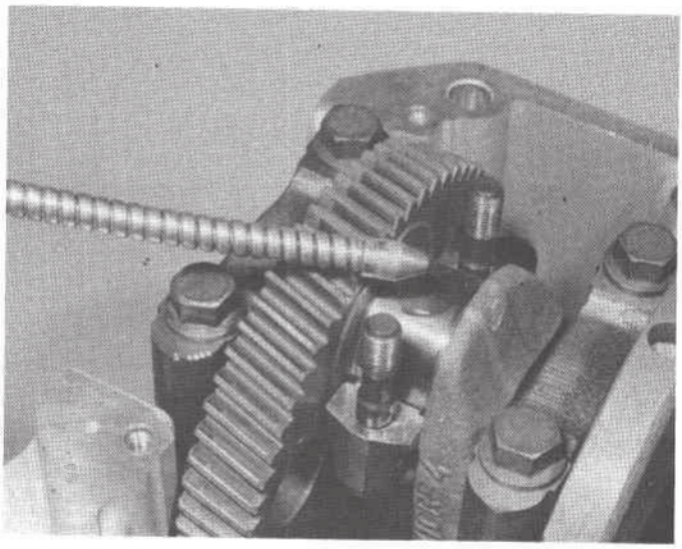
30.4a Arrow stamped in piston crown points to front (cam chain) end of engine – note larger (intake) valve cutaway uppermost



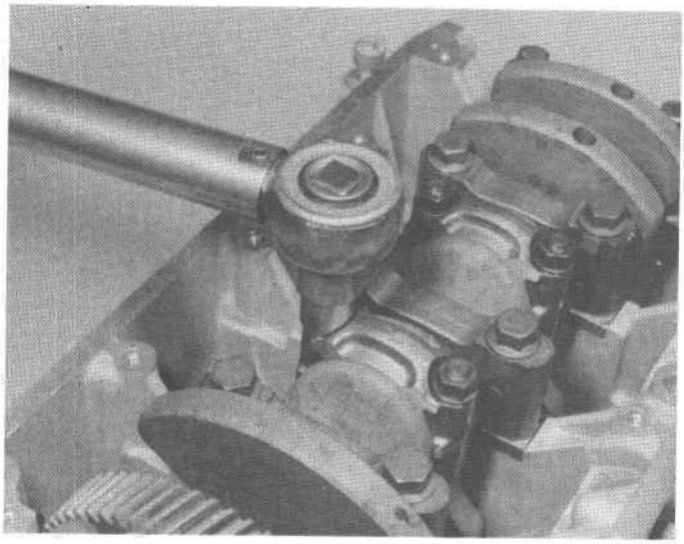
30.4b Marks on connecting rod and cap should ensure correct refitting of all components



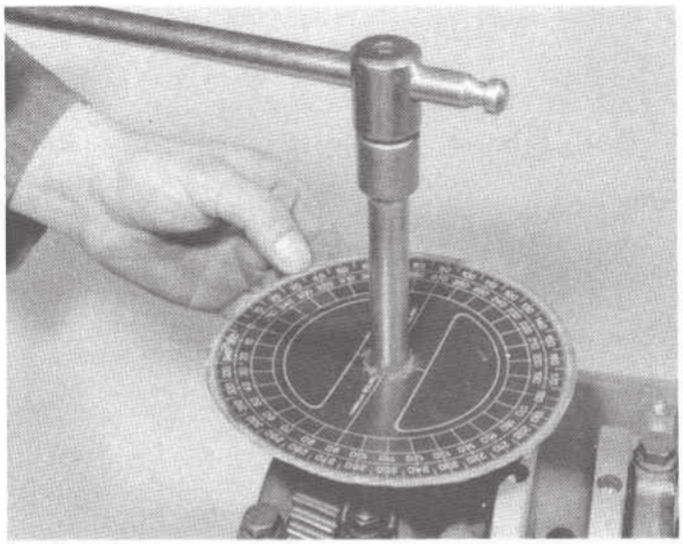
30.5 Use car-type ring compressor when refitting piston/rod assemblies



30.6 Oil liberally bearing surfaces before refitting bearing caps



30.7a Tightening big-end bearing cap retaining nuts – first stage is by torque wrench ...



30.7b ... second stage is by degrees of rotation – see text

31 Reassembling the engine unit: refitting the cylinder head

1 Check that the sealing faces of the cylinder head and block are completely clean and free from dirt, oil, grease, corrosion or old gasket material, also that they are undamaged.
2 Check that the tapped holes for the head retaining bolts are clean right to the bottom and free from oil. A quick squirt of aerosol-applied contact cleaner will clear any oil from each hole. Carefully clean the bolts, particularly the threads.
3 Fit the two locating dowels to their recesses in the cylinder block and fit the new gasket over them. No jointing compound should be used but a smear of grease will help the gasket to settle and will hold it in place. Note that the gasket will fit correctly only one way; check that all coolant passages, bolt holes, oilways and oil drain passages are clear. Lightly oil the threads and under the heads of the cylinder head bolts and check that all are fitted with their flat washers.
4 Refit the cylinder head, positioning it over the locating dowels, and fit the retaining bolts. Tighten them lightly at first, until all are in place and the head is settled.
5 Working in the sequence shown in the appropriate accompanying illustration tighten the bolts evenly, in gradual stages, to the 1st stage torque wrench settings specified; this seats the gasket.
6 After a 20-minute wait, repeat this procedure but tighten the bolts to the higher 2nd stage torque wrench setting specified. As can be seen from the accompanying photograph, the bolts can be tightened (but not all can be removed and refitted) with the camshaft in place; therefore this second stage tightening need not hold up reassembly work.
7 Where appropriate, refit the engine front left-hand mounting bolt and nut; do not forget to refit any shims that were found on removal.

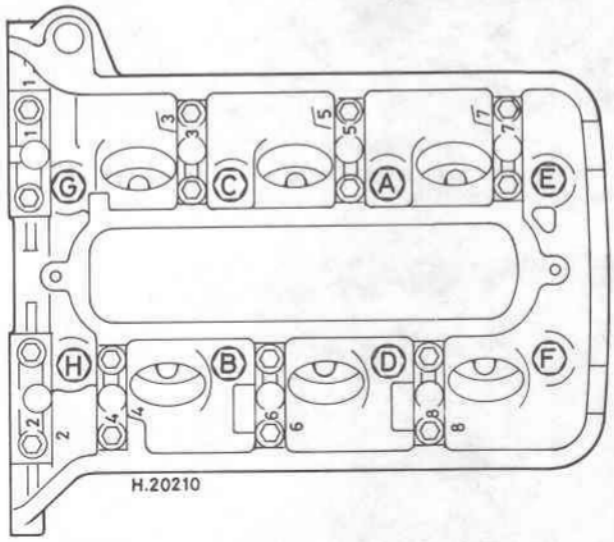


Fig. 1.10 Cylinder head bolt tightening sequence – 75 models

*A to H – head bolt tightening sequence **
1 to 8 – camshaft cap location numbering

** reverse for slackening*

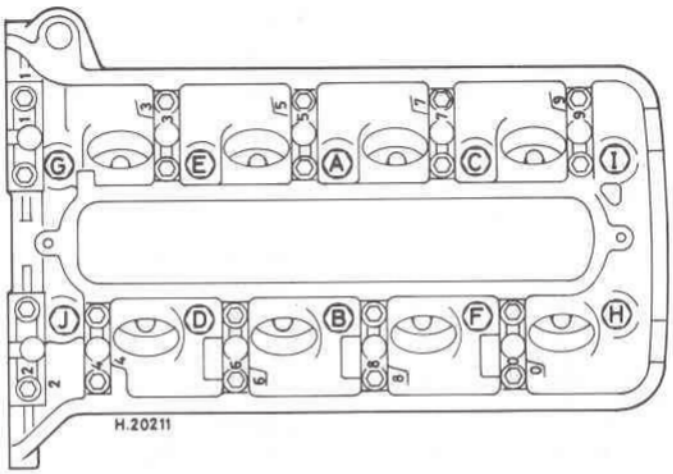
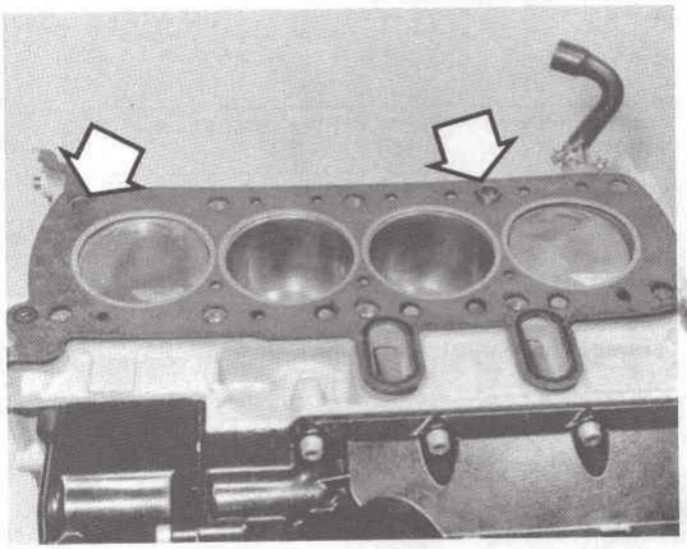


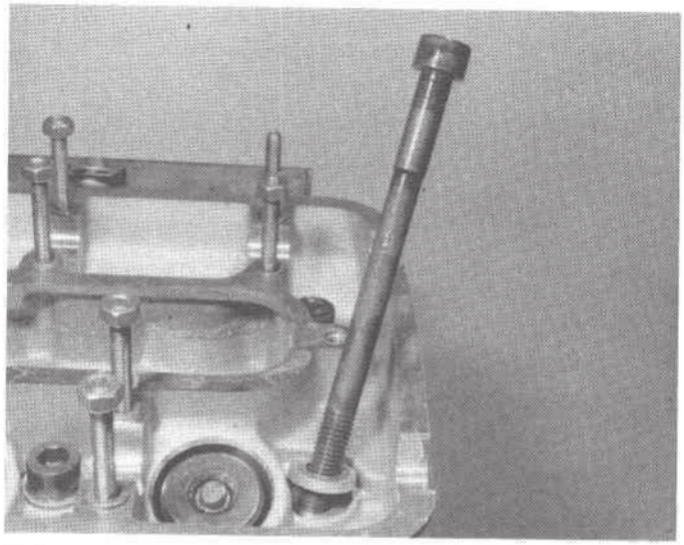
Fig. 1.11 Cylinder head bolt tightening sequence – 100 models

*A to J – head bolt tightening sequence **
0 to 9 – camshaft cap location numbering

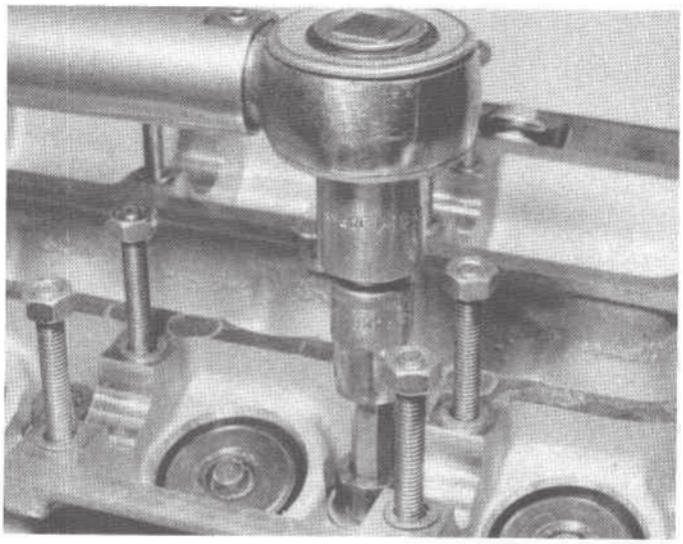
** reverse for slackening*



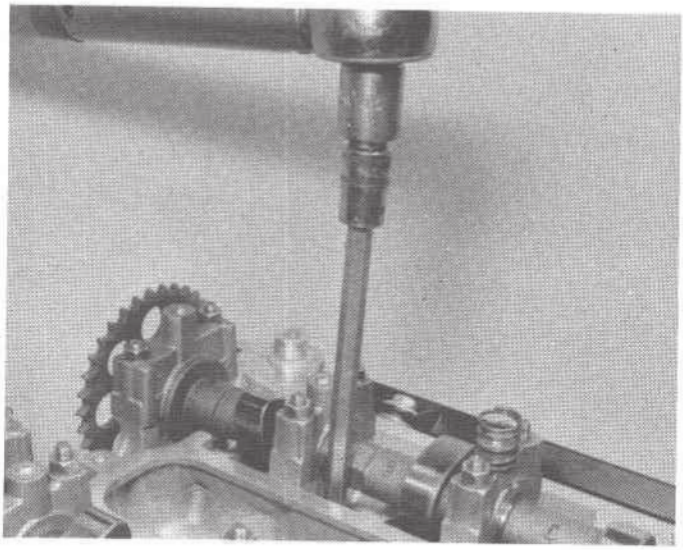
31.3a Fit new head gasket over two locating dowels (arrowed)



31.3b Clean threaded holes and oil retaining bolts lightly as described before refitting



31.5 Tighten cylinder head retaining bolts evenly to first stage torque setting ...



31.6 ... then to second stage setting after specified waiting time – note tool used to tighten bolts with camshafts in place

32 Reassembling the engine unit: refitting the camshafts and setting the valve timing

1 Remove the wooden dowels (if used) from the camshaft locations. Lay out all the bearing caps with their nuts and washers, keeping separate intake and exhaust components and remove all traces of dirt from the bearing surfaces and cam followers. Refit all four dowel pins to the cylinder head.

2 Remove each cam follower bucket in turn and check that the adjustment shim is correctly seated with its marked face downwards. These shims are easily displaced and can cause a lot of trouble if not checked at this stage. If work has been done on the valve gear, making it necessary to check the valve clearances, do not forget to do this at the appropriate time, the work necessary being described in Routine Maintenance.

3 Check that number 3 cylinder (75 models) or number 1 cylinder (100 models) is at top dead centre (TDC). Pack the spark plug channel with clean rag or similar so that oil cannot enter, and check that the blanking plug is securely fixed in the rear end of each camshaft.

4 Positioning the camshaft so that its lobes are pointing away from all valves as much as possible, copiously oil the bearing surfaces of the cylinder head, caps and camshaft and offer up the first camshaft, refit the rear bearing caps (ie not yet the front thrust bearing caps) and, when possible, the retaining nuts and washers. **Ensure that the number in each bearing cap matches the number cast into the cylinder head next to the bearing pedestal and that the number is above (intake) or below (exhaust) the threaded boss and can be read only from the rear;** this ensures that the caps are installed in exactly the same way as they were originally fitted. See the accompanying photographs and illustrations for details.

5 Working evenly and gradually, by a turn at a time, tighten the nuts of the inner bearing caps first (ie first and second from the front on 75 models, second and third from the front on 100 models) in a diagonal sequence. As the camshaft is tightened on to its bearings against valve spring pressure prevent any risk of its tilting by lightly tightening the nuts of the outer bearing caps. When the inner bearing caps are seated securely on the cylinder head, tighten the outer cap retaining nuts until all rear caps are seated, then lubricate and fit the front (thrust) bearing cap. When all caps are seated, tighten their retaining nuts in the same sequence to the specified torque wrench setting; be careful to maintain the same even application of pressure. **Note:** take a great deal of time and trouble over this – if any bearing cap is cracked or damaged by careless workmanship it can only be replaced as part of a new cylinder head assembly.

6 Copiously lubricate its bearing surfaces and refit the second camshaft as described above.

7 Slowly and carefully rotate each camshaft using an open-ended spanner on the hexagon provided, until the lobe for number 3 cylinder (75 models) or number 1 cylinder (100 models) is pointing away from its valve but is inclined slightly inwards towards the opposite camshaft. If resistance is encountered at any point **stop** and turn the crankshaft backwards so that there is sufficient clearance between the piston and valve for the camshaft to continue rotating. **Do not** apply any extra force other than that normally required to rotate the camshaft; there is a risk of damaging the valves or pistons if they are forced against each other.

8 When both camshafts and the crankshaft are thus positioned approximately so that number 3 or 1 cylinder (as appropriate) is at TDC on the compression stroke (both valves closed) refit the camshaft sprockets. If the cam chain can be removed and refitted with the sprockets in place they can be fully secured at this stage; if not they should be refitted loosely as they will have to be removed and refitted during the valve timing procedure. To fit the sprockets, place each one on its respective camshaft, aligning the locating pin protruding from the sprocket rear face with the camshaft keyway, then refit the large washer with its recessed face against the sprocket. Refit the sprocket

retaining bolt and, holding the camshaft by applying an open-ended spanner to the hexagon provided, tighten the bolt to the specified torque setting.

9 Rotate the camshafts until the marks on the sprockets are aligned exactly with the cylinder head top (ie left-hand, when installed) machined surface, ie the joint between the head and the front (thrust) bearing caps. See the accompanying photograph. Rotate the crankshaft until the ignition rotor flange locating pin aligns exactly with the centre rib cast in the cylinder block/crankcase; as can be seen from the accompanying photographs, later models have a more precise mark cast on the crankcase wall, closer to the flange for easier alignment (OT is the German equivalent of TDC). These are the valve timing marks, with number 3 or 1 cylinder exactly at TDC on the compression stroke; check regularly that all are aligned **exactly** as the chain is refitted.

10 Engage the cam chain on the sprockets so that the runs between the crankshaft and intake camshaft and the two camshafts are as taut as possible while all three shafts are aligned with their marks. In some cases, as previously noted, this will require the removal and refitting of the camshaft sprockets; proceed as described in paragraph 8 above.

11 To ensure that the chain runs are absolutely taut, it may be necessary to rotate the driven sprocket slightly towards the driving sprocket, ie intake cam sprocket towards crankshaft, exhaust cam sprocket towards intake, so that the chain can be fitted and the driven sprocket can be rotated forwards again until its timing mark aligns. However, depending on the degree of wear in the chain this may not be possible and some error will be inevitable as the chain wears. If the marks are no more than one tooth out they are as close as production tolerances will permit.

12 Fit the chain tensioner blade to its pivot and press it hard, by hand, against the chain lower run to take up any slack. Applying an Allen key to the ignition rotor flange retaining bolt, rotate the crankshaft slowly forwards (anticlockwise, looking at the rotor flange from the front of the machine) through a full cycle until number 3 (75 models) or 1 (100 models) cylinder is again at TDC on the compression stroke and the timing marks are all aligned. If resistance is encountered, **stop immediately** and find out the cause. If a valve is touching a piston the valve timing is incorrect and the procedure must be repeated until the error is found and rectified.

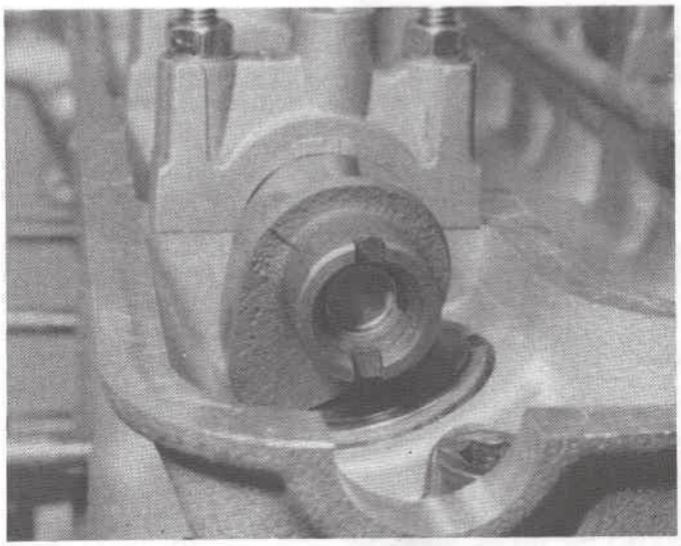
13 If the timing marks align exactly (or so closely that the error cannot be corrected by moving even one tooth at the driven sprocket) the valve timing is correctly set. Secure the chain tensioner blade by refitting its washer and retaining clip.

14 Refit the chain guide blade noting the washer under each retaining clip or circlip. Refit the chain top guide rail and tighten securely its retaining Torx screws; use the torque wrench setting, where specified.

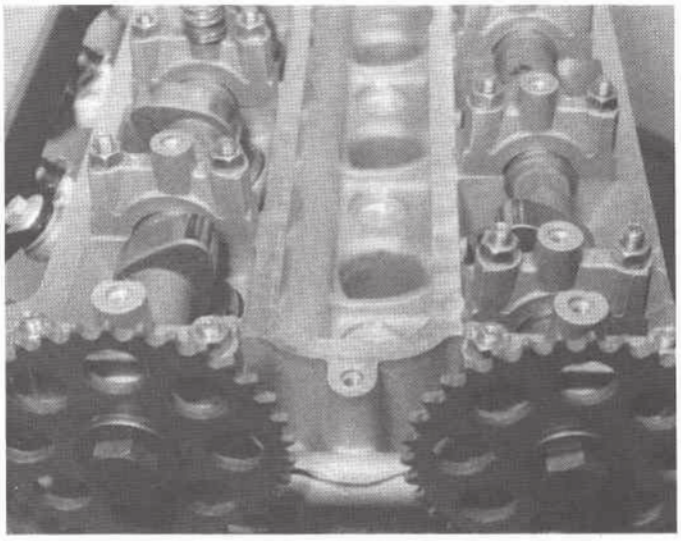
15 Rebuild the chain tensioner assembly. On the later type, without a locking screw, insert the plunger ratchet into the tensioner body, and place the spring inside the ratchet bore. Ensuring that the spring does not snag on the plunger guide pin, insert the plunger into the tensioner body, over the ratchet, until the guide pin engages with the curved slot in the ratchet. Press the plunger fully into the tensioner body, allowing it to twist as its guide pin follows the ratchet slot. When it is seated fully in the tensioner body, rotate the plunger clockwise until its head is square to the tensioner body with the two small tangs on the outside (see the accompanying photographs). Hold the assembly compressed while it is placed on the crankcase, noting that the plunger tangs match with the moulded extensions from the tensioner blade plastic face so that there is no metal-to-metal contact between the plunger and blade. Refit and tighten securely the tensioner mounting screws; use the torque wrench setting, where specified. Press the blade firmly against the chain run; the tensioner should extend to take up the slack.

16 On the early type of tensioner, fit the assembly exactly as described above but note that the plunger will not extend until the locking screw has been turned fully anticlockwise to release it.

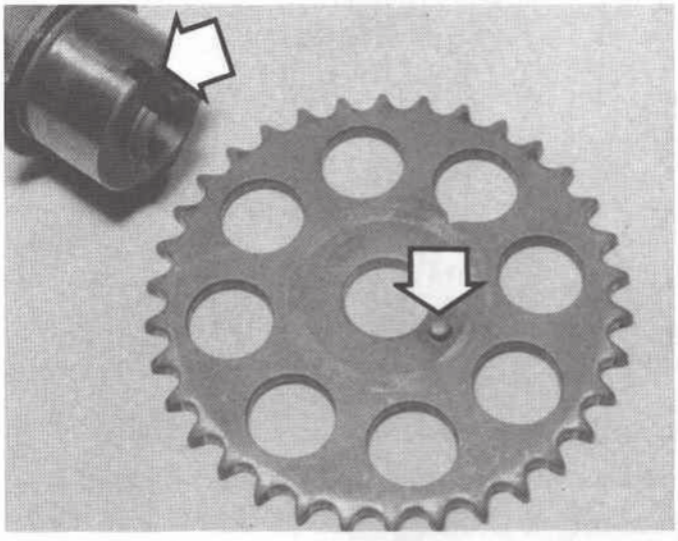
17 Refit the engine outer covers and the spark plugs.



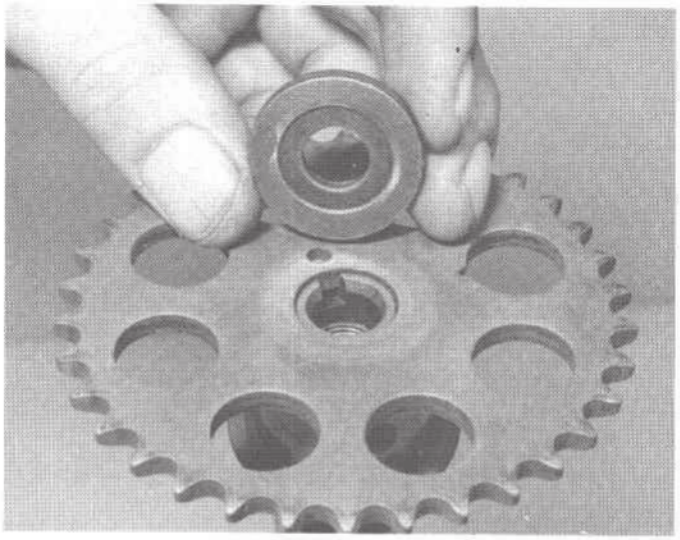
32.3 Check that blanking plug in securely fixed in each camshaft rear end



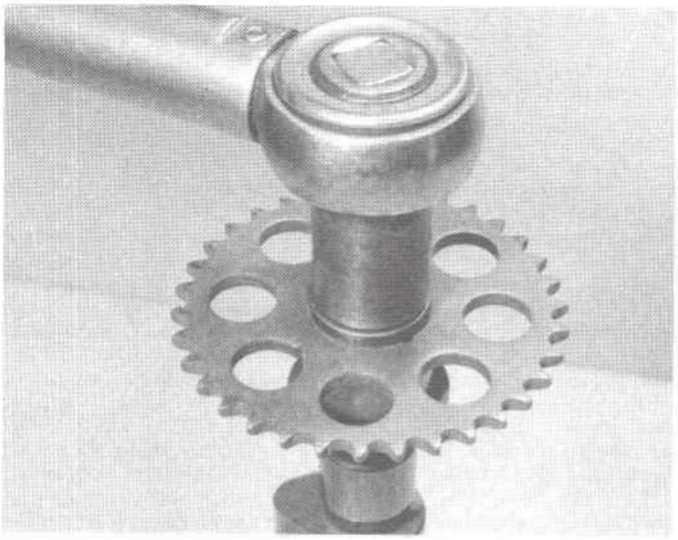
32.8a Note correct position of cam lobes when cylinder is at TDC on compression stroke – number 1 cylinder, 100 models shown



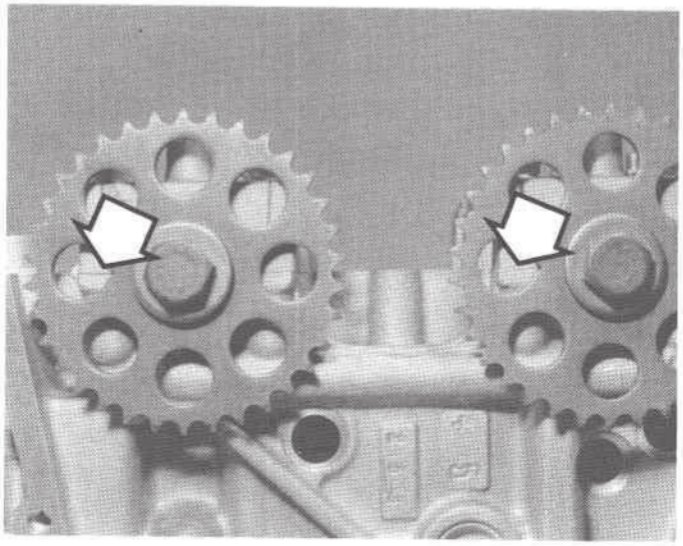
32.8b Align locating pin on sprocket rear face with camshaft keyway ...



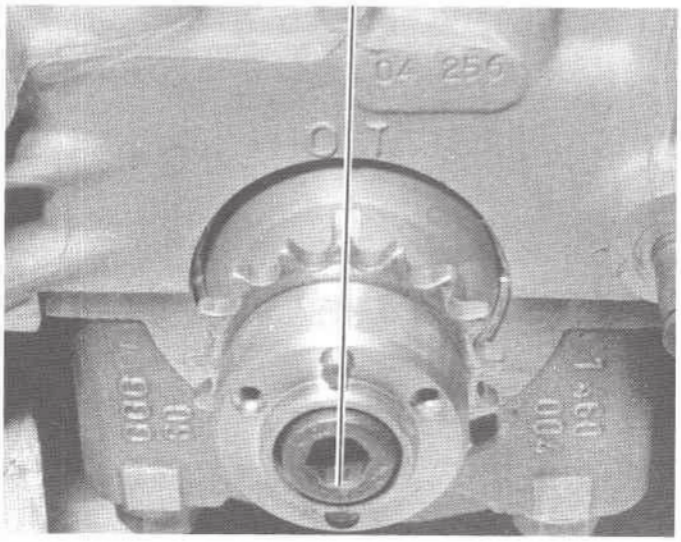
32.8c ... and fit large washer with recessed face against sprocket



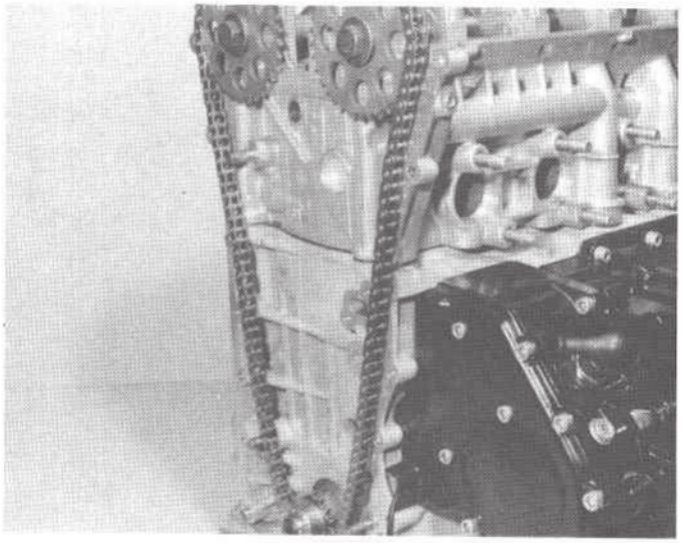
32.8d Tighten sprocket retaining bolts to specified torque wrench setting



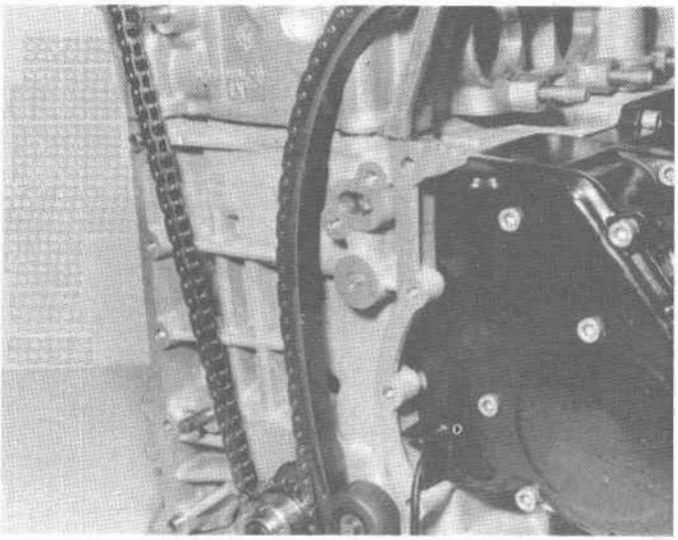
32.9a Rotate camshafts until notches in sprockets align exactly with bearing cap/cylinder head joints (arrowed)



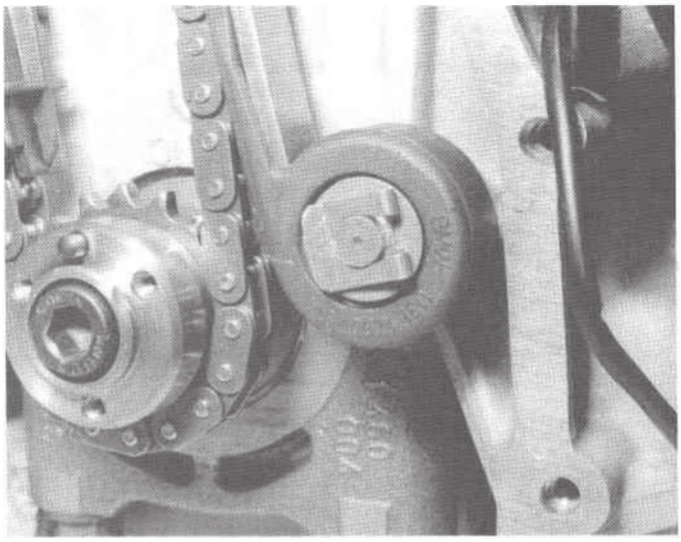
32.9b Rotate crankshaft until ignition rotor locating pin aligns with fixed crankcase mark when appropriate piston is at TDC



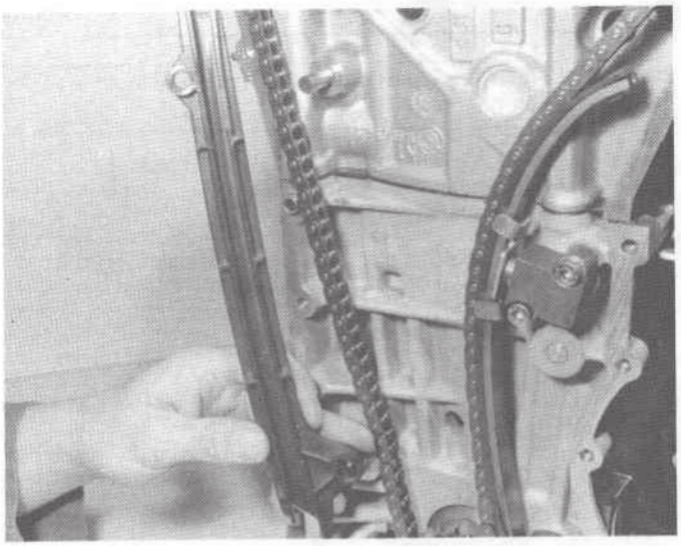
32.10 Refit the cam chain without disturbing timing mark alignment and so that chain runs are taut, see text



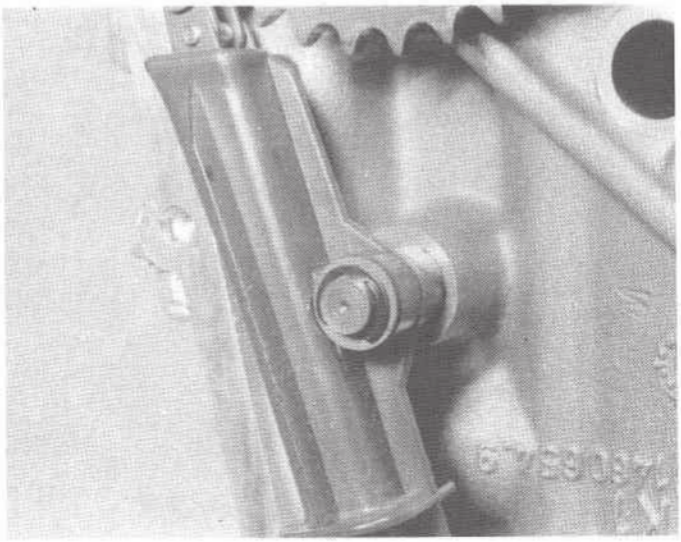
32.12 Fit chain tensioner blade and rotate engine to check valve timing ...



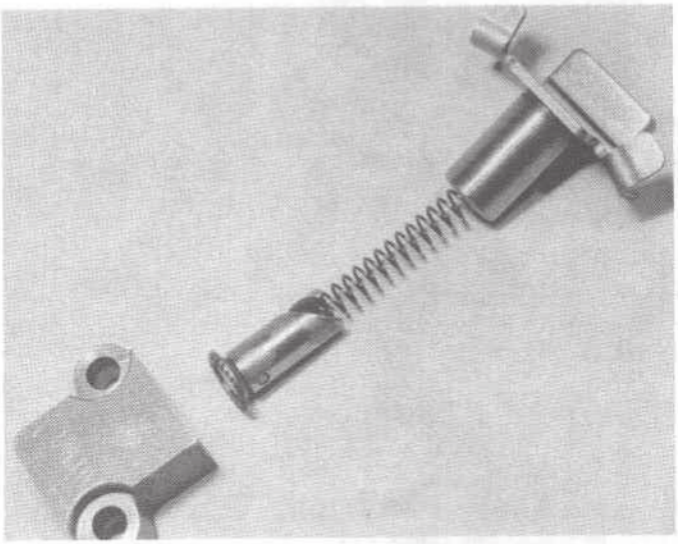
32.13 ... if correct, secure blade with large washer and retaining clip, as shown



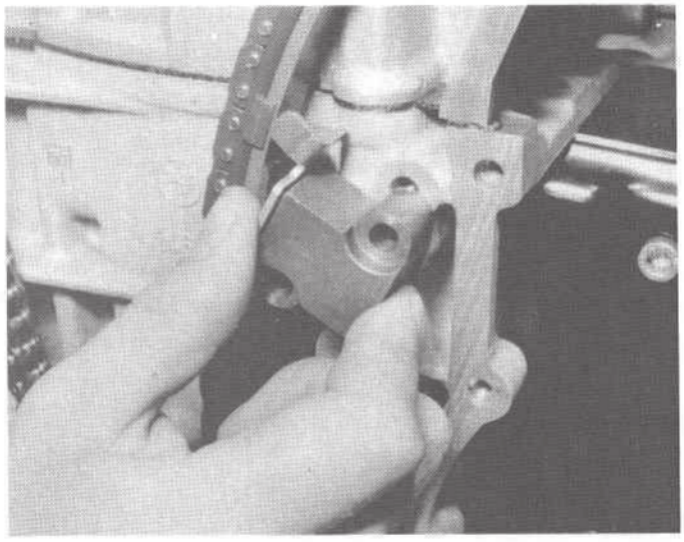
32.14a Chain guide blade is fitted over chain ...



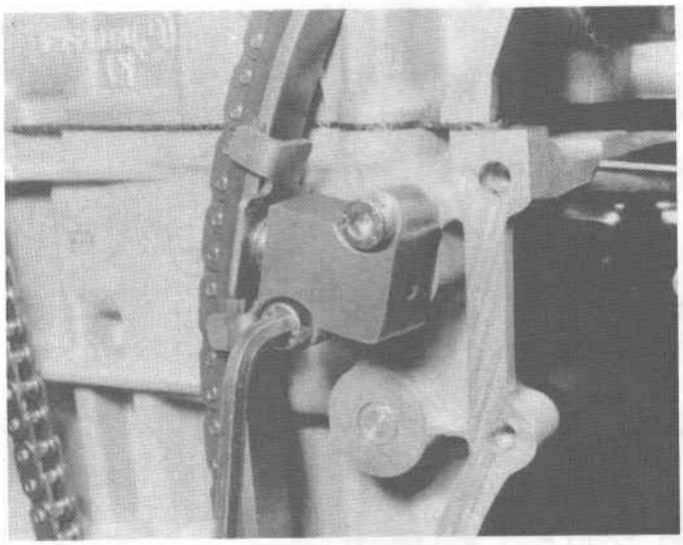
32.14b ... and is secured with a washer and retaining clip at each mounting



32.15a Reassemble tensioner as described in text – later type shown ...



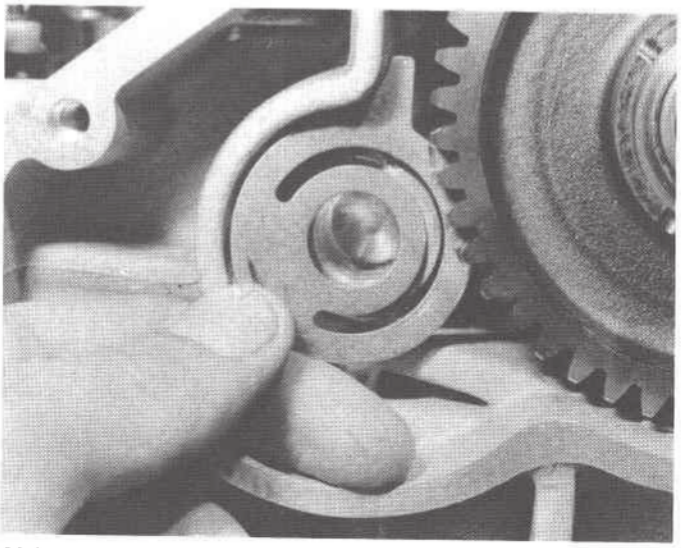
32.15b ... and refit, ensuring that plunger tangs engage on plastic lugs



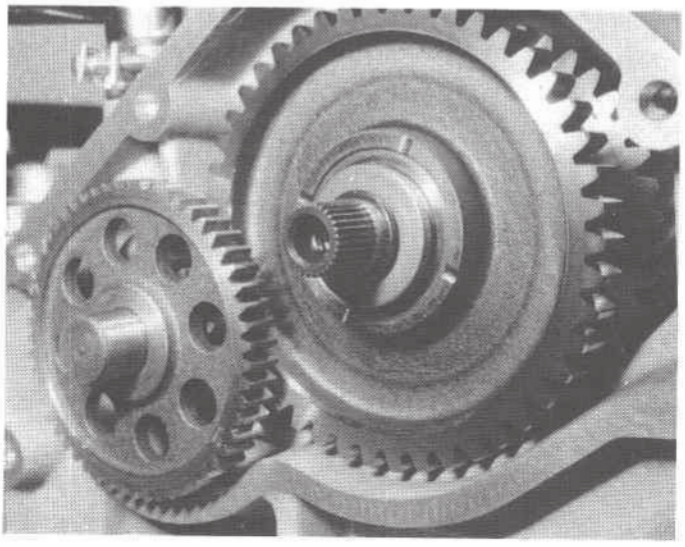
32.15c Tighten tensioner retaining screws securely

33 Reassembling the engine unit: refitting the auxiliary drive shaft components and the bellhousing

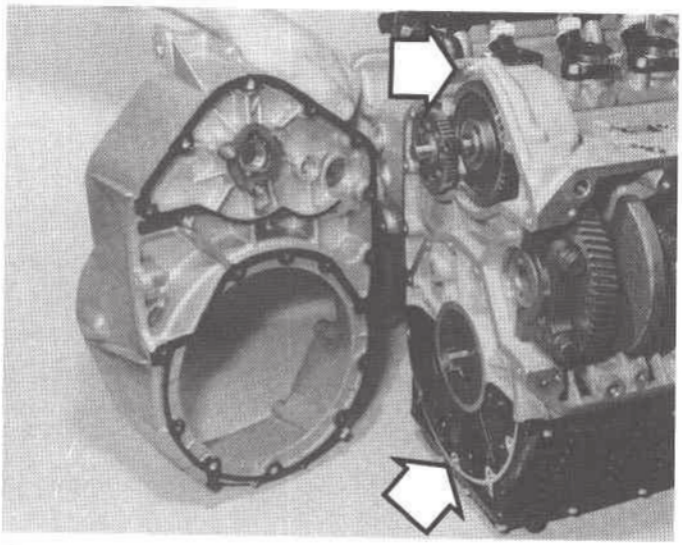
1 Lubricate the crankcase bearings. Ensuring that it has been thoroughly cleaned and degreased, and assembled with clean engine oil, fit as a single unit the auxiliary drive shaft.
2 Position the starter idler shaft spring (where fitted, early 100 models) around the crankcase webs with the narrower of its two protruding ears upwards; the spring outer diameter should bear against the starter clutch gear pinion, as should be shown by the wear marks. Refit the idler shaft and place the thrust washer and a new sealing O-ring on the auxiliary drive shaft rear end, using a dab of grease to retain them.
3 Check that the two locating dowels are firmly fixed in the crankcase mating surface; each must protrude by 6.5 – 7.0 mm (0.26 – 0.28 in). Apply a thin film of jointing compound to the mating surface.
4 Lubricate the bearing in the bellhousing and make a final check that the starter clutch is operating correctly; it should lock when the gear pinion is rotated anticlockwise but rotate freely when it is turned clockwise. Refit the bellhousing and tighten securely and evenly its retaining Torx screws; use the torque wrench setting where specified. Refit and tighten the frame/bellhousing mounting bolt to the specified torque setting.
5 Check that the two large locating dowels and the clutch housing rubber fillet are firmly fixed in place in the bellhousing rear mating surface; each of the dowels must protrude by 6.5 – 7.0 mm (0.26 – 0.28 in).
6 Check that the new O-ring and the thrust washer are in place on the auxiliary drive shaft rear end then fit the alternator drive flange. Apply a few drops of Loctite 273 FL or similar thread-locking compound to the threads of its retaining bolt and temporarily refit the clutch housing and locking device to prevent rotation while the bolt is screwed in and tightened to the specified torque wrench setting. Refit the crankshaft cover, as described in the next Section.
7 Refit the clutch (Chapter 2) and the gearbox and final drive (Chapter 3). Refit the alternator (Chapter 10) and the ignition HT coils (Chapter 6).



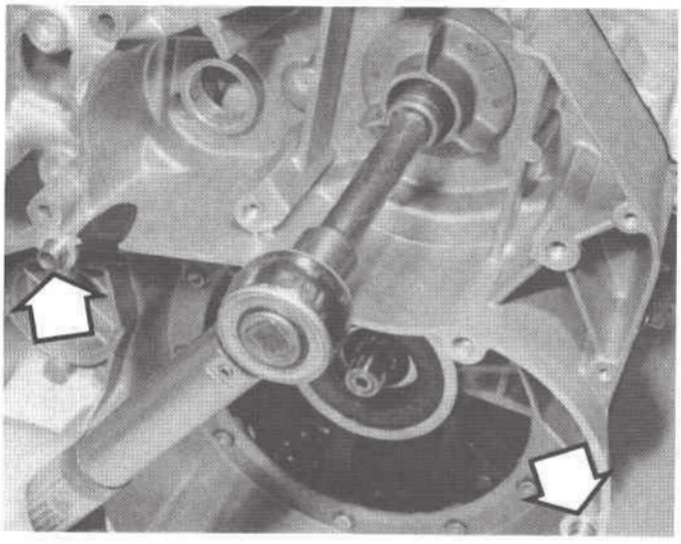
33.2a Fit auxiliary drive shaft, followed by (where fitted) idler shaft spring, as shown



33.2b Fit starter idler shaft – note thrust washer and O-ring on auxiliary drive shaft rear end



33.3 Apply sealant to bellhousing mating surface – note two locating dowels (arrowed)



33.6 Tighten alternator drive flange retaining bolt to specified torque setting – note gearbox locating dowels (arrowed) and rubber fillet

34 Reassembling the engine unit: refitting the outer covers

General

1 Before refitting any of the covers, check that the mating surfaces are free from dirt, oil, grease or old jointing compound and that they are flat and undamaged.

2 The rubber seals at the crankshaft and cylinder head covers should be checked for damage; they can be re-used many times if they are not torn, stretched, or distorted. Soak a rag in suitable high flash-point solvent and wipe over the sealing surfaces and seals to remove all traces of grease; do not forget the conical seals around the retaining bolts. Apply a very thin smear of jointing compound to the moulded inner edges of the cover seals and use this to stick the seal in place in the cover groove. The only jointing compound required on the actual mating surface is a thin smear at the joint between the crankcase and bellhousing or crankcase and cam chain cover (crankshaft cover) and between the cam chain cover and cylinder head (cylinder head cover); the coating should extend approximately 10 mm (0.4 in) on each side of the joint. Fit the cover and hold it in place while the bolts are refitted; do not forget a smear of jointing compound around the bolt seals. Tighten the bolts securely but do not overtighten them or the seals will be distorted; use the specified torque wrench settings, where given, and tighten the bolts in a diagonal sequence working from the centre outwards.

Cam chain (engine front) cover

3 Apply a thin smear of jointing compound to both mating surfaces, fit the new gaskets noting the two locating dowels set in the top surface and offer up the cover. Pass the oil pressure switch lead through the cover passage and keep it taut as the cover is refitted so that a loop of wire does not become trapped.

4 Smear grease over the lips of the crankshaft front oil seal and carefully ease the cover into place, ensuring that it fits over the locating dowels and that the seal lips are not damaged as they fit over the ignition rotor. Fit the retaining screws and tighten them evenly to the specified torque wrench setting working from the centre outwards in a diagonal sequence.

5 Feed the oil pressure switch lead up through the cover passage and secure it with the metal clips. On 75 models only, refit the horn.

6 Fit the ignition trigger assembly as described in Chapter 6 and set the ignition timing as accurately as possible.

7 Refit the engine 'side' covers as described below.

Crankshaft (engine right-hand) cover

8 This cover is refitted as described in the general notes above (paragraphs 1 and 2).

9 Refit the radiator bottom hose and refill the cooling system. See Chapter 4.

10 Refit the cover panels or fairing components disturbed on dismantling.

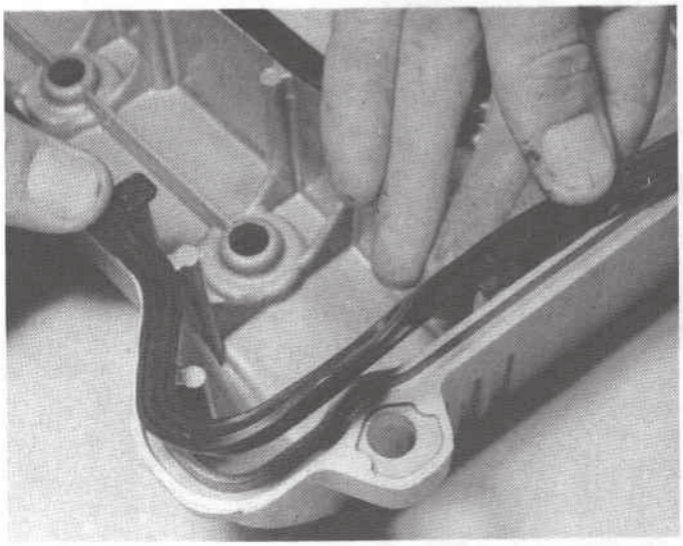
Cylinder head (engine left-hand cover)

11 This cover is refitted as described in the general notes above (paragraphs 1 and 2) but note that the half-moon seals at the camshaft rear ends will require special care to ensure that they are properly seated, and that the coil spring must not be forgotten that is fitted to one of the camshaft bearing caps.

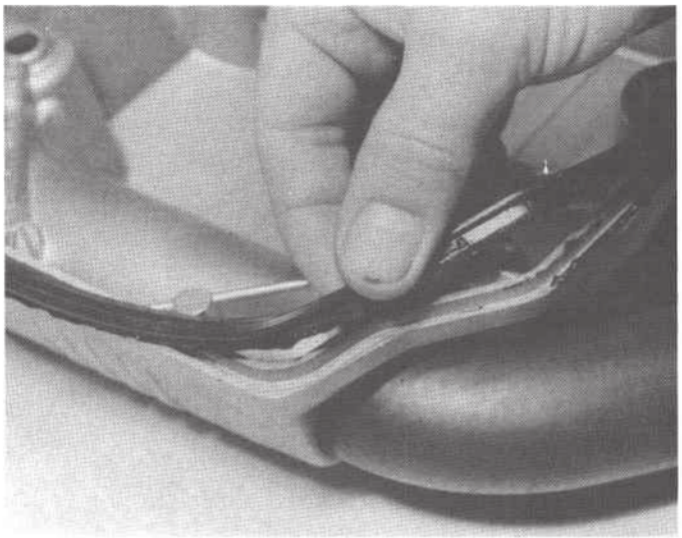
12 The spring is fitted to provide an earth return from the cylinder head cover (which is otherwise totally insulated, being rubber mounted) so that static charges caused by the spark plugs are dispersed; otherwise the static charges might build up and jump the gap to the crankcase, thus producing a stray spark which might well interfere with the ignition system components. On models with black-painted engine castings, ensure that the paint is scraped away from the inside of the cover so that the spring makes a good metal-to-metal contact.

13 Refit the oil drain plugs (where fitted), tightening them to the specified torque wrench setting, then refit the spark plug cover. See Routine Maintenance.

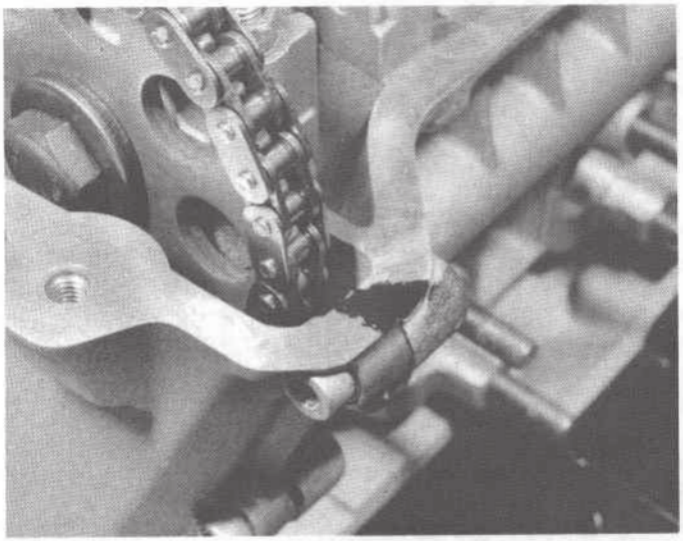
14 Refit the fairing components disturbed on dismantling.



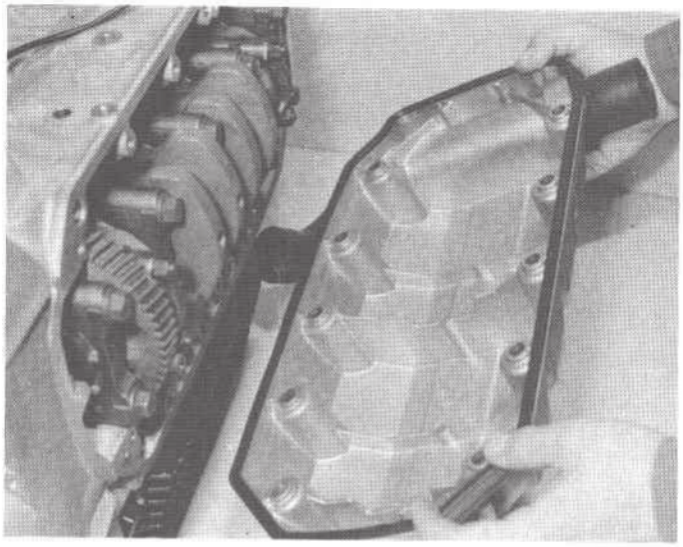
34.2a Engine cover rubber seals can be re-used if undamaged – check carefully



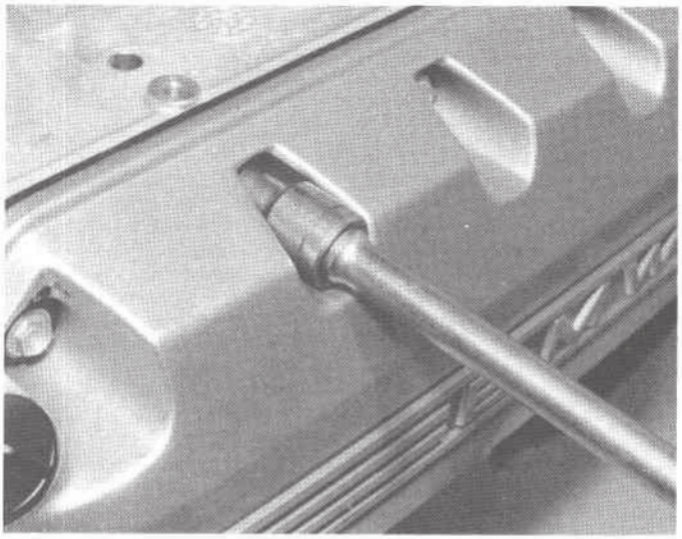
34.2b Apply smear of sealant to stick seal in cover groove



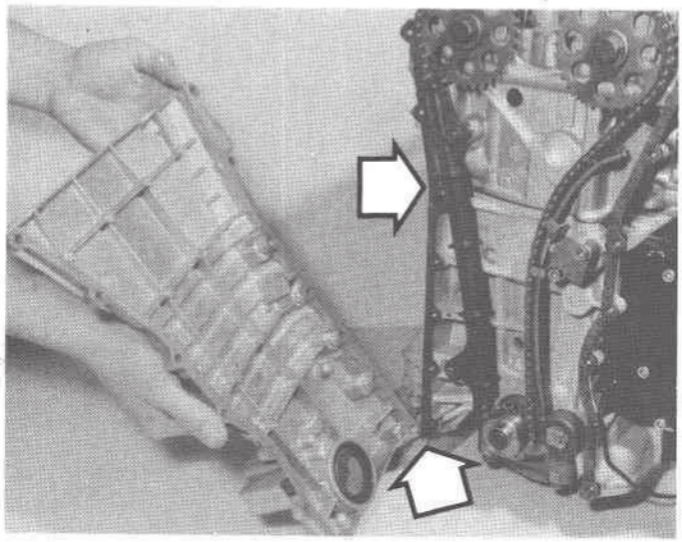
34.2c Sealant is required only at points mentioned in text



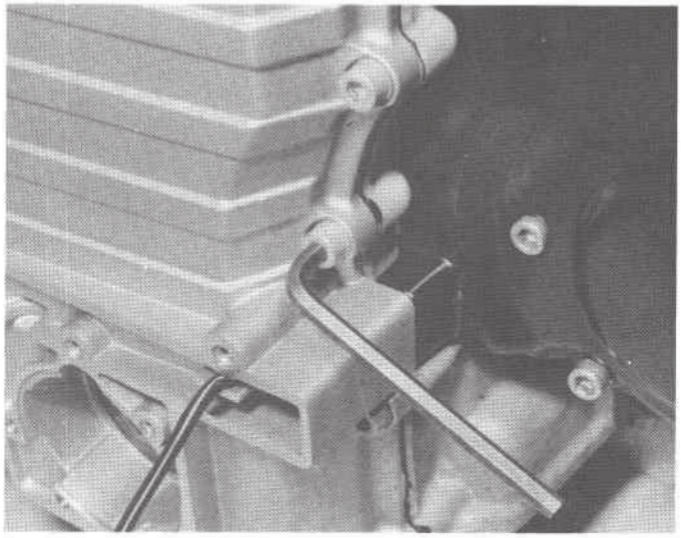
34.2d Hold seal securely in place as cover is refitted



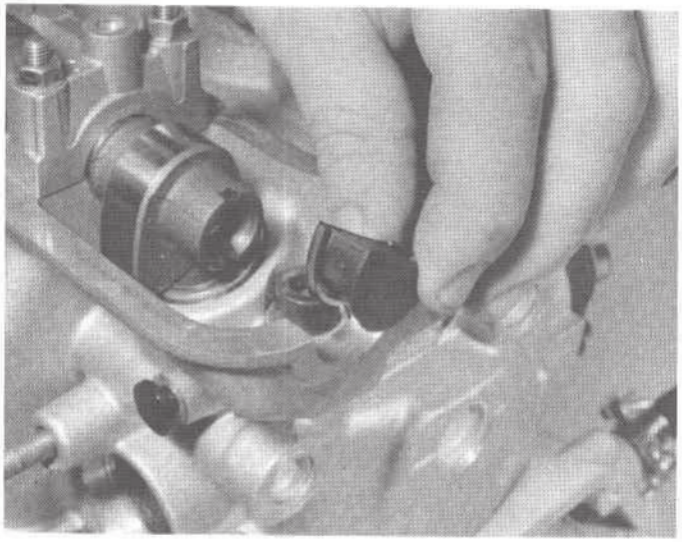
34.2e Tighten bolts securely and evenly – do not overtighten



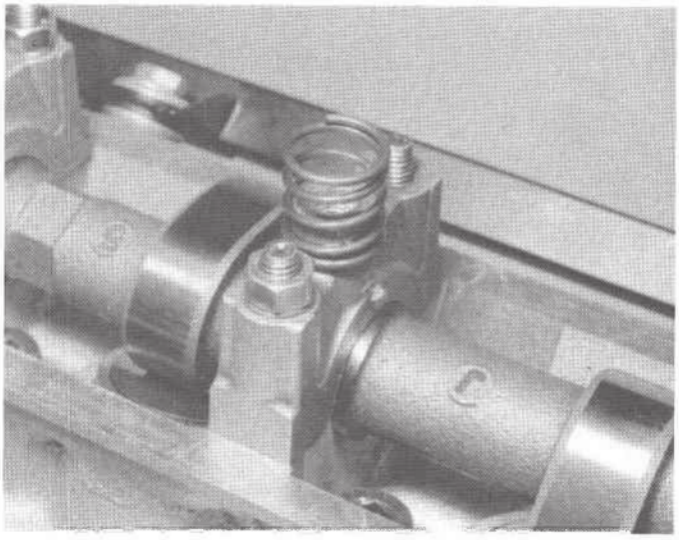
34.3 Cam chain cover upper gasket fits over two locating dowels (arrowed)



34.5 Ensure oil pressure switch lead is correctly routed on refitting cover



34.11 Half-moon seals require special care on refitting cylinder head cover



34.12 Do not omit coil spring – ignition system may be damaged

35 Reassembling the engine unit: refitting ancillary components

1 Refit the ignition trigger assembly and set the ignition timing as carefully as possible. See Chapter 6. Remember to take the machine to a good BMW authorised dealer for the timing to be checked as soon as possible.
2 Refit the oil/water pump assembly (see Chapters 4 and 5), and the pump pick-up and sump (oil pan) as described in Chapter 5.
3 Ensuring that the HT leads are refitted to their correct terminals, refit the spark plugs and HT leads and connect the leads to the coils. Refit the spark plug cover. See Routine Maintenance and Chapter 6.
4 Refit the coolant hose stub. See Chapter 4.
5 Working as described in Chapter 5, refit the EECS valve and hose (where fitted), the intake stubs and throttle bodies, the plenum chamber and crankcase breather, the fuel rail and injectors and the air filter assembly. Ensure that the engine wiring harness is routed correctly and secured by any clamps or ties provided.
6 Refit the clutch. See Chapter 2.
7 Refit the gearbox (Chapter 3) with the stand assembly, then refit the alternator and starter motor (Chapter 10). Assemble the swinging arm, drive shaft, final drive case, rear brake components and rear wheel as described in Chapter 8.
8 Check that all components have been refitted which have been disturbed and that the frame and engine/transmission unit are now ready to be assembled.

36 Refitting the engine unit to the frame

1 First check that the frame paint has been scraped away and the metal cleaned at the frame earth point and the bellhousing mounting point. Apply a thin smear of silicone grease at both points to prevent corrosion but to ensure good electrical contact. Many different electrical faults can be caused by a poor earth contact at these two points on these machines.
2 Next check that all mounting bolts and nuts are completely clean and free from dirt or corrosion, and that the bolt shanks are well greased to aid refitting and to prevent corrosion. Enlist the aid of two or three assistants to ensure safe refitting.
3 The installation procedure varies slightly according to model. Early (ie 1984 and 1985) 100 models, which have a frame/bellhousing mounting bracket 70 mm (2.7 in) wide, must have both front mountings shimmed. All 75 models and 1986-on 100 models, which have a frame/bellhousing mounting bracket 100 mm (3.9 in) wide, must have shims at the bellhousing mounting and for rubber-mounted frames, at the front left-hand engine mounting. Proceed as described in the relevant sub-section below.

Early 100 models

4 Lower the frame over the engine/transmission unit and refit loosely the mounting bolts, including the rear suspension mounting. While specific mounting points require careful attention on these models, the fit of the frame to the engine/transmission unit should always be checked and corrected if necessary with shims at all points; remember that vibration will be greatly increased if stresses are trapped in a frame member which is distorted by being clamped on to an engine mounting.
5 Check the fit of the frame/gearbox mountings and of the frame/bellhousing mounting. If significant clearance is found at any point, it must be eliminated using shims of the required thickness placed between the frame and the mounting lug. Note that at the gearbox mountings two thin shims of equal thickness must be used, one on each side, rather than one thick shim, to ensure that the gearbox is exactly central in the frame.
6 Tighten the rear suspension mounting firmly, the gearbox mountings and the bellhousing mounting. Note that BMW recommend a thin coat of copper-based anti-sieze compound such as Copaslip or Never-Sieze for this latter bolt, to prevent corrosion and aid electrical contact.
7 Check with feeler gauges the gap between each frame lug and its respective engine front mounting boss and install shims of the required thickness to remove it as closely as possible. Shims are available from BMW dealers in 0.25 mm (0.01 in) increments from 1.00 mm (0.04 in) to 5.50 mm (0.22 in) thick. Again, note that rather than use one thick shim to take up all the clearance, two thinner shims of equivalent total thickness should be used, one on each side, to ensure that the engine unit is exactly central in the frame.
8 When the frame is closely fitted and is seated securely but without stress on all mountings, tighten the mounting bolts or nuts to their specified torque settings.

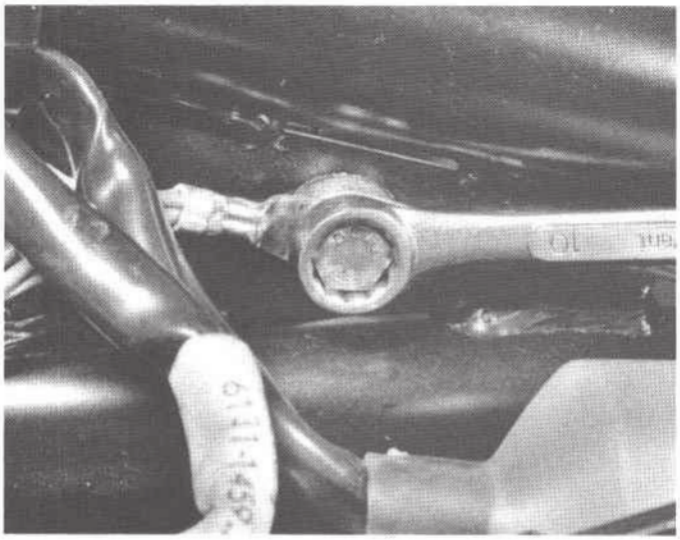
All other models

9 Lower the frame over the engine/transmission unit and refit loosely the mounting bolts, including the rear suspension mounting but not yet the engine front left-hand bolt. While specific mounting points require careful attention on these models, the fit of the frame to the engine/transmission unit should always be checked and corrected, if necessary, with shims at all points; remember that vibration will be greatly increased if stresses are trapped in a frame member which is distorted by being clamped onto an engine mounting.
10 Check the fit of the frame/gearbox mountings. If significant clearance is found it must be eliminated using shims of the required thickness placed between the frame lugs and the gearbox mounting bosses. Rather than use one thick shim to take up all the clearance, two thinner shims of equivalent total thickness should be used, one on each side, to ensure that the gearbox is exactly central in the frame.
11 Tighten to the specified torque setting the engine front right-hand mounting bolt and the gearbox right-hand mounting bolt.
12 Use feeler gauges to measure the gap between the frame bracket and the bellhousing and insert shims of the required thickness to eliminate the gap as much as possible; the maximum permissible clearance remaining after shimming is 0.25 mm (0.01 in). A range of shims is available from BMW dealers in thicknesses from 1.00 mm (0.04 in) to 5.50 mm (0.22 in) in 0.25 mm (0.01 in) increments. With the gap closed by shims, check that there is clean metal-to-metal contact across the shims between the bellhousing and frame bracket (paint scraped away) and apply a smear of silicone grease to prevent corrosion. Smear the bolt with a thin coat of copper-based anti-seize compound such as Copaslip or Never Seeze, refit it and tighten it to the specified torque setting.
13 Tighten to the specified torque wrench settings the gearbox left-hand mounting bolt and the rear suspension unit bottom mounting nut.
14 On all 75 models and K100 models (ie those with rigid engine front mountings) clearance between the frame lug and the engine left-hand front mounting should have been eliminated and the mounting bolt and nut can be refitted and tightened to the specified torque setting. However, if a significant gap is found on any machine it should be closed with shims (as described in paragraph 12 above) before the bolt is fitted and tightened.
15 On K100 RS, K100 RT and K100 LT models (ie those with rubber bushes at the engine front mountings) the clearance between the frame lug and the engine mounting boss must be measured with feeler gauges and closed as much as possible, using shims of the required thickness; the maximum permissible clearance remaining after shimming is 0.25 mm (0.01 in). When the gap has been closed as far as possible refit the mounting bolt and nut and tighten them to the specified torque setting.

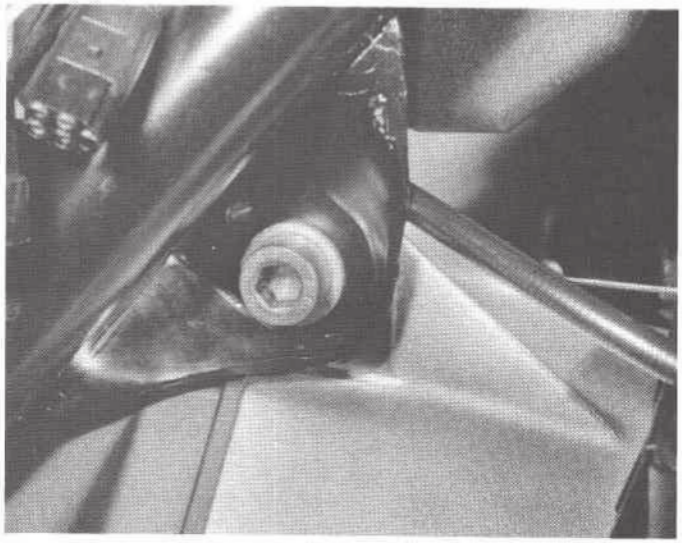
All models

16 Check that the engine/transmission unit is refitted securely and without strain to the frame mountings and that all fasteners are secured to their specified torque wrench settings. Check also that no other components are trapped or distorted, and that the machine is now supported securely on the front wheel and centre stand so that it cannot fall.
17 Ensuring they are correctly routed and secured neatly out of harm's way by any clamps or ties provided, reconnect to the main wiring loom all electrical components. Use the notes made on dismantling to ensure that components such as the ignition HT coils are correctly re-connected.
18 Working as described in Routine Maintenance connect the throttle, choke and clutch cables again and adjust them correctly.
19 Refit the rear mudguard and number plate bracket and the alternator and ignition HT coil covers. Refit the exhaust system as described in Chapter 5.

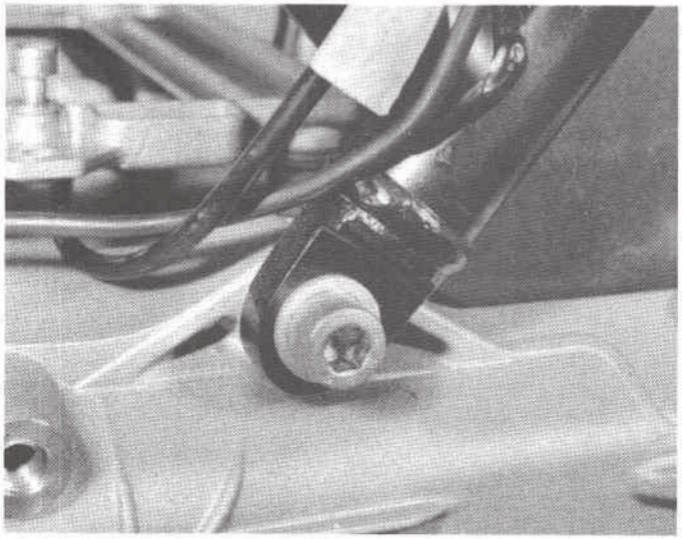
20 Refit the radiator, check that the drain plug is securely fastened and all cooling system components are correctly refitted. Fill the system with coolant (see Chapter 4) and check for leaks. Do not forget to recheck the coolant level after the engine has first been started; accordingly do not fit the radiator cap until this has been done.
21 Refit the battery (see Routine Maintenance) and install the coolant expansion tank. Refit the fuel injection control unit and storage tray. See Chapter 5. Refit the air intake hose and fasten its single mounting bolt.
22 Working as described in Routine Maintenance, fit a new oil filter element and refill the crankcase with oil. Note that a larger amount than usual will be required if the engine has been dismantled.
23 On those machines so equipped, refit the fairing. See Chapter 7.
24 Make a final check that all components have been correctly refitted and are correctly adjusted and working properly, where applicable. Refit the fuel tank, the radiator cover panels (where fitted), the side panels and the seat, but remember that the coolant and engine oil levels must be checked after the engine has been run, also that the ignition timing may have to be checked. It will be necessary for example to remove the fuel tank again to check the coolant level at the radiator.



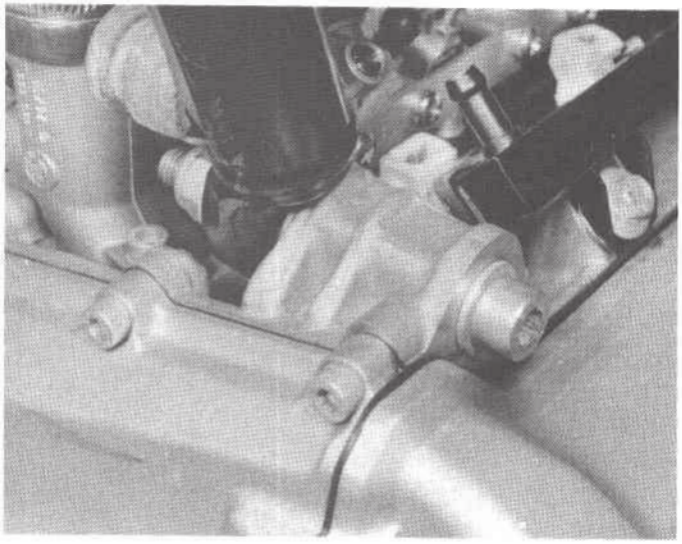
36.1a Carefully clean away paint at frame earth point ...



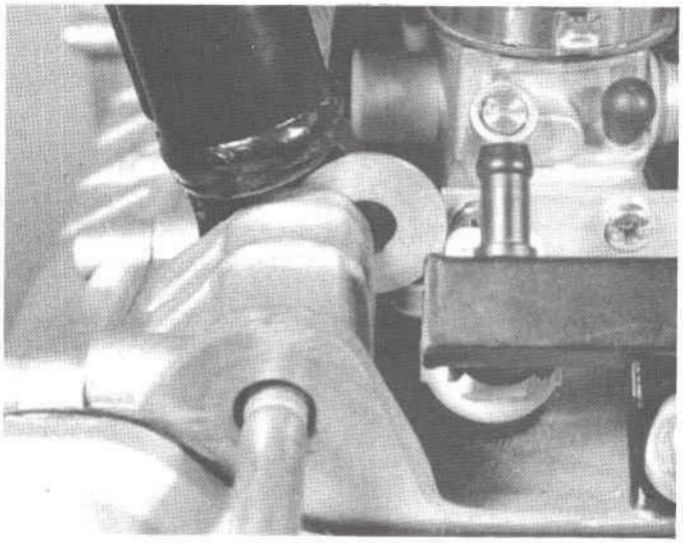
36.1b ... and bellhousing mounting to ensure good earth contact



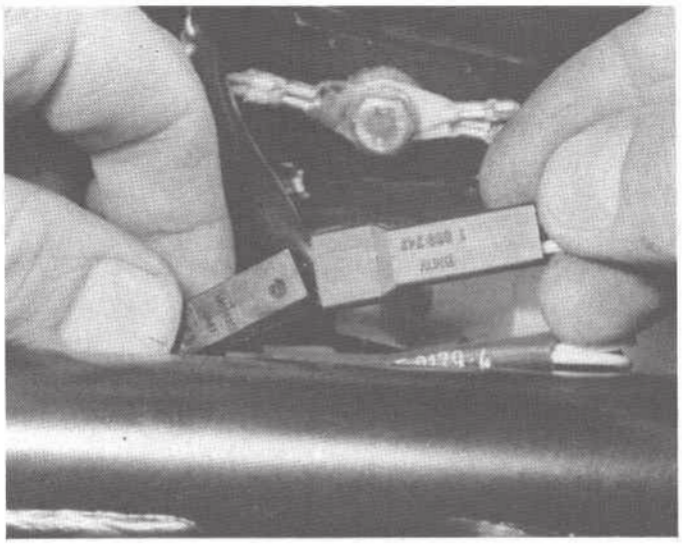
36.10 Fasten frame to gearbox mountings as described



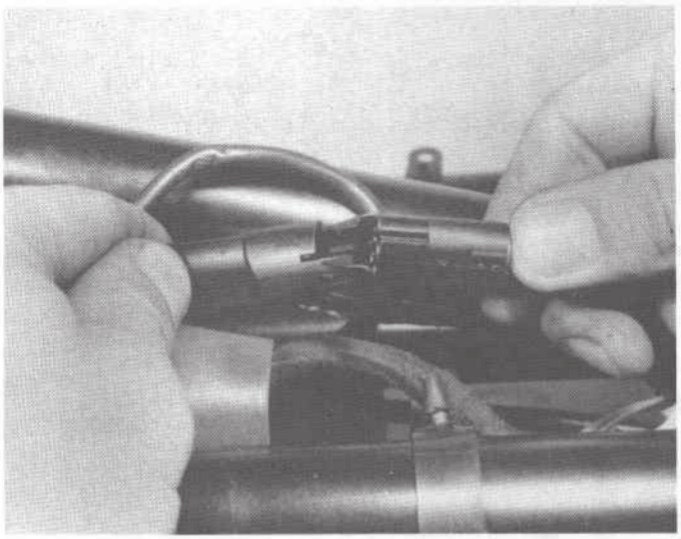
36.14 On machines with rigid front mountings shims should not be required ...



36.15 ... but gap must be eliminated using shims on rubber-mounted engines



36.17a Ensure that all electrical components are connected to wiring loom ...



36.17b ... noting that some connectors can be refitted only the correct way

37 Starting and running the rebuilt engine

1 Start the engine using the usual procedure adopted for a cold engine. Do not be disillusioned if there is no sign of life initially. A certain amount of perseverance may prove necessary to coax the engine into activity even if new parts have not been fitted. Should the engine persist in not starting, check that the spark plugs have not become fouled by the oil used during reassembly. Failing this go through the fault finding charts and work out what the problem is methodically.

2 When the engine does start, keep it running as slowly as possible to allow the oil to circulate. The oil warning light should go out almost immediately the engine has started, although in certain instances a very short delay can occur whilst the oilways fill and the pressure builds up. If the light does not go out, the engine should be stopped before damage can occur, and the cause determined. Open the choke as soon as the engine will run without it. During the initial running, a certain amount of smoke may be in evidence due to the oil used in the reassembly sequence being burnt away. The resulting smoke should gradually subside.

3 Check the engine for blowing gaskets and oil leaks. Before using the machine on the road, check that all the gears select properly, and that the controls function correctly.

4 When the machine has reached normal operating temperature, check the coolant level at the radiator filler neck. Top up if necessary (see Chapter 4) and fit the cap, then check the expansion tank level.

5 If the ignition trigger assembly was disturbed and the ignition timing is still to be checked, ride the machine slowly and carefully to the nearest BMW dealer for the work to be done as soon as possible.

6 Finally, check the engine oil level and top up if necessary, as described in Routine Maintenance.

38 Taking the rebuilt machine on the road

1 Any rebuilt machine will need time to settle down, even if parts have been replaced in their original order. For this reason it is highly advisable to treat the machine gently for the first few miles to ensure oil has circulated throughout the lubrication system and that any new parts fitted have begun to bed down.

2 Even greater care is necessary if the engine has been rebored or if a new crankshaft has been fitted. In the case of a rebore, the engine will have to be run-in again, as if the machine were new. This means greater use of the gearbox and a restraining hand on the throttle until at least 500 miles have been covered. There is no point in keeping to any set speed limit; the main requirement is to keep a light loading on the engine and to gradually work up performance until the 500 mile mark is reached. Experience is the best guide since it is easy to tell when an engine is running freely.

3 If at any time a lubrication failure is suspected, stop the engine immediately, and investigate the cause. If any engine is run without oil, even for a short period, irreparable engine damage is inevitable.

4 When the engine has cooled down completely after the initial run, recheck the various settings, especially the valve clearances. During the run most of the engine components will have settled into their normal working locations. Check the various oil levels, particularly that of the engine as it may have dropped slightly now that the various passages and recesses have filled.

Chapter 2 Clutch

Contents

General description 1
Clutch: removal 2
Clutch: dismantling 3
Clutch: examination and renovation 4
Clutch: reassembly 5
Clutch release mechanism removal, examination and reassembly 6

Specifications

Clutch friction plate	
Diameter:	
75 models	165 ± 1 mm (6.50 ± 0.04 in)
100 models	180 ± 1 mm (7.09 ± 0.04 in)
Thickness:	
Standard	5.05 – 5.55 mm (0.1988 – 0.2185 in)
Service limit	4.50 mm (0.1772 in)

Torque wrench settings	**75 models**		**100 models**	
Component	**Nm**	**lbf ft**	**Nm**	**lbf ft**
Clutch housing/engine output shaft retaining nut:				
1st stage	140 ± 5	103 ± 4	140	103
2nd stage – release, then tighten to	N/App	N/App	90 – 114	66 – 84
Cover plate/housing bolts or screws	19 ± 2	14 ± 1.5	21	15.5

1 General description

The clutch is of the dry single plate type mounted in a light alloy housing which is bolted to the engine output/balancer shaft rear end. A diaphragm spring, seated on a wire ring in the housing, forces a pressure plate to clamp the friction plate firmly against the cover plate which is bolted securely to the housing. Since the friction plate is mounted on the gearbox input shaft drive is thus transmitted from the engine to the gearbox.

The release mechanism is operated by cable from the handlebar lever and acts on a pushrod, via a thrust bearing, that is situated in the gearbox input shaft. The pushrod front end is held in a pilot bearing set in the engine output shaft rear end; when the release mechanism is operated a shoulder on the pushrod forces the diaphragm spring to deform and relax the clamping force it exerts on the pressure and friction plates.

Clutch adjustment is described in Routine Maintenance.

Note that BMW recommend that the clutch be dismantled once a year so that the gearbox input shaft and clutch friction plate centre splines can be degreased, checked for wear and lubricated on reassembly. This is to preserve the clutch's smooth action and reliability.

2 Clutch: removal

1 Although the clutch release mechanism is located on the gearbox housing rear end and can be dismantled with the gearbox in place, except for the pushrod (75 models), if the clutch itself requires attention the gearbox must be removed to gain access to it. Refer to Chapter 3.

2 The clutch can be serviced with the engine in the frame, or it can be removed with the engine and dismantled on the bench. Refer to Chapter 1 for details of engine removal.

3 Check the gearbox input shaft and clutch friction plate centre splines whenever the gearbox is removed, lubricating them on reassembly, and also take the opportunity to overhaul the clutch operating mechanism.

4 Note also the two large locating dowels protruding from the bellhousing rear surface: these should be checked whenever the gearbox is removed. See Section 4.

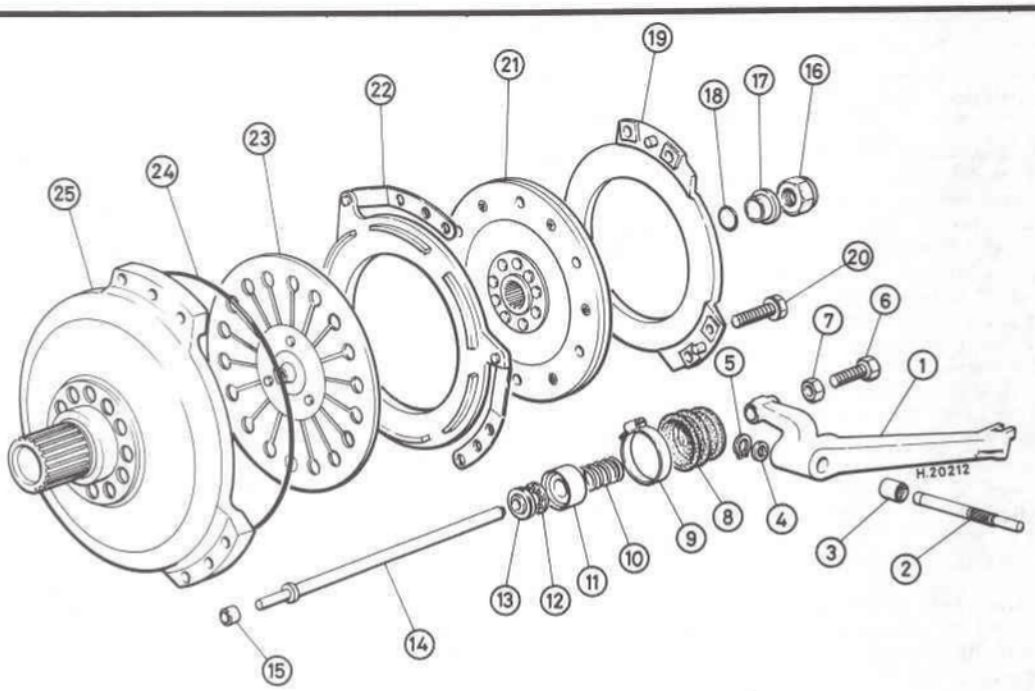


Fig. 2.1 Clutch assembly – 75 models

1 *Release lever*
2 *Pivot pin*
3 *Needle roller bearing*
4 *Washer – 2 off*
5 *Circlip – 2 off*
6 *Adjuster bolt*
7 *Adjuster locknut*
8 *Rubber boot*
9 *Clamp*
10 *Coil spring*
11 *Thrust piston*
12 *Thrust bearing*
13 *Thrust bearing front race*
14 *Pushrod*
15 *Pilot bearing bush*
16 *Nut*
17 *Shouldered spacer*
18 *O-ring*
19 *Cover plate*
20 *Bolt*
21 *Friction plate*
22 *Pressure plate*
23 *Diaphragm spring*
24 *Wire ring*
25 *Housing*

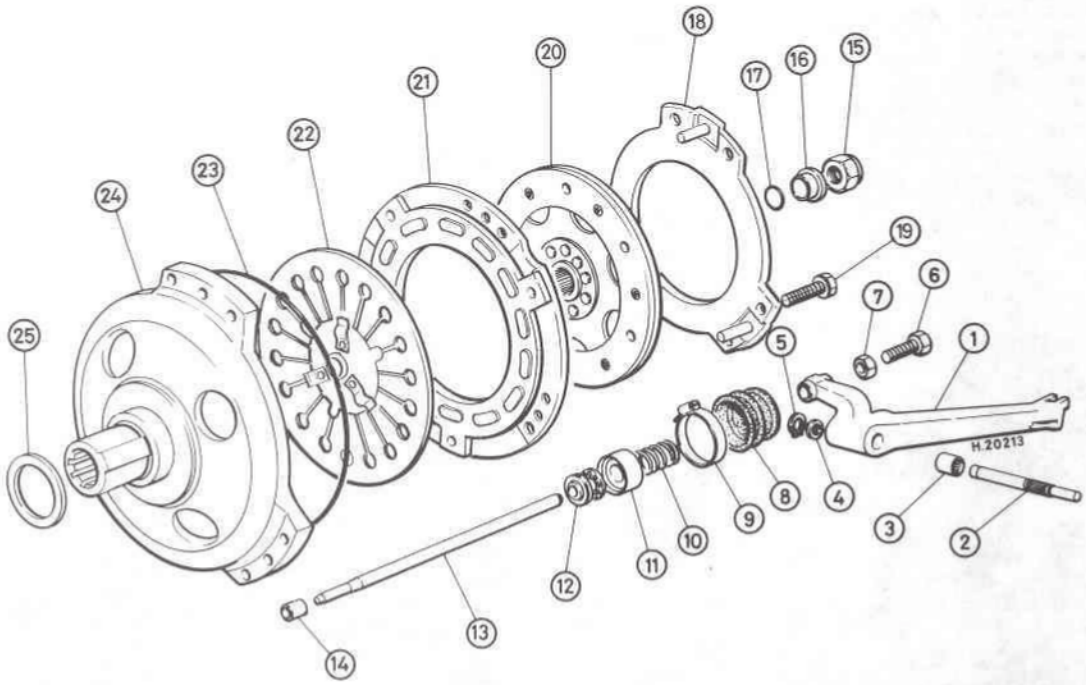


Fig. 2.2 Clutch assembly – 100 models

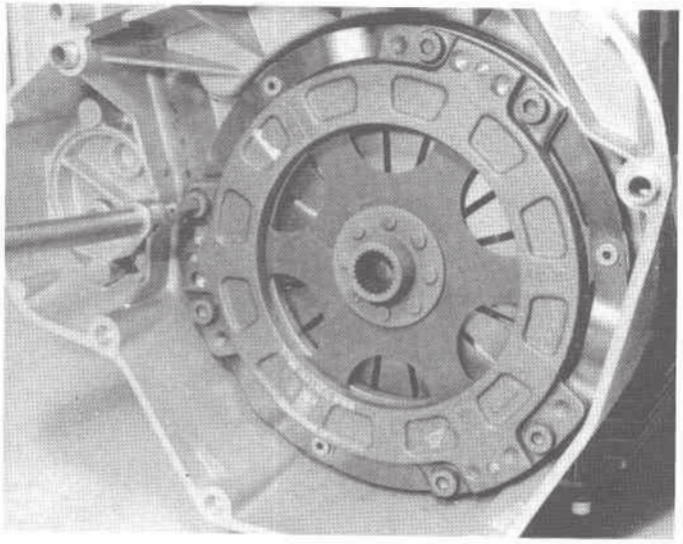
1 *Release lever*
2 *Pivot pin*
3 *Needle roller bearing*
4 *Washer – 2 off*
5 *Circlip – 2 off*
6 *Adjuster bolt*
7 *Adjuster locknut*
8 *Rubber boot*
9 *Clamp*
10 *Coil spring*
11 *Thrust piston*
12 *Thrust bearing*
13 *Pushrod*
14 *Pilot bearing bush*
15 *Nut*
16 *Shouldered spacer*
17 *O-ring*
18 *Cover plate*
19 *Bolt*
20 *Friction plate*
21 *Pressure plate*
22 *Diaphragm spring*
23 *Wire ring*
24 *Housing*
25 *Thrust washer*

3 Clutch: dismantling

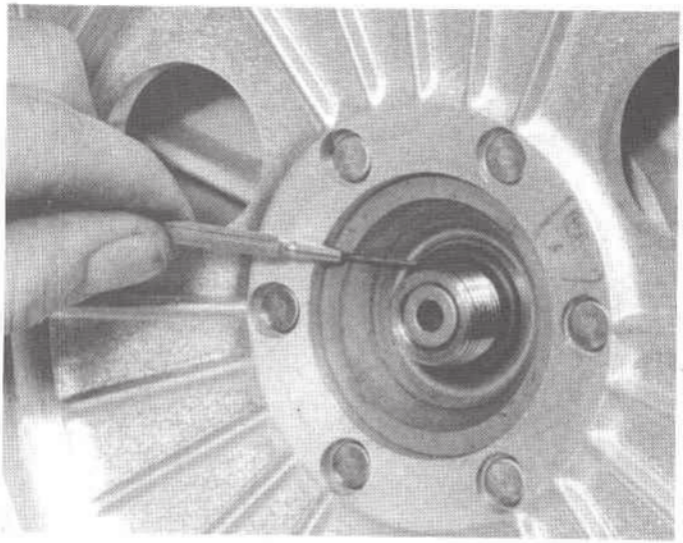
1 Before starting dismantling work check the clutch components for balancing marks; there should be a yellow- or white-painted mark on the cover plate, pressure plate and housing, which should be spaced at 120° to each other. If no marks can be seen, make your own. Using paint or a thick-nibbed felt marker, draw a line across the housing, pressure plate and cover plate so that these three components can be refitted in their original position by aligning their marks. Remember that they represent a significant proportion of the engine's rotating mass and, if unbalanced, may produce severe vibration.
2 Note also which way round the clutch friction plate is fitted; the longer extended part of the centre boss usually faces towards the gearbox. It is advisable to mark the outer (rearmost) face of the clutch friction plate with paint or a felt marker to ensure that this is not fitted the wrong way round on reassembly.
3 Slacken the six bolts or screws around the periphery of the cover, then, working in a diagonal sequence, slacken each bolt or screw by one turn at a time to release spring pressure smoothly and evenly. When spring pressure is released, remove the six bolts or screws and their lock washers.
4 Remove the cover plate, clutch friction plate, pressure plate (checking the balancing marks) and diaphragm spring, noting which way round the latter is fitted. If the cover plate is very tight on its three locating dowels it must be carefully levered away; take care not to let it fly off under spring pressure. The wire ring can be prised out of the housing if desired.
5 The housing must be locked to prevent rotation while the retaining nut is slackened. On 100 models pass a large wooden rod (a hammer handle or similar) through one of the holes in the housing and lock it against the crankcase webs.
6 On 75 models obtain a short but thick strip of metal with an 8 mm (0.32 in) hole drilled in one end. Attach this to the housing using one of the cover plate bolts or screws and wedge it against a strongly-reinforced part of the bellhousing so that the housing cannot rotate anticlockwise.
7 Both of the above methods are an alternative to the use of the BMW service tool number 11 2 800 which is meant to bolt to the housing so that it will lock against the bellhousing wall. The tool would not fit the housing of the machine featured in the accompanying photographs, however, and required some modification. If owners wish to fabricate such a tool the basic dimensions are given in the accompanying illustration; the standard item is constructed of metal strip 6 mm (0.24 in) thick and may need to be shortened to approximately 220 mm (8.66 in) to fit inside the bellhousing.
8 With the housing securely locked, unscrew the retaining nut and withdraw the shouldered spacer behind it. Grasp the housing in both hands and work it backwards and forwards along the shaft splines until the O-ring can be reached and removed with a pointed instrument. Withdraw the housing, noting the thrust washer fitted to it (100 models only).
9 If it is to be renewed, the pushrod pilot bearing can be extracted by cutting a thread on its inside (6 mm/0.24 in dia) using a suitable tap and then screwing in a bolt or screw which can be gripped to provide purchase for removal; do not screw the tap or extracting tool in too far as the locking plug (100 models only) may be damaged. Do not disturb the pilot bearing unless necessary.

4 Clutch: examination and renovation

1 If the clutch friction plate is damaged in any way, or if the friction material is worn to the rivets, fouled with grease or oil, or glazed, it must be renewed as a matter of course. If it appears to be in good condition measure the thickness of the friction material at several points; if the plate is worn to 4.5 mm (0.1772 in) or less at any point, it must be renewed.
2 Check carefully the condition of the friction plate centre splines and check for signs of cracking or splitting around the centre; if any damage is found the plate must be renewed.
3 Check the friction and pressure plates for distortion and the spring pressure of the diaphragm spring; renew any component that is found to be damaged, worn or otherwise faulty.
4 If the clutch action has become sudden, with grabbing or snatching in evidence, first check the release mechanism (see Section 6). If this is in good condition check closely the gearbox input shaft and friction plate centre splines; renew either component if excessive wear is found. Lastly check the preload of the input shaft. See Chapter 3.
5 If the clutch has been slipping and the plate friction material is found to be in good condition, the clutch cover plate should be checked very carefully and renewed.
6 If oil has found its way into the clutch housing, thoroughly degrease all clutch components and wash all traces of oil off the crankcase and gearbox castings. Check the seals at the output shaft rear end and the gearbox input shaft front and rear. Check carefully that the housing has not been rubbing on the output shaft seal, renewing the seal if traces of this are found.
7 Note that the clutch housing retaining nut is of the self-locking type and must be renewed whenever it is disturbed; also the housing O-ring.
8 If severe damage to clutch components or excessive wear of the splines is found, check that the locating dowels are fitted to align correctly the engine, bellhousing and gearbox castings. There are two large locating dowels set in each of the bellhousing front and rear faces; always ensure that these are refitted whenever the bellhousing joints are disturbed.



3.3 Note balancing marks and installed direction of friction plate before dismantling clutch



3.8 Removing O-ring from centre of clutch housing

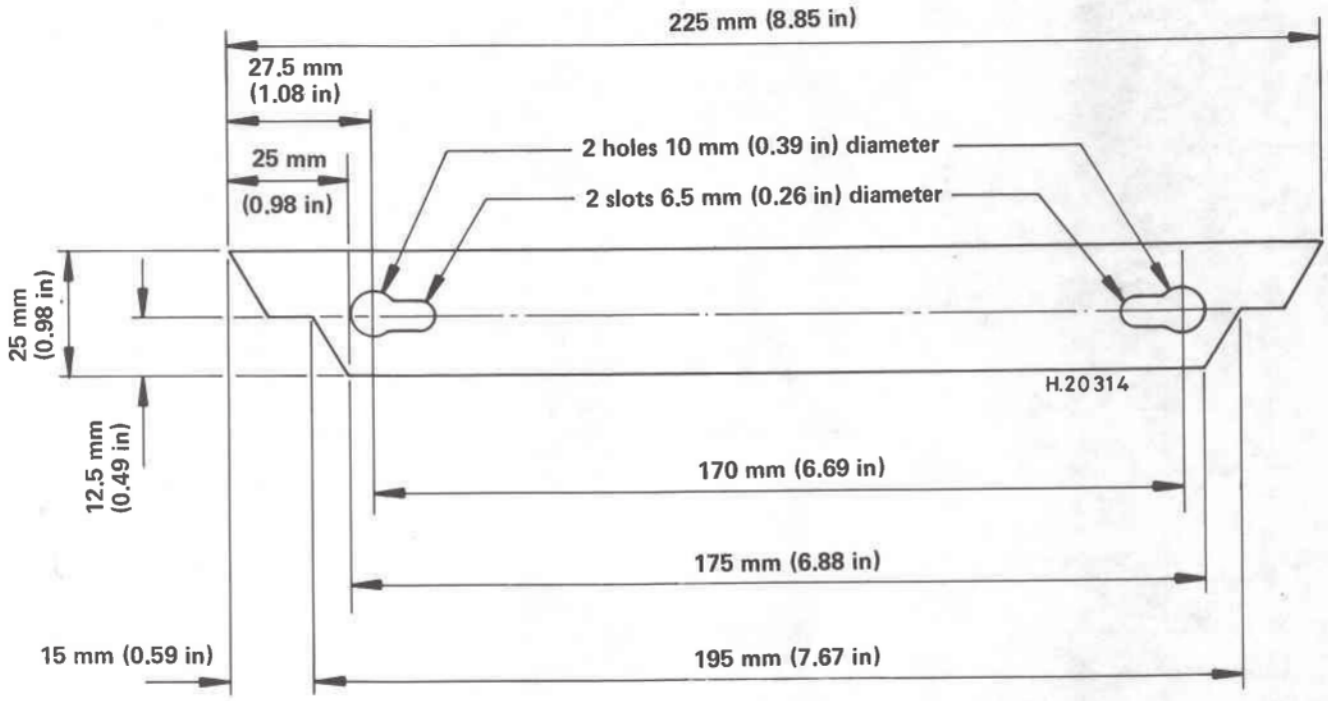
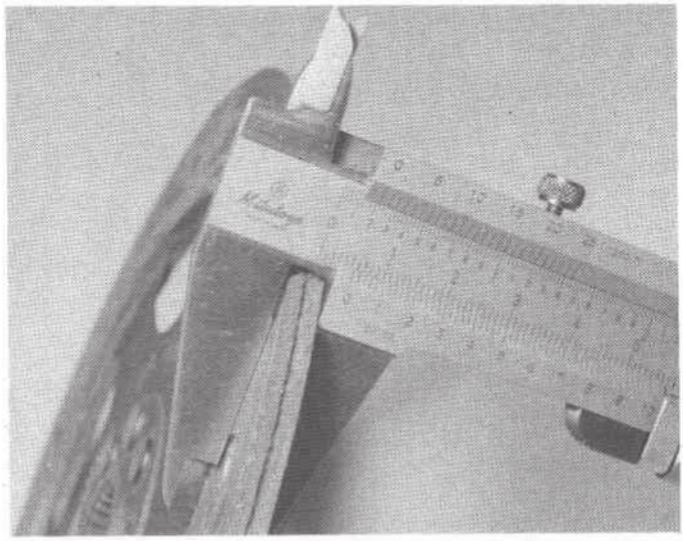


Fig. 2.3 Clutch housing locking tool



4.1 Measuring clutch friction plate thickness

5 Clutch: reassembly

1 On 100 models only, fit the thrust washer to the front of the clutch housing. On all models, tap the new pilot bearing (if disturbed) into the output shaft rear end. Apply a smear of the specified lubricant to the bearing.

2 Insert the housing into the output shaft and press it fully into place. Fit the new O-ring and the shouldered spacer (spacer flange outwards, towards the gearbox) followed by the new retaining nut. Lock the housing by the method used on dismantling.

3 On 100 models tighten the nut to the first stage torque wrench setting to settle the housing and O-ring then slacken it fully and tighten it again to the (final) second stage setting. On 75 models tighten the nut to the setting specified. Refit the wire ring to the housing.

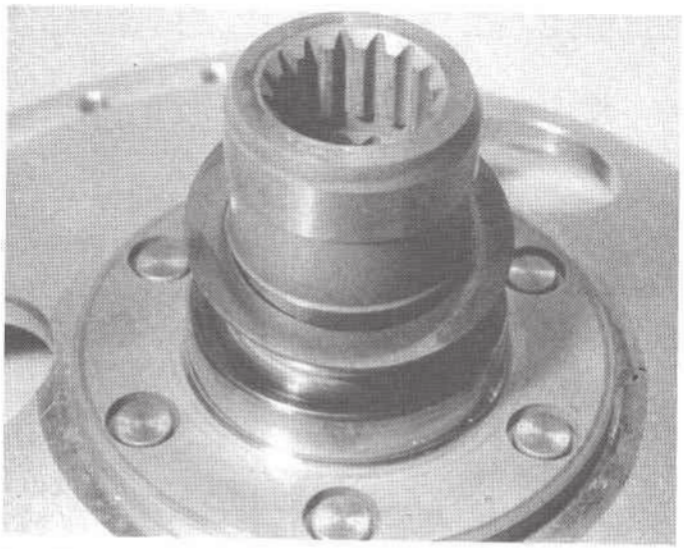
4 For the next part of the operation have an assistant hold each component in place while the next is fitted. Some lubricant will be required; BMW recommend Optimol Paste PL, Staburags NBU 30 PTM compound, or Uni Moly C220 Slip Agent. If these cannot be obtained locally, seek the advice of a BMW dealer. Degrease all components carefully before applying new lubricant and apply only thin smears; do not allow any lubricant on to the friction material.

5 Fit the diaphragm spring to the housing wire ring applying a smear of lubricant to all points of contact between the two and to the three support arms securing the spring centre. Ensure that the spring is the correct way round; refer to the accompanying photographs and illustrations to check this, or examine the spring closely, looking for polished wear marks where the spring contacts the pressure plate. With the spring the correct way round refit the pressure plate. Ensure that the balancing marks are correctly aligned; if BMW's own marks are used, the pressure plate mark must be 120° away from that on the housing. If your own marks were made as recommended, align the pressure plate mark with that of the housing. Apply a smear of lubricant to all points of contact between the spring and pressure plate.

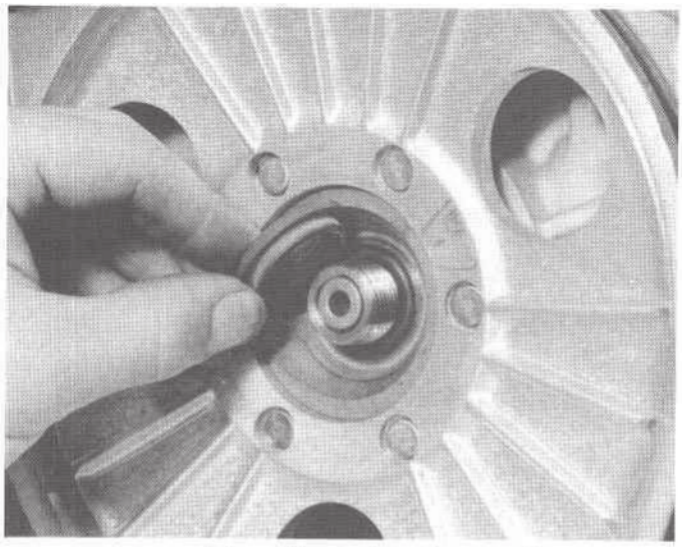
6 Fit the friction plate to the pressure plate, ensuring that it is fitted the correct way round; the centre boss extended end should face the gearbox.

7 Refit the cover plate, aligning the balancing mark as described above. Apply a smear of lubricant to the cover dowels to prevent corrosion. Before the screws are fully tightened, the friction plate must be centred. The easiest way of doing this is to push the gearbox input shaft into the clutch assembly and to line it up with the dowels protruding from the rear of the bellhousing. If this is not possible it will be necessary to acquire the BMW centring tool No. 21 2 670 or to make up a substitute for it, as shown in the accompanying illustration. Insert the tool into the friction plate centre splines, passing the long nose into the output shaft pilot bearing. The BMW tool now incorporates a bridge which fits on the bellhousing locating dowels to ensure perfect alignment. With the friction plate aligned, tighten the cover plate bolts or screws evenly and in a diagonal sequence to the specified torque wrench setting.

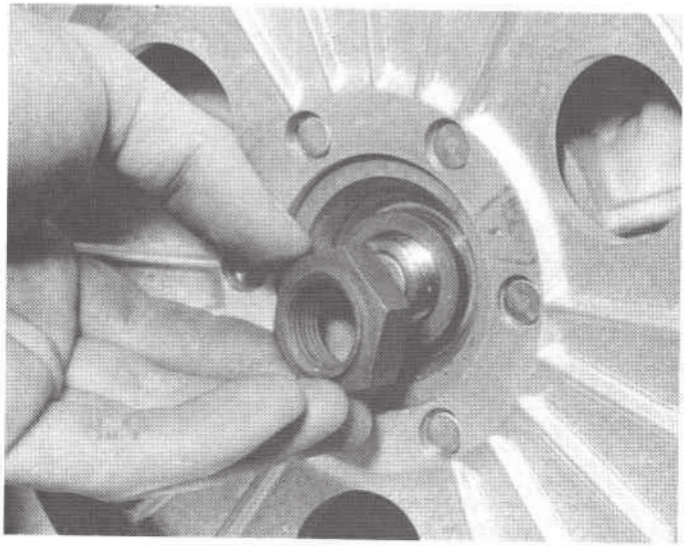
8 Apply a smear of lubricant to the pushrod and pilot bearing and to the splines of the gearbox input shaft and friction plate centre before refitting the gearbox.



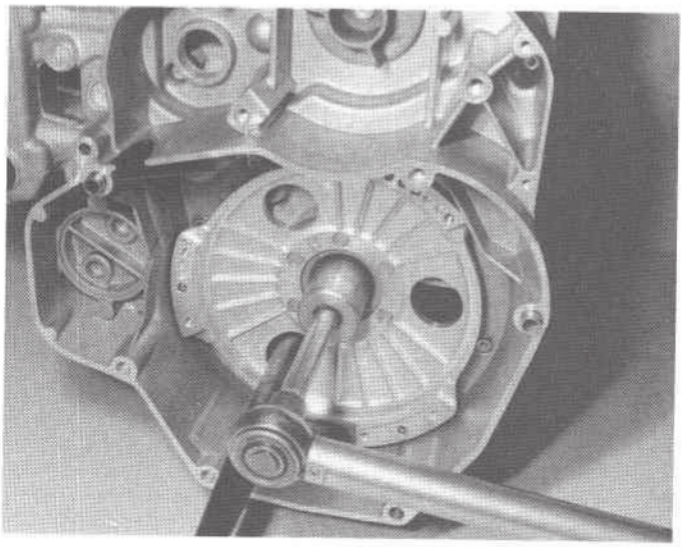
5.1 100 models only – fit thrust washer to clutch housing front boss



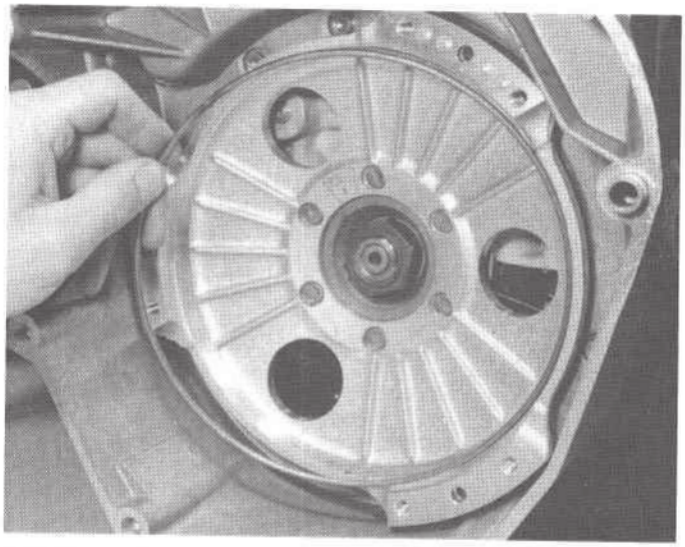
5.2a Fit new O-ring, followed by shouldered spacer – fit as shown



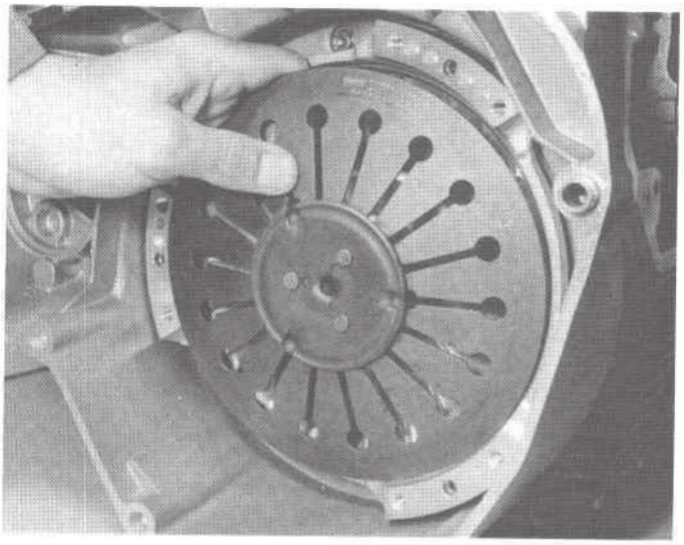
5.2b Housing nut is self-locking type – renew whenever disturbed



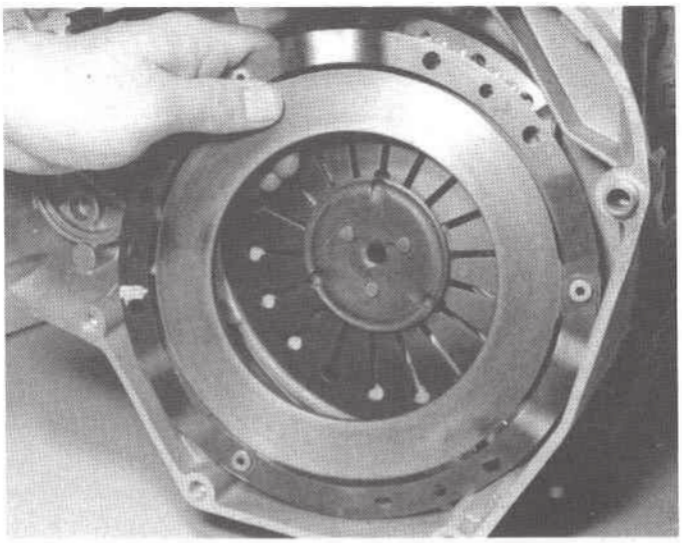
5.3a Note method used to lock housing (100 models only) to tighten or slacken retaining nut



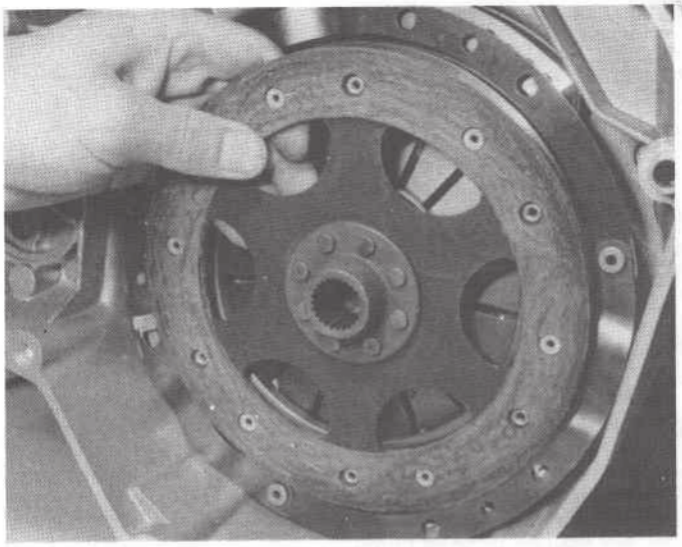
5.3b Fit wire ring to clutch housing and smear with specified lubricant



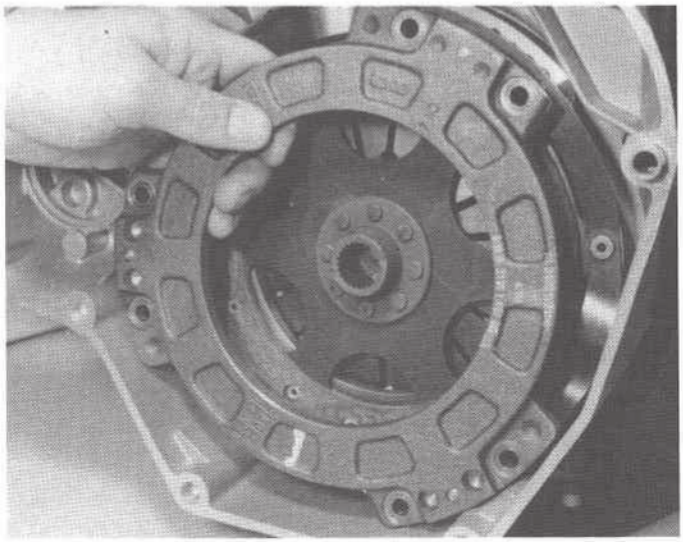
5.5a Fit clutch spring as shown – pressure plate wear marks confirm direction of installation



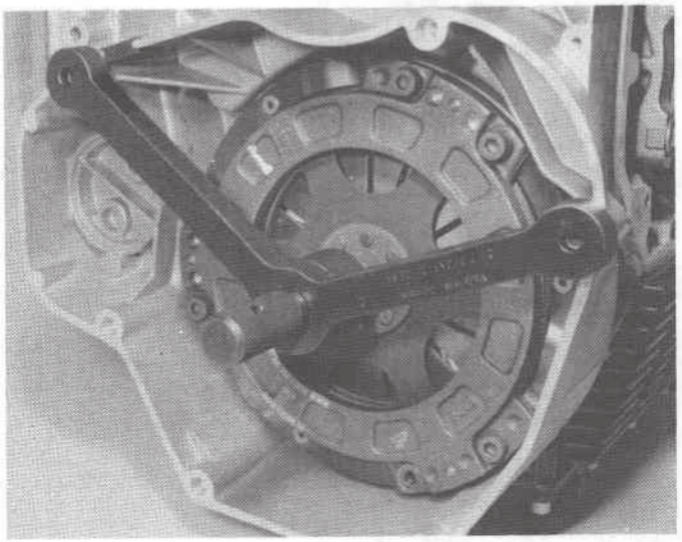
5.5b Lubricate points of spring contact when refitting pressure plate – note balancing mark



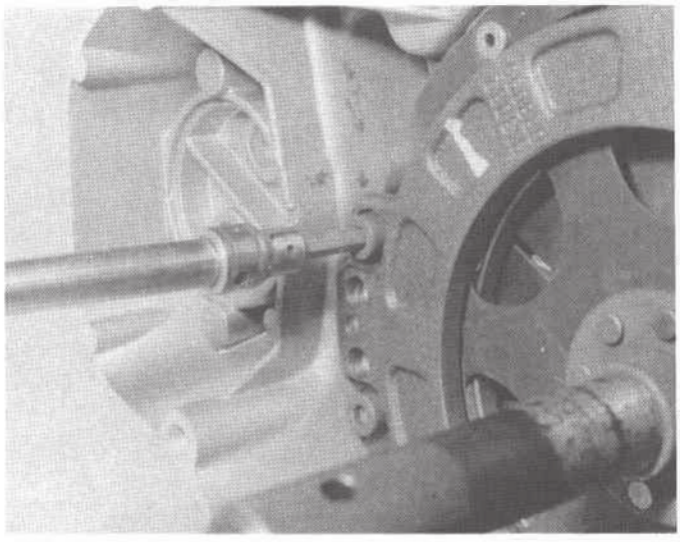
5.6 Friction plate centre boss extends towards gearbox



5.7a Lubricate locating dowels when refitting cover plate – note balancing mark



5.7b BMW service tool locates on bellhousing dowels to centre clutch components



5.7c Tighten clutch cover bolts or screws evenly to specified torque setting

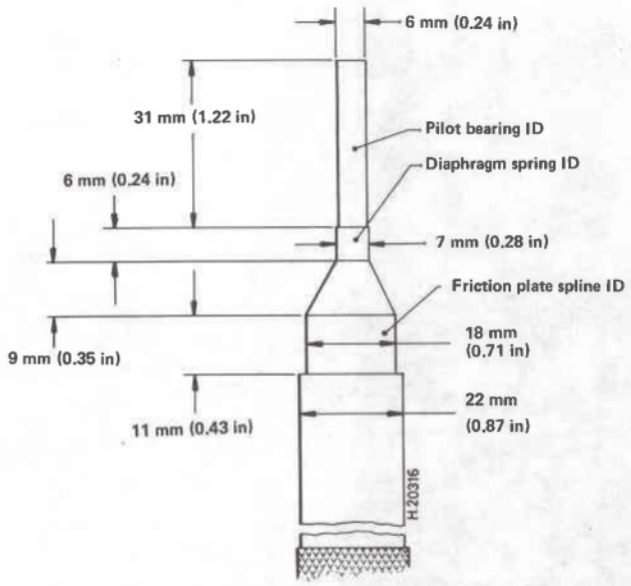


Fig. 2.4 Clutch friction plate centring tool

6 Clutch release mechanism: removal, examination and reassembly

1 Slacken the handlebar adjuster locknut, screw in the adjuster to gain the maximum cable free play and disconnect the cable from the operating lever on the gearbox.
2 The lever pivot pin is retained by a circlip at each end; remove the right-hand circlip and plain washer and pull the pivot pin out to the left. On models fitted with the side stand retracting mechanism the link rod nut must first be unscrewed so that the lever return spring pressure is released; the lever and spring can then be withdrawn with the pivot pin.
3 Slacken the clamp screw securing the rubber boot to the gearbox cover and withdraw the lever assembly, followed by the coil spring, the thrust piston, the thrust bearing and, on 100 models only, the clutch pushrod. These last three items can be removed using a suitable pair of pliers or similar, but if they prove to be awkward a piece of hooked wire or a strong magnet (the aluminium alloy pushrod has a steel cap and head) should be able to extract them. If they are bent or stuck fast; the gearbox must be removed to release them. Note that the rear wheel must be removed (100 models) only to permit the pushrod to be completely withdrawn.
4 On 75 models the pushrod has a raised flange at its front end which bears against the clutch spring; it is therefore necessary to remove the gearbox (see Chapter 3) before the pushrod can be withdrawn. Remove the clutch release components as described above, then tap the pushrod forwards out of the thrust bearing front race and pull it forwards out of the input shaft. On refitting, grease it thoroughly and push it very carefully backwards through the input shaft rear seal; a very thin layer of insulating tape wrapped around its tip would also help to protect the seal lips as the pushrod end passes through them. Hold the pushrod in place when it is fully inserted, remove the tape (if used) and use a hammer and a tubular drift such as a socket spanner to tap the bearing race on to its rear end. Lubricate the pushrod front end and clutch plate splines before refitting the gearbox.
5 Check all components, cleaning them thoroughly. The pushrod must be straight; roll it on a flat surface such as a sheet of plate glass to check for any signs of warpage. Check that the rubber boot is undamaged and that the thrust bearing and piston are undamaged and in good condition. If any signs of wear or damage are found on any component it must be renewed.
6 Check the lever pivot bearings; if these are worn or corroded they must be driven out and renewed. Immerse the alloy lever in boiling water (taking due care to prevent any risk of injury) to ease the task of removal and refitting. Pack the lever bores with grease on reassembly.
7 Whenever the gearbox is removed, examine the condition of the pilot bearing bush in the engine output shaft rear end. This carries the front end of the pushrod; if the pushrod is a slack fit at any time, or if the bearing is otherwise damaged, it must be renewed. Lubricate it whenever the opportunity arises.
8 Reassembly is the reverse of the dismantling procedure. On 75 models fit the clutch pushrod as described above, then refit the gearbox (see Chapter 3). On 100 models pack a small amount of lubricant via the seal into the input shaft; grease or oil the pushrod and refit it. On all models, oil the release bearing, the thrust piston and coil spring with gearbox oil as they are refitted.
9 Refit the rear wheel, if disturbed (100 models only). Connect the clutch cable and adjust the clutch as described in Routine Maintenance.

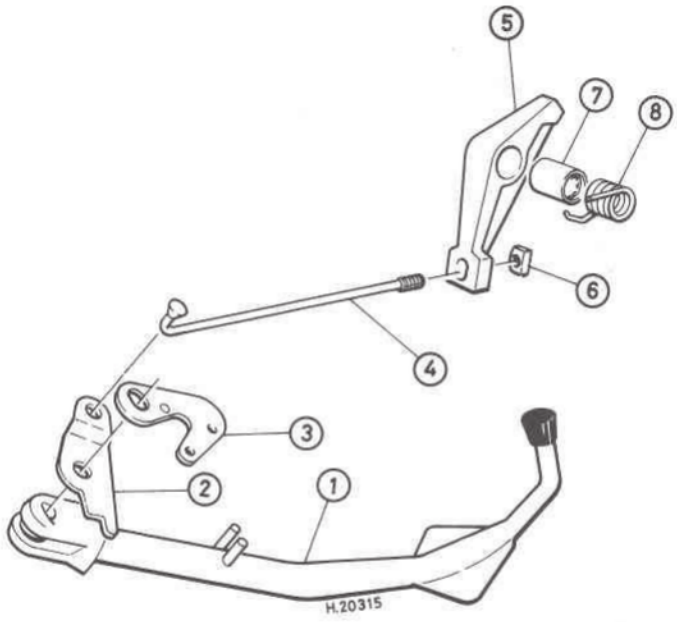
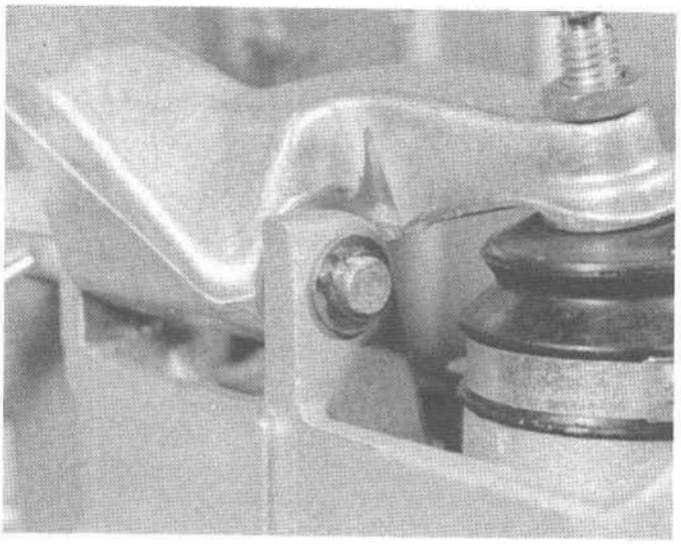
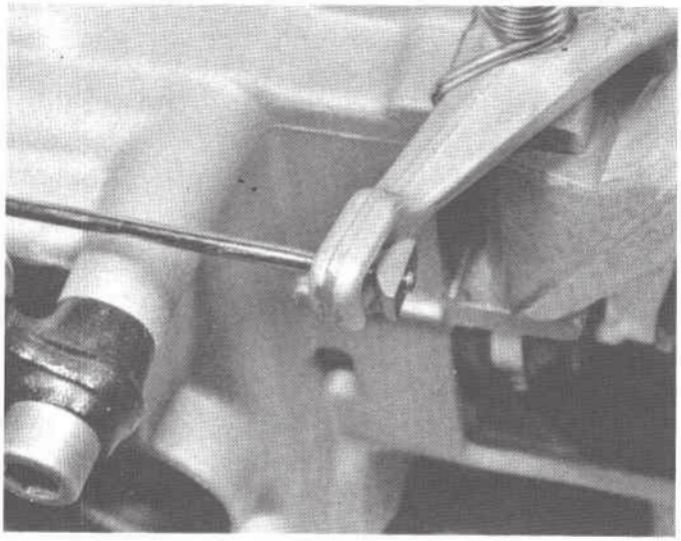


Fig. 2.5 Side stand retracting mechanism – late models

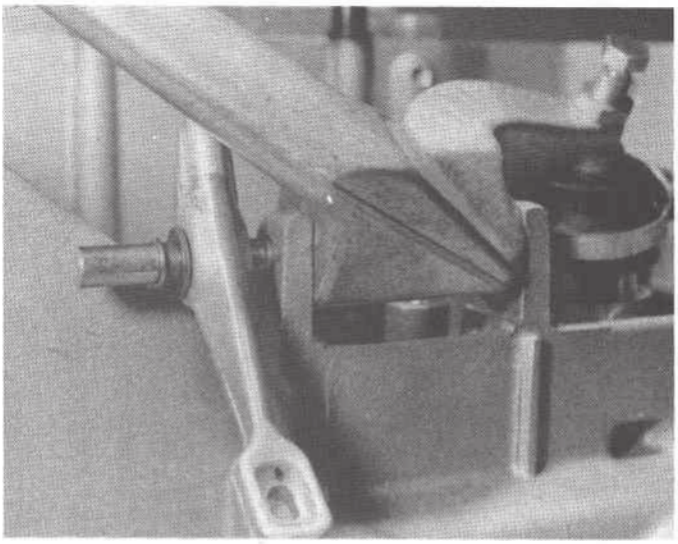
1	*Side stand*	5	*Lever*
2	*Lifting lever*	6	*Adjusting nut*
3	*Spring hook*	7	*Needle roller bearing*
4	*Link rod*	8	*Return spring*



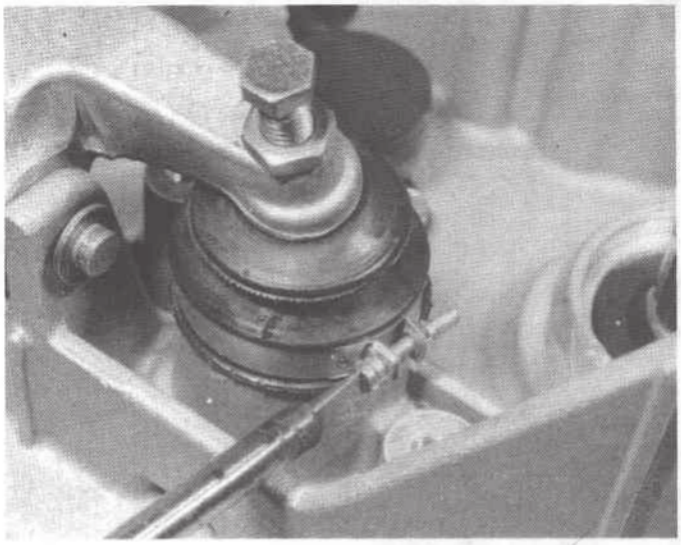
6.2a Withdraw circlip and washer, then tap clutch release pivot out to left



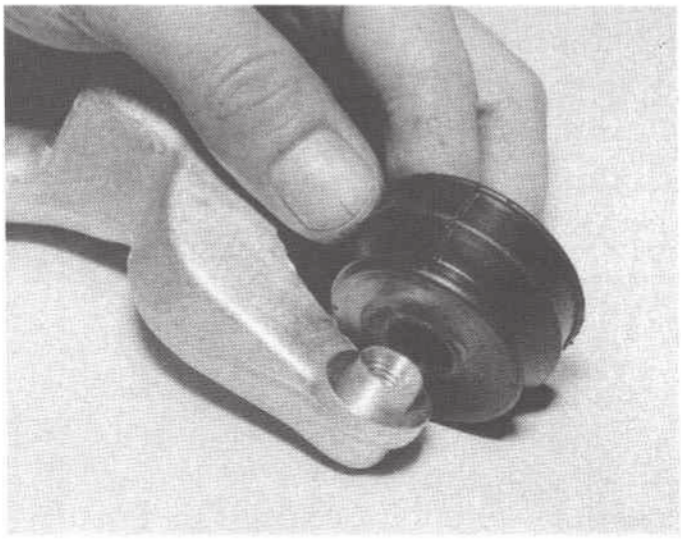
6.2b Where fitted, unscrew side stand retracting mechanism link rod nut



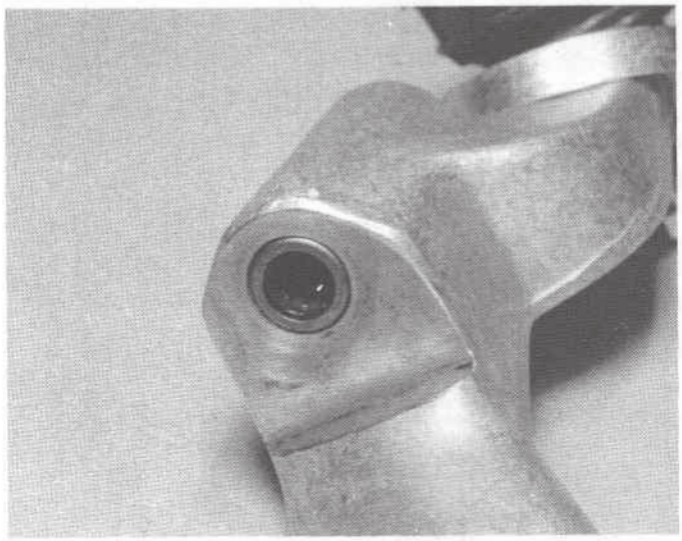
6.2c Withdraw retracting mechanism lever with release lever pivot pin



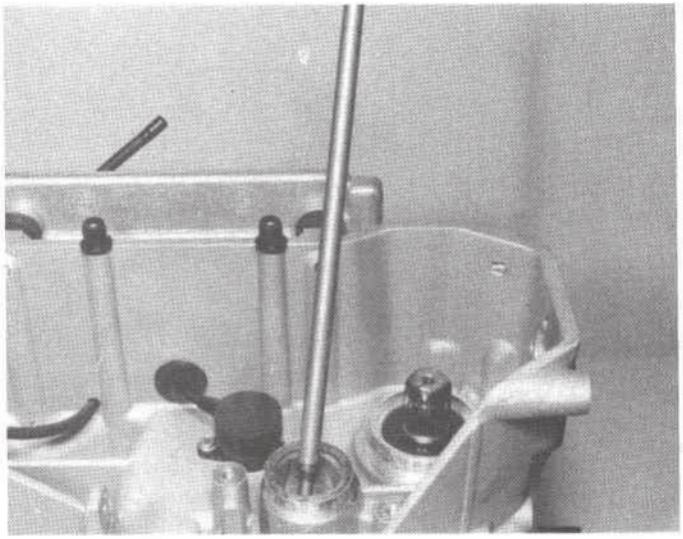
6.3 Slacken clamp to release rubber boot and lever



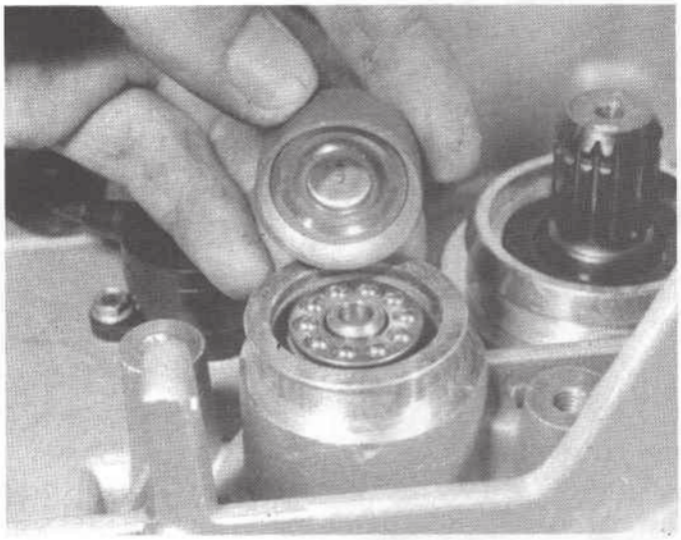
6.5 Check rubber boot for splits or tears – renew if leaking



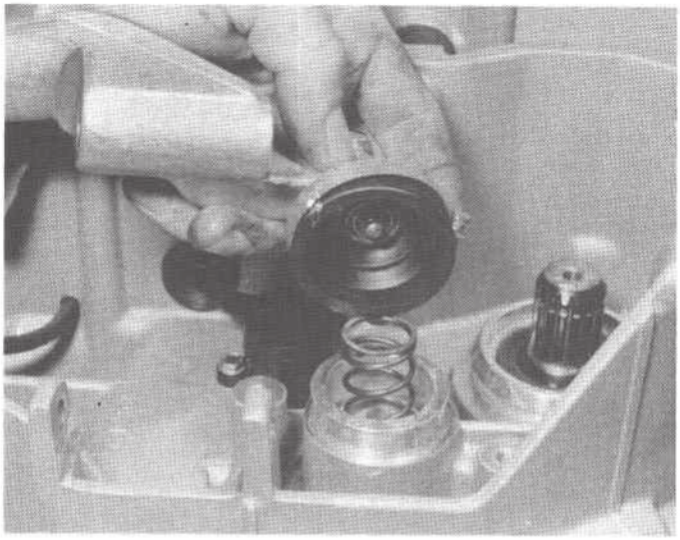
6.6 Needle roller bearings fitted to lever pivots – pack with grease on refitting



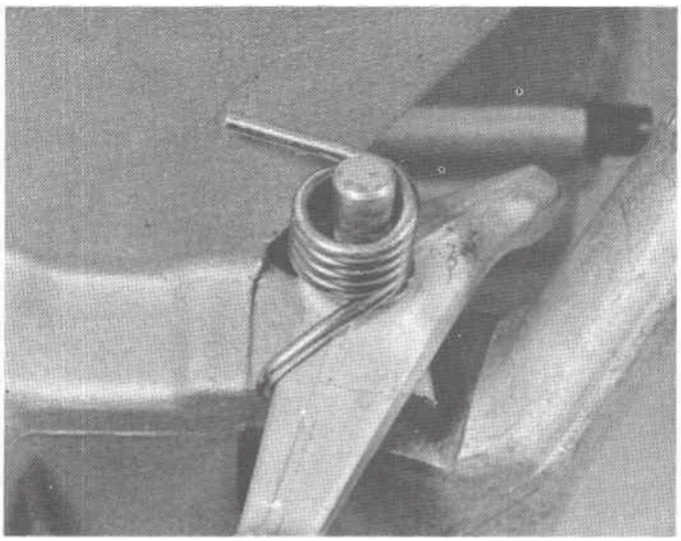
6.8a Pushrod can be withdrawn to rear on 100 models – gearbox must be removed first on 75 models



6.8b Lubricate and fit clutch thrust bearing as shown, followed by thrust piston ...



6.8c ... coil spring and release lever assembly



6.8d Retracting mechanism lever return spring fits as shown

Chapter 3 Gearbox

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Gearbox; removing and refitting the bearings and seals 4
Gearbox shafts: dismantling and reassembly 5
Gearbox: examination and renovation 6
Checking and resetting the gearbox shafts endfloat and preload 7
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Refitting the gearbox to the frame 9

Specifications

Gearbox

Reduction ratios – inclusive of input shaft/layshaft reduction of 1.944:1 (35/18T):	
1st	4.497:1
2nd	2.959:1
3rd	2.304:1
4th	1.879:1
5th	1.666:1
Layshaft and output shaft standard endfloat	0.050 – 0.150 mm (0.0019 – 0.0059 in)
Input shaft preload:	
Tolerance	0.030 – 0.080 mm (0.0012 – 0.0032 in)
Approximate equivalents of preload values, expressed in friction values:	
0.030 mm (0.0012 in) preload	0.19 ± 0.02 Nm (0.14 ± 0.01 lbf ft)
0.055 mm (0.0022 in) preload	0.34 ± 0.02 Nm (0.25 ± 0.01 lbf ft)
0.080 mm (0.0032 in) preload	0.50 ± 0.02 Nm (0.37 ± 0.01 lbf ft)

Gearbox lubrication

Recommended oil	Good quality hypoid gear oil of API class GL-5 or to specification MIL-L-2105 B or C
Viscosity:	
Above 5°C (41°F)	SAE90
Below 5°C (41°F)	SAE80
Alternatively	SAE80W90
Capacity	850 ± 50 cc (1.50 ± 0.09 Imp pint, 0.90 ± 0.05 US qt)

Torque wrench settings

Component	75 models		100 models	
	Nm	lbf ft	Nm	lbf ft
Selector lever/gearchange pedal shaft grub screw	17 ± 2	12.5 ± 1.5	N/Av	N/Av
Neutral detent assembly plug	13 ± 2	9.5 ± 1.5	25 – 29	18.5 – 21.5
Front cover retaining screws	9 ± 1	6.5 ± 0.5	9 – 11	6.5 – 8
Gearbox/bellhousing retaining screws	16 ± 1	12 ± 0.5	16 ± 1	12 ± 0.5
Engine and transmission unit/frame mountings:				
Early (1984, 1985) 100 models	N/App	N/App	32	23.5
Late (1986 on) 100 models, 75 models	40.5 ± 4	30 ± 3	40.5 ± 4	30 ± 3
Filler and drain plugs	20 ± 3	15 ± 2	N/Av	N/Av

1 General description

The gearbox is a separate unit bolted on to the rear face of the engine unit and carries the clutch friction plate on its input shaft. Developed with and built for BMW by Getrag, the gearbox is a five-speed constant-mesh type which differs from general motorcycle practice in being all indirect, with a three shaft layout.

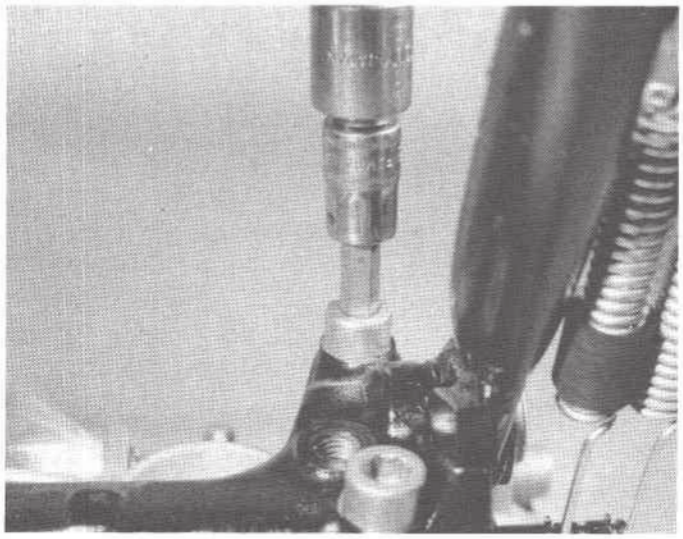
The input shaft rotates on taper roller bearings which are preloaded in service by the addition of shims between the front bearing and a collar on the shaft. The shaft carries a two lobe face-cam shock absorber tensioned by a single coil spring to damp out transmission shock loads and transmits drive from the clutch to the output shaft via the layshaft.

These latter two shafts rotate in ball journal bearings and apart from the helical-cut top gear pinions, use straight-cut gears. The different gear ratios are selected by moving two pinions on the output shaft and one on the layshaft. These pinions are splined on to their respective shafts and have integral dogs which lock into corresponding dogs or slots in their neighbouring pinions, thus locking the second pinion to the shaft to transmit the drive. The sliding pinions are controlled by selector forks which are guided by slots machined in a selector drum. The drum is rotated by a claw mechanism operated from the gearchange pedal and fitted with a spring-loaded positive stop roller arm, or detent arm, and a limiting pawl on the selector claw arm which rotates the drum to prevent overselection. A spring-loaded ball provides the neutral detent mechanism and a switch on the outside of the rear cover transmits information about the selector drum position to the instrument panel where a green lamp lights when neutral is selected (ignition switched on) and a liquid-crystal display (LCD) panel in the tachometer (rev counter) face indicates which gear is selected.

2 Removing the gearbox from the frame

Note: *It is possible to remove the engine and transmission as a single unit from the frame, and then to separate the unit into its major components. If this course is preferred, refer to Chapter 1 for details of the procedure. Given below are instructions on removing the transmission from the frame, leaving the clutch and engine in place.*

1 If the gearbox is to be overhauled, drain the oil (see Routine Maintenance).
2 Lift the seat and remove both side panels, then disconnect the fuel injection control unit and withdraw it with the storage tray. See Chapter 5.
3 Remove the battery as described in Routine Maintenance, then secure the coolant expansion tank to the frame seat tube out of harm's way. Remove their retaining screws and withdraw the ignition HT coil and alternator covers.
4 Remove the exhaust, as described in Chapter 5.
5 On K75, K75 C and K75 T models unscrew the adjusting nut to disconnect the rear brake operating rod. On all models, disconnect the wires from the speedometer impulse transmitter, the stop lamp rear switch and the gear position indicator switch.
6 Remove the rear wheel. See Chapter 9. Remove its four mounting nuts and withdraw the rear mudguard.
7 Working as described in Chapter 8, remove both footrest plates and the rear brake system components, disconnect the rear suspension unit bottom mounting and withdraw the final drive case, dismantle the swinging arm and withdraw the final drive shaft.
8 Disconnect the clutch cable from the release lever and remove it from the gearbox. See Routine Maintenance. Working as described in Chapter 2, remove the clutch release mechanism components.
9 Unscrew the starter motor mounting bolts and withdraw the starter motor. Enlist the aid of two assistants for the next stage.
10 Place a jack under the engine, with a block of wood positioned to protect the sump fins and raise the machine until the centre stand is clear of the ground; be very careful that the machine does not topple. Place blocks of wood or similar supports underneath the sump and in front of the front wheel. If a suitable support can be obtained, the frame rear end should be secured at the necessary height. If work is being carried out in a building with strong enough roof timbers a satisfactory support could be obtained by hanging the frame rear end from one of these timbers using a length of strong rope or a strong webbing strap. If all else fails have your assistants support the frame rear end while the gearbox is removed.
11 When the machine is securely supported, unscrew the four mounting bolts and withdraw the stand assembly. Unscrew the six gearbox/bellhousing Allen screws.
12 Remove the two gearbox/frame mounting Allen bolts and pull the gearbox backwards off the clutch splines. There should be no difficulty in separating the gearbox from the engine, but if any problems are encountered first check that the starter motor and all the gearbox/bellhousing retaining screws have been removed, also any other component which might prevent separation. If the gearbox is still stuck in place it is probably because one of the locating dowels is corroded. Apply a good quantity of penetrating fluid to the affected area, allow time for it to work, then tap the gearbox backwards with a few firm blows of a soft-faced mallet on the swinging arm pivot or frame mounting lugs.
13 Note the two large locating dowels protruding from the mating surface of the bellhousing rear face; it is essential that these are present and firmly fixed at all times to ensure that the gearbox is correctly aligned on the bellhousing. If this is not the case, the clutch action will be heavy and the clutch will suffer excessive spline wear and even serious damage. Note also the rubber fillet sealing the clutch housing, underneath the starter motor; check that this is securely installed.
14 On 75 models, and on 100 models if necessary, withdraw the clutch pushrod from the input shaft.



2.11a Remove the stand assembly ...



2.11b ... to permit the removal of all gearbox/bellhousing retaining screws

3 Gearbox: dismantling

1 Unscrew the neutral detent plug and tip out the coil spring and ball behind it. Remove the gear position indicator switch from the rear cover.

2 Unscrew the front cover retaining screws, then withdraw the front cover; a loud click will be heard as the detent roller arm slips off the selector cam. BMW recommend that the cover is heated evenly, in an oven or similar to 100°C (212°F) to permit removal but it was found in practice that this was not necessary; although the cover was a tight fit, as soon as the retaining screws were removed a few taps on the input and output shaft ends with a soft-faced mallet broke the seal so that the cover could then be pulled off with the aid of a few further taps. Note the provision of a leverage point at the bottom right-hand (gearbox in position on the machine) 'corner' of the front cover; this is provided so that a screwdriver can be inserted to exert sufficient leverage to break the initial seal. **Do not** force the screwdriver (or any other tool) between the machined sealing surfaces, and **do not** exert excessive pressure to release a stubborn cover or it may crack.

3 As soon as the cover is removed, check inside the bearing locations and note exactly the presence and number of any shims that may be fitted. These shims must be clearly labelled so that they can be returned to their original locations on reassembly. Note also the two locating dowels in the mating surface.

4 Withdraw the selector fork shafts and place them in separate, clearly-marked containers; while they are identical when new they must not be confused when part-worn or the mis-matching of part-worn components will cause greatly accelerated wear. Rotate all three selector forks away from their drum tracks.

5 Press back the selector claw arm and lift out the selector drum; a very light tap on its rear end with a soft-faced mallet will dislodge it if it proves stubborn. The cam and pins can be withdrawn from the drum if required.

6 Noting the presence of the separate rollers around their guide pins, remove and place in separate, clearly-marked containers the selector forks. As each fork is removed use a spirit-based felt marker or similar to mark its top (or front surface).

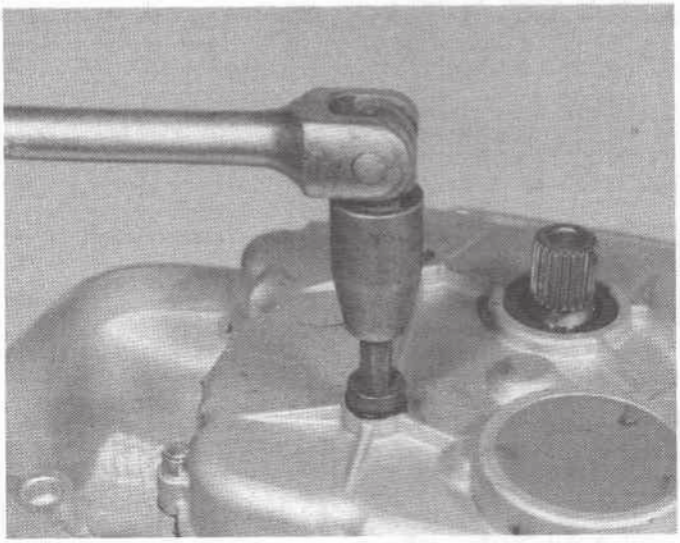
7 Holding them together as a single unit, pull out the layshaft and output shaft. BMW recommend that the housing is heated evenly, in an oven or similar, to approximately 100°C (212°F) to permit shaft removal but again this was found not to be necessary in practice; a firm tap on the output shaft rear end from a soft-faced mallet proved sufficient to dislodge both shafts. With these removed the input shaft can be withdrawn. Check that there are no shims fitted at the shaft rear bearings.

8 To dismantle the selector mechanism, first prise off the black plastic cap from the gearbox breather then use a hammer and a suitable drift to tap out the breather sleeve from the inside; take care not to deform the sleeve.

9 Withdraw the circlip from the claw arm mounting guide rod and push the guide rod upwards and out through the breather orifice. Withdraw the claw arm and mounting; if desired the two can be separated by removing the retaining circlip from the claw arm pivot. Note how the spacer fits inside the loop of the claw arm spring.

10 Unscrew the tapered grub screw from the gearchange pedal shaft and withdraw the shaft; note the shim between the return spring and the housing wall. Displace the two circlips and withdraw the locating plate with the selector lever and return spring and the shim. If the gearchange pedal is to be removed from the shaft, first mark the shaft end next to the split in the lever so that the lever can be refitted in the same position.

11 The detent roller arm can be withdrawn from the front cover by lifting its return spring straight end over the cover stop lug to release the spring pressure and then removing the retaining circlip to release the arm. The roller can be removed and refitted after its retaining circlip has been withdrawn. Drive out from the inside the small plug which seals the passage next to the detent roller arm.



3.1 Unscrew detent plug to release neutral detent assembly

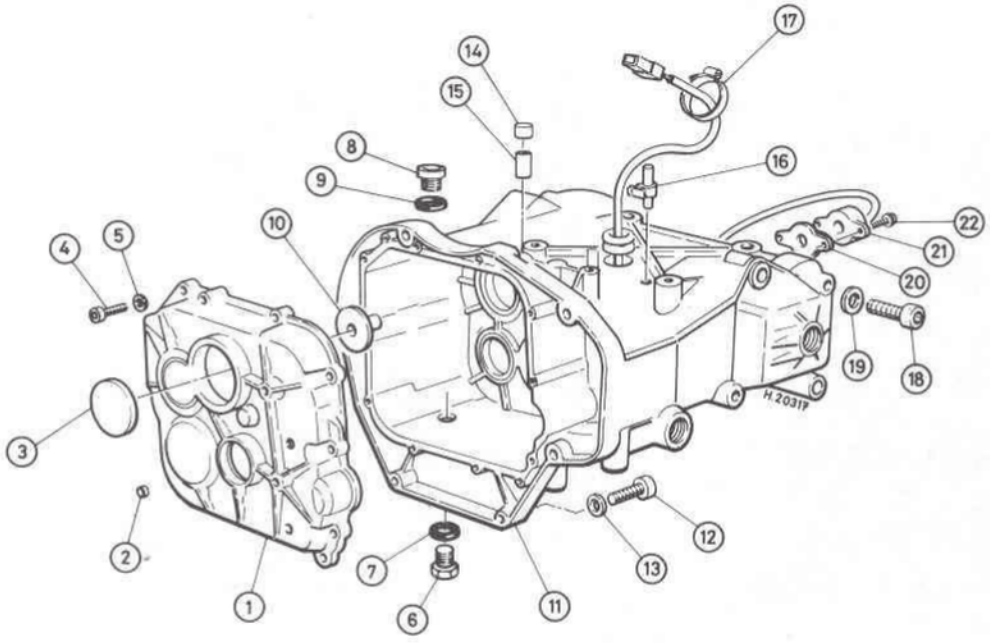


Fig. 3.1 Gearbox housing

1 *Front cover*
2 *Locking plug*
3 *Sealing plug*
4 *Screw – 10 off*
5 *Wave washer*
6 *Drain plug*
7 *Sealing washer*
8 *Filler plug*
9 *Sealing washer*
10 *Oil guide*
11 *Gearbox housing*
12 *Screw – 6 off*
13 *Washer – 6 off*
14 *Cap*
15 *Breather sleeve*
16 *Clamp*
17 *Cable clamp*
18 *Gearbox/frame mounting bolt – 2 off*
19 *Washer – 2 off*
20 *Gasket*
21 *Neutral switch*
22 *Bolt – 2 off*

4 Gearbox: removing and refitting the bearings and seals

1 All oil seals should be renewed as a matter of course whenever they are disturbed and especially if they show any signs of leakage or of damage.

2 Using a socket or similar as a drift, tap out the seal from the inside outwards; note first which way round the seal is fitted and at exactly what depth. In the case of the output shaft front sealing plug, this will mean that the oil guide must be removed as well; do not forget to clean it and install it with the protruding spout projecting inwards (to the rear) before fitting a new sealing plug. Where seals cannot be driven out from behind, eg input shaft rear end seal or gearchange shaft seal, they must be levered out using a tool with rounded edges, taking great care not to scratch or damage the seal housing.

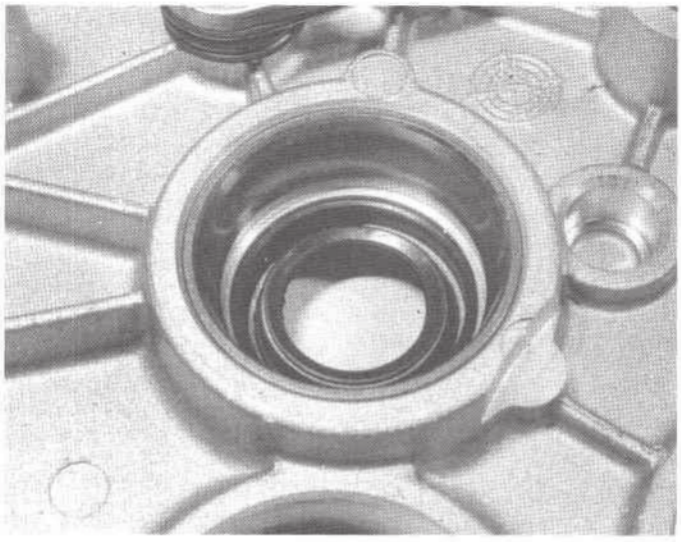
3 To fit new seals, find a socket spanner or similar tube which bears only on the seals hard outer edge and use this to position the seal squarely in the mouth of its housing. Apply a thin smear of grease to the seal outside edge and tap it into place until it is flush with its surrounding housing or, in cases such as the output shaft rear seal, until it seats on a locating shoulder. Seals should be installed with the manufacturer's marks facing outwards, ie with the spring-loaded centre lip towards the fluid or gas being sealed. Note that the shaft rear seal, therefore is installed with the centre lip outwards, ie to the rear. If rotation arrows are found, the seal must be installed so that these face in the normal direction of rotation of the shaft.

4 All gearbox ball bearings should be easily removed with their shafts. If this is not the case, or if taper roller bearing outer races are to be removed, heat the casting evenly in an oven or similar to 100°C (212°F) and tap it firmly down on to a clean, flat wooden surface; this should dislodge the bearings or bearing outer races easily. Take great care to prevent any risk of personal injury when heating components or handling heated components. Note carefully the presence and number of any shims behind any of the bearings. Remember also to renew any seals that may have been left in place; the heat will almost certainly damage them.

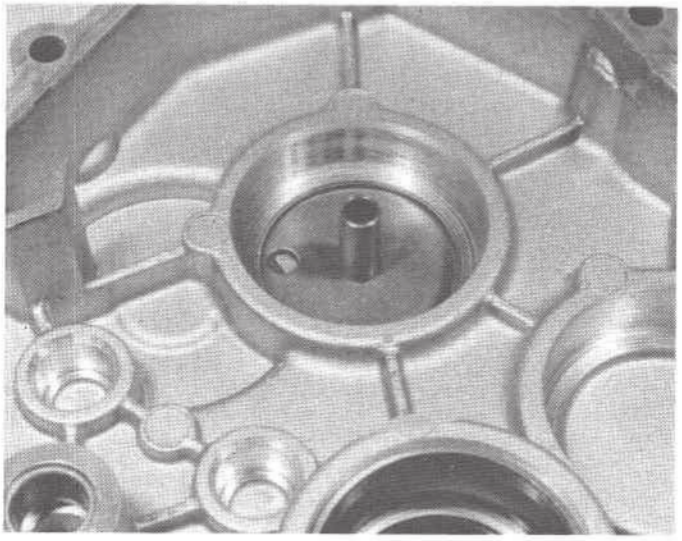
5 If any of the shafts or bearings are renewed, or if the tolerances are found to be incorrect, the shim thicknesses must be adjusted. Before any bearings or seals are refitted, refer to Section 7 of this Chapter.

6 Ball bearings are refitted to their shafts using a hammer and a tubular drift such as a socket spanner, which bears only on the bearing inner race. Drive each bearing down its shaft until the inner race contacts the locating shoulder or other component against which it must rest.

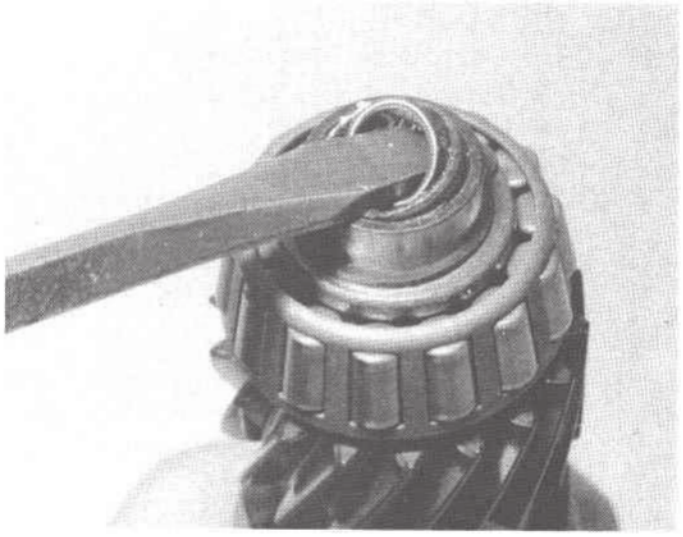
7 Input shaft taper roller bearings are fitted in a similar manner but must be heated first to approximately 80°C (176°F) before they can be fitted. The front bearing must be driven down to rest against shims placed against the shaft front flange and the rear bearing must be driven along the shaft until the retaining circlip can be refitted in its groove; the bearing must then be pulled back against the circlip to locate it.



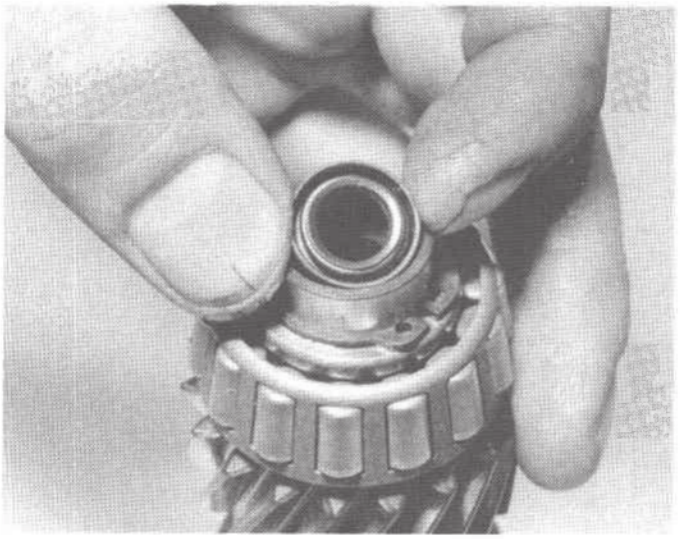
4.1 Oil seals should be renewed as a matter of course – remove and refit as described in text



4.2a Note correct fitted position of output shaft oil guide



4.2b Be careful not to damage seal housing when levering seals out ...



4.3 ... and note how seal is fitted so that the new component can be correctly installed

5 Gearbox shafts: dismantling and reassembly

Input shaft

1 Before the input shaft can be dismantled some means must be devised of compressing safely the shock absorber spring. On the machine featured in the accompanying photographs a knife-edged bearing puller was assembled on the shaft rear end with its edges pulling against the shock absorber front cam. This relieved spring pressure enough for the retaining circlip to be removed and the shaft rear bearing to be drawn off using another puller.

2 Gradually release spring pressure by unscrewing the compressing tool until the spring is at full extension (43 mm/1.7 in on the machine featured) and its pressure is released.

3 Dismantle the compressor and withdraw the rear cam, the front cam, the spring and the spring seat. If the front bearing is to be renewed, draw it off using one of the pullers and note the presence and number of any shims fitted between it and the shaft collar. Do not forget to renew the bearing outer race at the same time. See Section 4.

4 On reassembly, lubricate the shaft splines and fit the spring seat, the spring, the front cam and the rear cam. Clamp the shaft front end in a vice with soft jaws so that the shaft is held securely upright but cannot be marked or damaged. Obtain a new circlip as a safety measure; re-used circlips can occasionally fail in service.

5 BMW recommend that the bearing is heated to approximately 100°C (212°F) to permit refitting but this was found in practise to be unnecessary. Although the bearing was a tight fit it was possible to refit it using a hammer and a long tubular drift which bore only on the inner race. Drive the bearing down until it contacts the shoulder, at which point the circlip groove should be exposed. Fit the new circlip and use a bearing puller to draw the bearing back into contact with it. Note, there must be no clearance between the bearing inner race and the circlip or the preload setting will be incorrect.

6 BMW recommend the input shaft front bearing be heated to approximately 80°C (176°F) before it can be installed. Whether this actually proves necessary or not it is essential that the correct size shim is placed against the shaft collar and that the bearing is driven down the shaft, using a tubular drift which bears only on its inner race, to rest firmly against the shim and collar. See Section 7.

Layshaft

7 If it is necessary to renew the layshaft bearings they can be removed and refitted using respectively a knife-edged bearing puller and a hammer and tubular drift of suitable size, as described above. If it is found to be faulty in any other way, the shaft must be renewed complete.

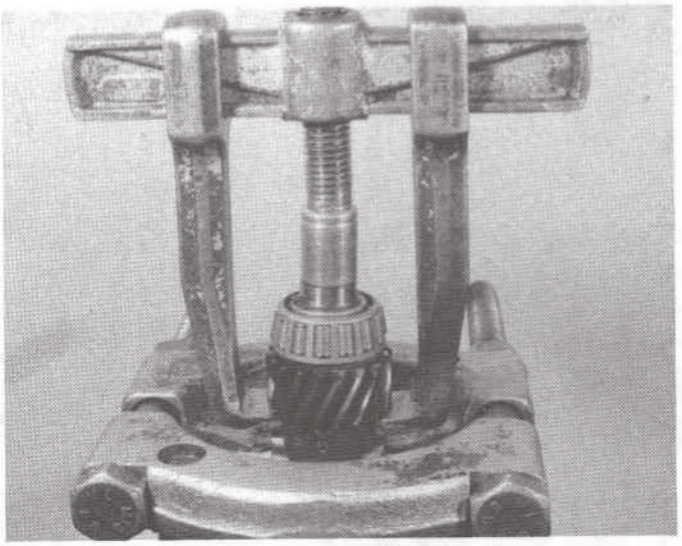
Output shaft

8 Use a knife-edged bearing puller or similar to remove the bearing from each end of the shaft, then remove the various gear pinions with their bushes or needle roller bearings, using circlip pliers to release the retaining circlips, where fitted.

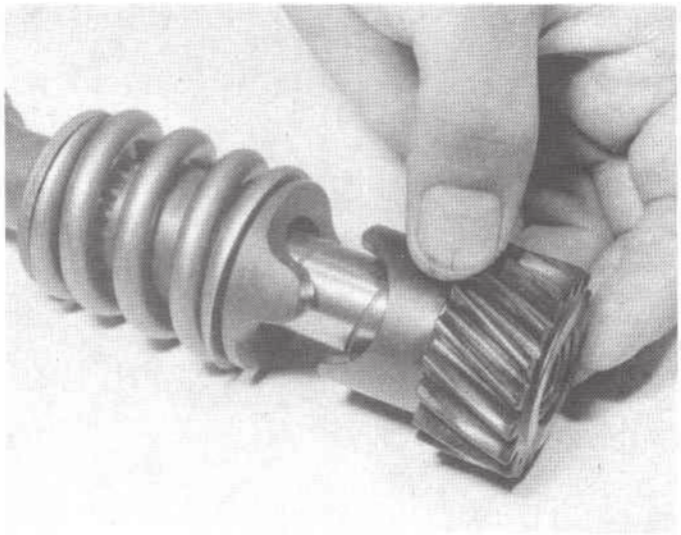
9 BMW recommend that the 1st gear pinion centre bush must be heated to approximately 80°C (176°F), to permit removal, using a puller bearing on the 4th gear pinion; in practice the bush was found to be a fairly slack fit and could be pulled off by hand.

10 Ensure that all components are stored exactly as they are removed so that they can be refitted the same way round and in the original sequence. If in doubt, refer to the photographs and illustration accompanying the text.

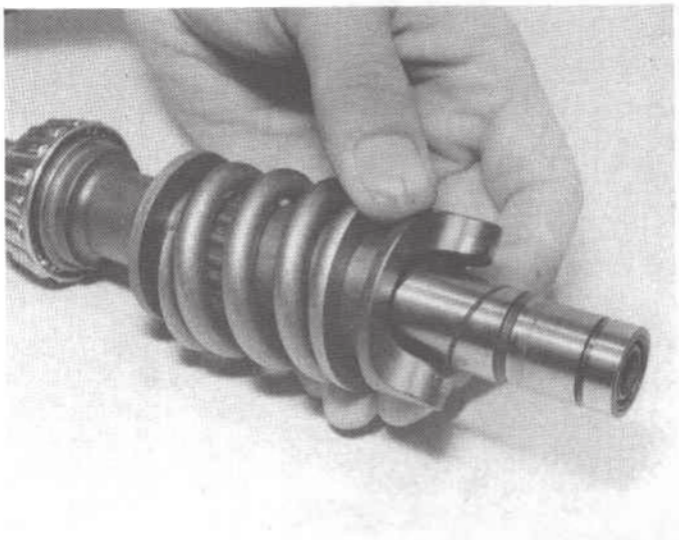
11 On reassembly, lubricate all components, and renew any circlips which appear to be distorted, damaged or worn. The accompanying series of photographs show the rebuilding of an output shaft assembly; use this if in any doubt about the fitting or location of any component.



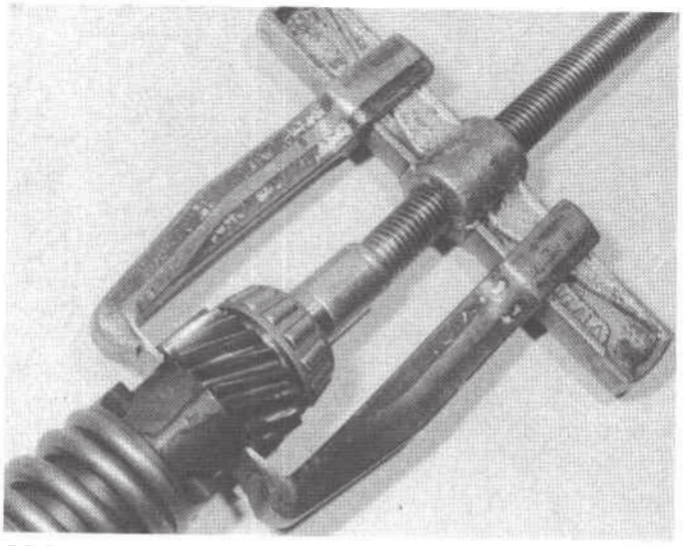
5.1 Note method used to compress shock absorber spring before removing or refitting input shaft rear bearing



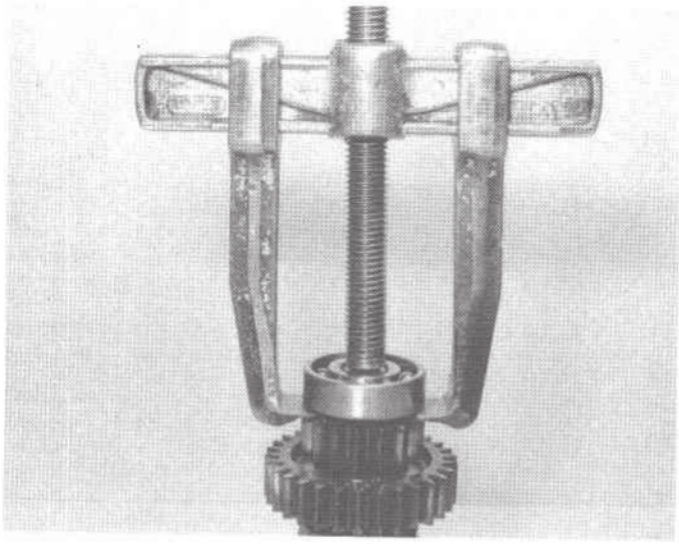
5.3 Input shaft shock absorber can be easily dismantled once rear bearing is removed



5.4 Fit spring seat, spring and shock absorber as shown – note shoulder and circlip groove on shaft rear end



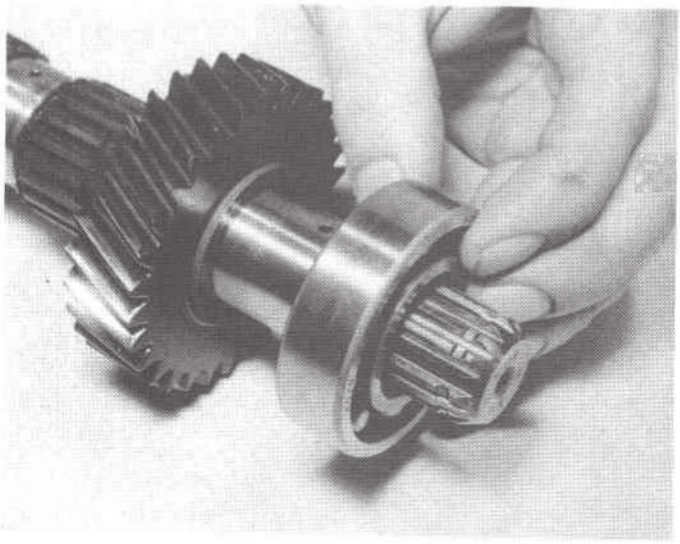
5.5 Rear bearing should be tapped down to shoulder until circlip can be fitted, and then drawn back against circlip to produce correct installed length



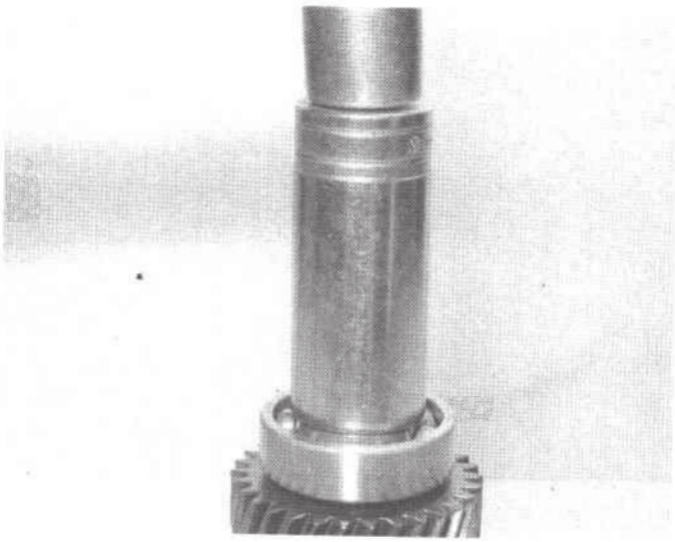
5.8 Use bearing puller as shown to remove shaft bearings



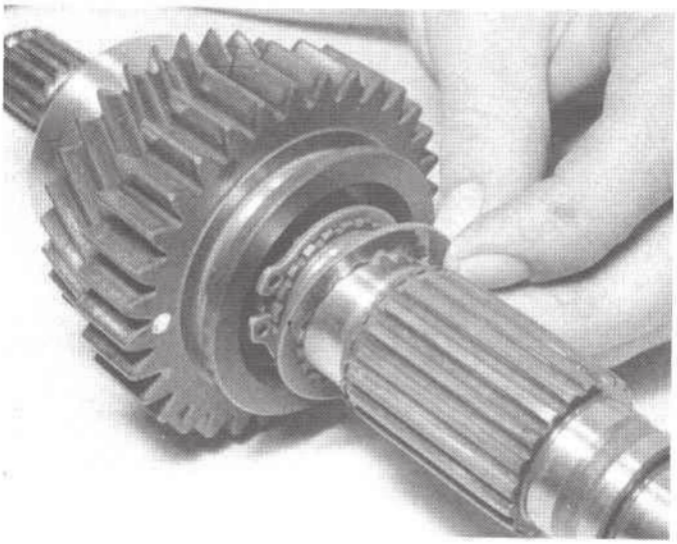
5.9a Fit shim and 5th gear pinion centre bush to output shaft as shown ...



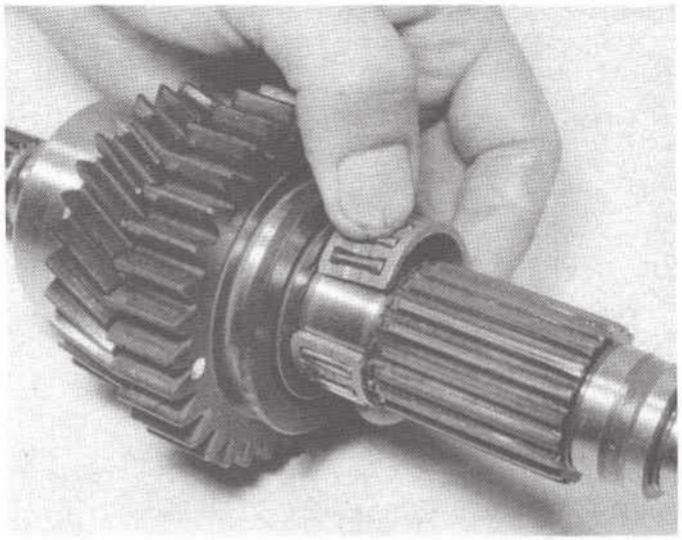
5.9b ... followed by the 5th gear pinion and a second shim, and the rear bearing ...



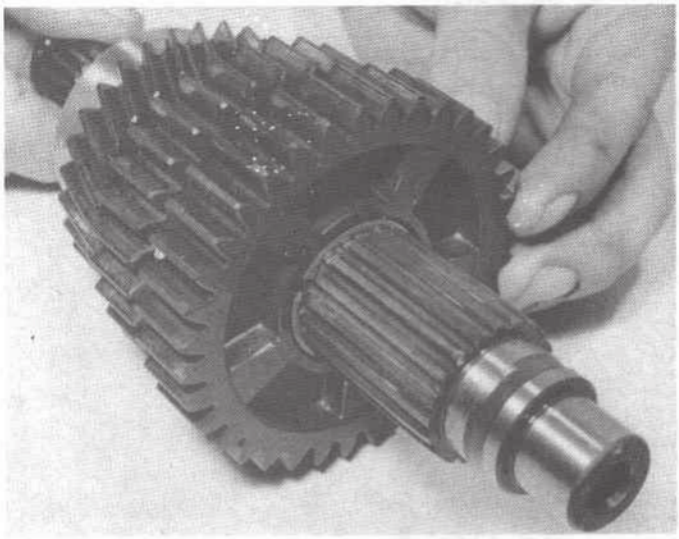
5.9c ... which is fitted as shown to rest against the centre bush and shim



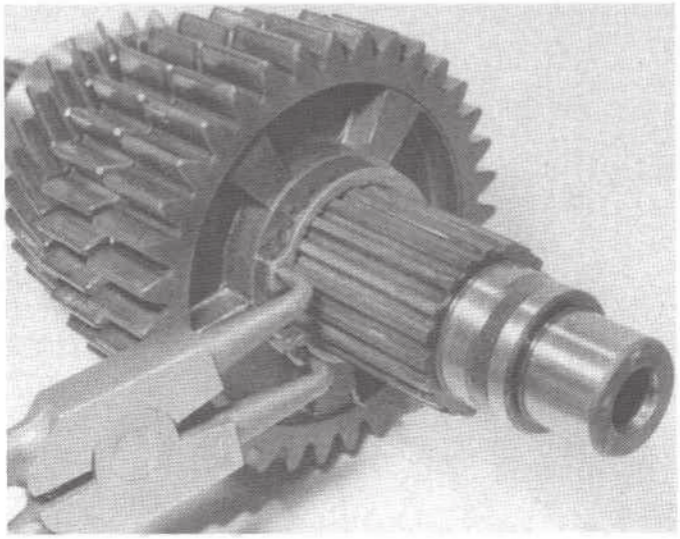
5.10a Fit the 3rd gear pinion as shown over the shaft front end followed by a circlip and a splined thrust washer



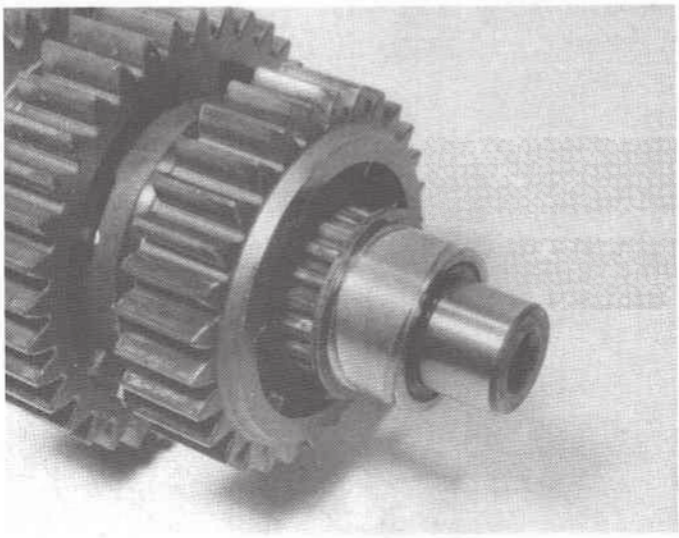
5.10b 2nd gear pinion rotates on a split-cage needle roller bearing



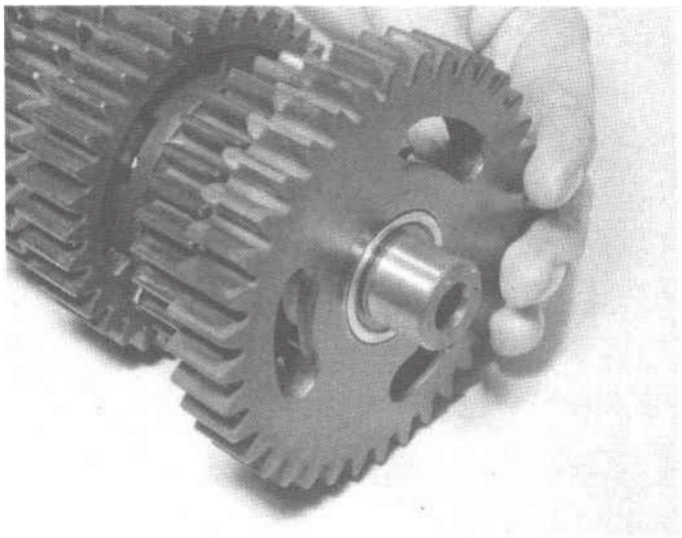
5.10c Fit the 2nd gear pinion as shown ...



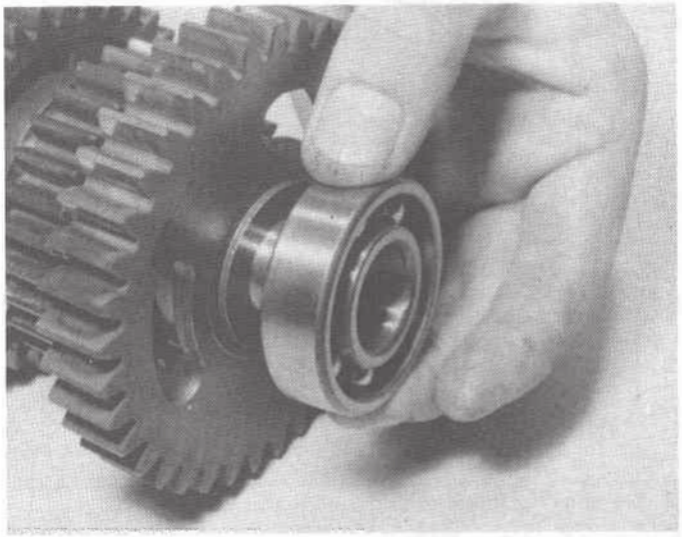
5.10d ... pinion is located by a splined thrust washer and secured by a circlip



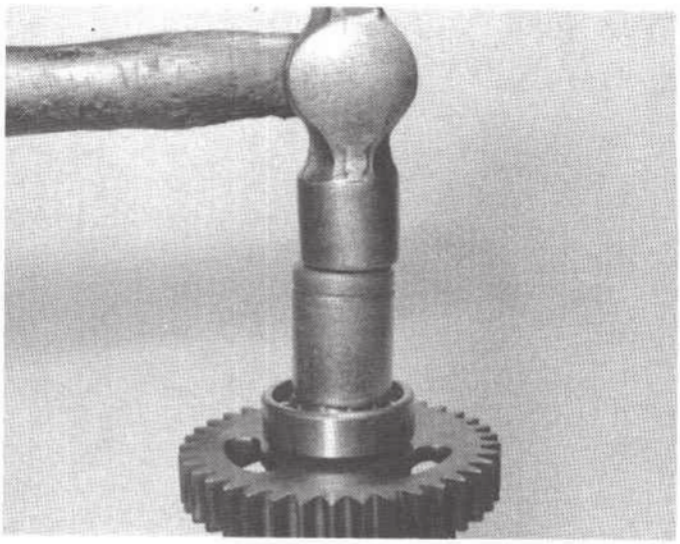
5.11a Fit 4th gear pinion as shown, followed by shim and 1st gear pinion centre bush



5.11b Fit 1st gear pinion as shown, followed by ...



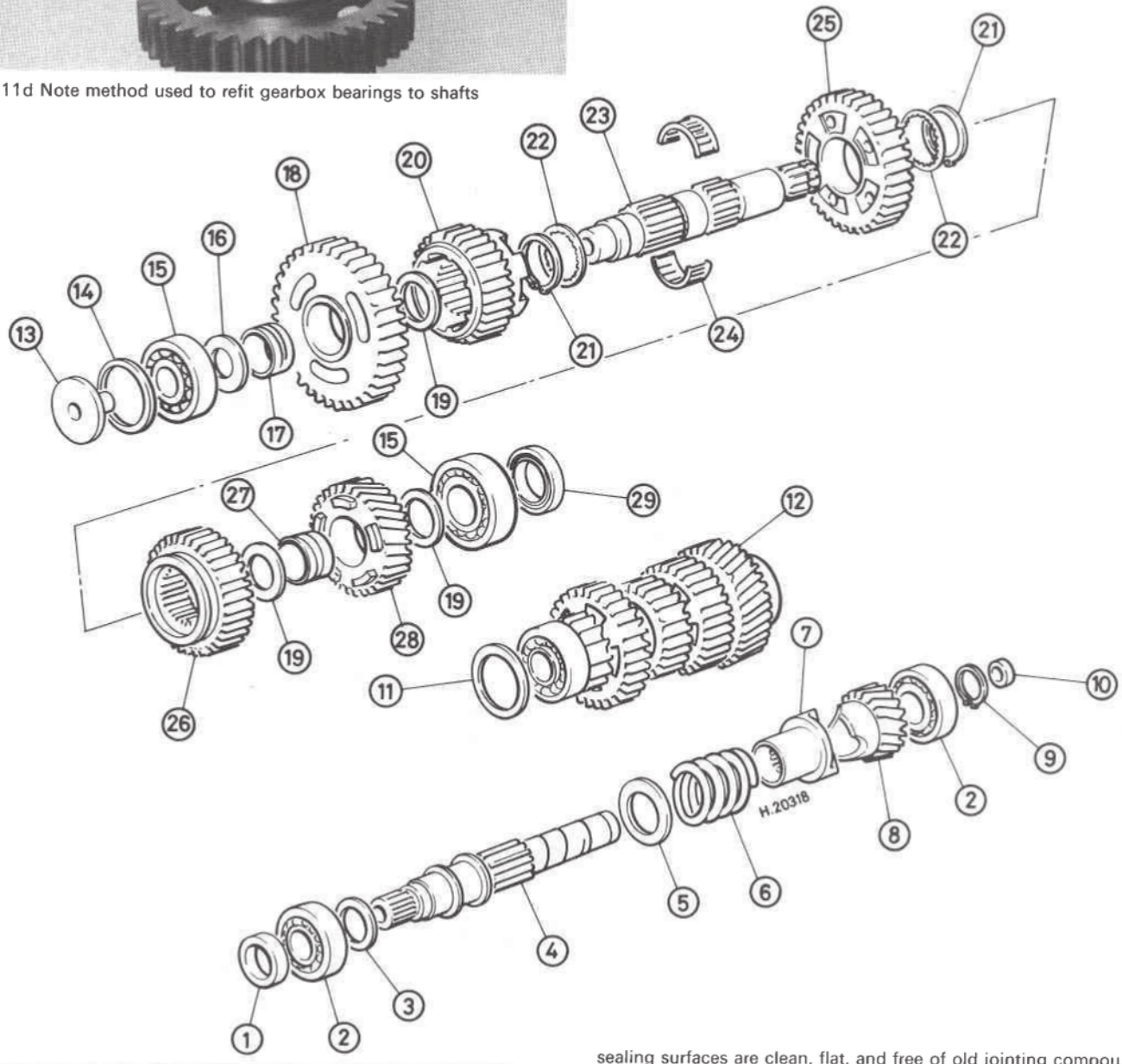
5.11c ... shim and shaft front bearing



5.11d Note method used to refit gearbox bearings to shafts

Fig. 3.2 Gearbox shafts

1 *Oil seal*
2 *Taper roller bearing – 2 off*
3 *Shim – as required*
4 *Input shaft*
5 *Spring seat*
6 *Coil spring*
7 *Shock absorber front cam*
8 *Shock absorber rear cam/drive gear*
9 *Circlip*
10 *Oil seal*
11 *Shim – as required*
12 *Layshaft assembly*
13 *Oil guide*
14 *Shim – as required*
15 *Ball bearing – 2 off*
16 *Shim*
17 *Bush*
18 *1st gear pinion*
19 *Shim – 3 off*
20 *4th gear pinion*
21 *Circlip – 2 off*
22 *Splined thrust washer – 2 off*
23 *Output shaft*
24 *Split needle roller bearing*
25 *2nd gear pinion*
26 *3rd gear pinion*
27 *Bush*
28 *5th gear pinion*
29 *Oil seal*



6 Gearbox: examination and renovation

1 Thoroughly clean all components removing all traces of dirt, corrosion, old oil and other foreign matter. Check that the front cover sealing surfaces are clean, flat, and free of old jointing compound.

2 Check the housing and front cover for cracks, damage or other faults such as damaged threads. Most faults of this sort can be repaired but such work is usually for the expert, a good authorised BMW dealer should be able to recommend such an expert, depending on the nature of the fault.

3 Examine each of the gear pinions to ensure there are no chipped, rounded or broken teeth and that the dogs on the ends of the pinions are not rounded. Worn dogs are a frequent cause of jumping out of gear; renewal of the pinions concerned is the only effective remedy. Check that the inner splines are in good condition and the pinions are not slack on the shafts. Bushed pinions require special attention in this respect, since wear will cause them to rock.
4 Check both the input and the output shafts for worn splines, damaged threads and other points at which wear may occur, such as the extremities which pass through the bearings. If signs of binding or local overheating are evident, check both shafts for straightness.
5 Examine the selector forks to ensure they are not twisted or badly worn. Wear at the fork end will immediately be obvious; check each claw end in conjunction with the groove with which it normally engages. Do not overlook the roller which engages with the selector drum groove; this is subject to wear.
6 **Note:** If any wear or damage is found on the selector drum, selector forks or the gearchange pedal arm, do not attempt any sort of repairs involving the use of heat. These components are made from a special light alloy which may well react strongly if heated excessively. It is recommended that all of these components are renewed if they are found to be worn or damaged.
7 Check the remaining selector components for damage or wear. Check that all are straight and that there is little or no wear at the various points of contact. Renew any worn or damaged component.
8 As previously stated, all oil seals should be renewed as a matter of course whenever they are disturbed.
9 Wash the bearings thoroughly in a high flash-point solvent. Do not pull bearings off their shafts if they can be cleaned and checked in place. Do not 'spin' a dry bearing. If any radial play is evident, or if the bearing feels rough when turned, it should be renewed. Examine the inner and outer races and the balls or rollers for damage. Renew any bearing that is showing the least sign of pitting or discoloration on any of its tracks or elements.
10 Any circlps that were disturbed during the course of dismantling should be examined closely and renewed if there is the slightest doubt about their condition. If any are a slack fit on their shafts they must be renewed as a matter of course.
11 Similarly the various springs in the selector mechanism should be renewed if there is any doubt about their condition. Unless they are actually damaged, in which case renewal should be automatic, it is difficult to assess whether springs are fatigued or not.

7 Checking and resetting the gearbox shafts endfloat and preload

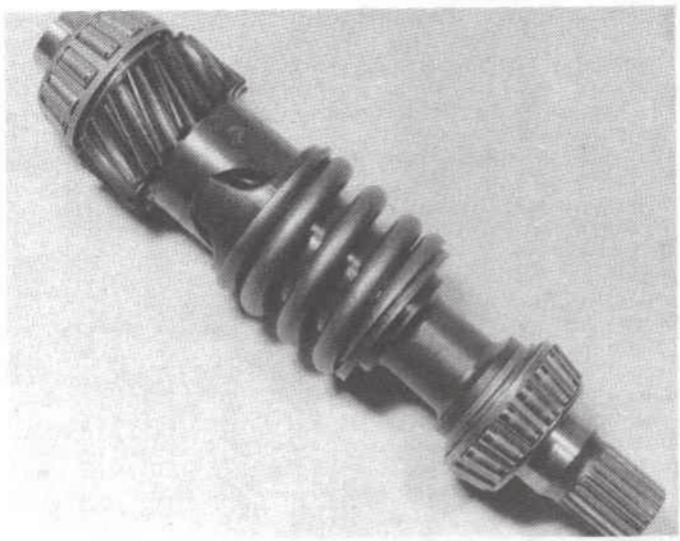
1 If any of the gearbox shafts are renewed, or if any of their bearings are renewed, the fit of the shafts in the gearbox must be checked and adjusted, if necessary, using shims.

Layshaft and output shaft

2 With the gearbox housing stripped and heated evenly, in an oven or similar, to approximately 100°C (212°F), check that each shaft is completely rebuilt and that its bearings are pressed as far on to the shaft as possible, then mesh the two together and install them in the housing. Tap each shaft firmly into place with a soft-faced mallet; the heated casing should ensure that the shaft rear bearings are fully and correctly seated.
3 Lay a straightedge across the housing mating surface next to the shafts and using a vernier caliper depth gauge or similarly accurate measuring device, measure the distance from the front edge of each shaft's front bearing outer race to the straightedge, ie the total amount each shaft projects beyond the gearbox housing mating surface; let this measurement be called dimension A.
4 Record this measurement for both shafts, then lay the straightedge across the front cover over the shaft front bearing housings. Measure the distance from the straightedge to the shoulder in each shaft's bearing housing against which the bearing outer race will locate; let this measurement be called dimension B.
5 For each shaft, subtract dimension A from dimension B to give the total amount of endfloat available for that shaft. Subtract the specified standard endfloat tolerance from this total to give the required thickness of shims.
6 Shims are available from BMW dealers in thicknesses of 0.30, 0.40 and 0.50 mm (0.0118, 0.0158 and 0.0197 in); use whatever number and combination of these that will reduce the endfloat as much as possible within the specified limits. Store the shims carefully with their respective shafts until reassembly.

Input shaft

7 Assemble the input shaft as described in Section 5 but do not yet fit the front bearing. Check that the rear bearing is correctly positioned against the circlip and that its outer race is pressed fully into the gearbox housing, then heat the front cover evenly, in an oven or similar, to approximately 100°C (212°F) and fit the front bearing outer race, ensuring that it is driven squarely into its housing to rest against the locating shoulder. Allow the cover to cool.
8 Fit the input shaft into the stripped housing and lay a straightedge across the housing mating surface next to the shaft. Use a vernier caliper depth gauge or similarly accurate measuring device to measure the distance from the straightedge to the shaft collar (the locating flange against which the shims and bearing will be fitted); let this measurement be dimension A.
9 Place the straightedge across the front cover mating surface over the shaft front bearing outer race and measure the distance from the straightedge to the rear edge of the outer race; let this measurement be dimension B.
10 Subtract dimension A from dimension B to give the total amount of endfloat available for the input shaft; let this be dimension C. However, since the input shaft must be **preloaded** (ie slightly compressed when the front cover is fitted) the required shim thickness is C **plus** the specified preload tolerance.
11 Shims are available from BMW dealers in thicknesses of 0.30, 0.40, 0.50, 1.42, 1.44, 1.46, 1.48 and 1.50 mm (0.0118, 0.0158, 0.0197, 0.0559, 0.0567, 0.0575, 0.0583 and 0.0591 in); use whatever number and combination of these that will preload the shaft as closely as possible within the specified limits. Fit the selected shims to the shaft and drive the bearing into place against them.
12 To check the preloading, assemble the shaft into the housing, lubricating its bearings with the specified oil, and refit the front cover, tightening its retaining screws to the specified torque wrench setting. The shaft oil seals must not be fitted yet or their drag may produce a false reading.
13 The amount of effort required to rotate the shaft can be measured with a friction gauge or with an extremely accurate spring balance attached to the end of a lever of known length from the shaft centre, ie the setting is correct if the pull required is in the range 0.13 – 0.38 lb measured at the end of a lever 1 ft from the shaft centre. If the setting proves to be incorrect, the measurements or calculations must have been faulty at some point and the operation must be repeated until the setting is correct.



7.11 Input shaft preload shims are fitted between bearing and shaft collar

8 Gearbox: reassembly

1 All components should be completely clean and renewed or repaired as necessary. All bearings or bearing inner races should be installed correctly on their respective shafts and all oil seals, oil guides and taper roller bearing outer races should be installed in the housing or front cover, as appropriate.
2 Refit the detent roller arm and secure it with its circlip, ensuring that its spring is fitted as shown in the accompanying photograph.
3 Refit the gearchange pedal to the shaft using the mark made on removal to ensure that the pedal is correctly positioned. Tighten the pinch bolt securely.
4 Fit the return spring and the locating plate to the selector lever as shown in the accompanying photograph and fit the assembly to the housing; do not forget the shim between the spring and the housing wall. Refit the two retaining circlips. Grease the gearchange pedal shaft and refit it, taking care not to damage the lips of the shaft oil seal. The shaft will fit only one way if the tapered grub screw is to lock it correctly to the selector lever; ensure that the two are correctly aligned, apply a few drops of Loctite 242 or similar thread-locking compound to the screw threads and refit it, tightening it securely. Use the torque wrench setting, where specified.
5 Fit the spacer and claw arm spring to the claw arm, ensuring that the spacer fits inside the spring loop. Fit the assembly to the claw arm mounting and secure it by refitting the pivot retaining circlip. Position the claw arm mounting and refit the guide rod and its circlip to retain it. Tap the gearbox breather sleeve into its orifice, but be careful not to drive it so far in that the black cap rests on the gearbox housing. Refit the black plastic cap to the breather sleeve.
6 Install the input shaft in its rear bearing; lubricate both bearings with the specified oil.
7 Lubricate their bearings, bearing surfaces and all other points of contact, then mesh together the gear pinions of the layshaft and output shaft assemblies and insert the two as a single unit. Rock the input shaft away from the layshaft until its bearing is clear of the layshaft gear pinion teeth. Press the layshaft and output shaft into position and straighten the input shaft.
8 Note that if the shaft bearings will not fit easily into the housing locations the housing must be heated evenly, in an oven or similar, to approximately 100°C (212°F) to permit this. If this is found to be necessary first remove all components which might be damaged by the heat and take great care to prevent any risk of personal injury when heating components or when handling heated components.
9 Check that all three shafts are free to rotate, then install the selector forks using the marks or notes made on dismantling to identify each fork and which way it is fitted. If no marks were made, proceed as follows:
10 The first fork to be refitted is to the output shaft 3rd gear pinion groove; this actually selects 5th gear and is the widest across the claw ends of the three forks. It is fitted with its guide pin towards the front of the gearbox housing; this will engage the selector drum rear groove.
11 The next fork selects 3rd and 4th gears and is fitted to the layshaft sliding gear pinion groove; its guide pin will engage the selector drum centre track. It is the narrowest across the claw ends and can be identified by its long neck. It is refitted with its guide pin towards the rear of the gearbox housing.
12 The last fork selects 1st and 2nd gears and is refitted with its guide pin towards the rear of the gearbox housing, to engage the selector drum front groove. Of medium width across the claw ends, it is fitted to the output shaft 4th gear pinion groove.
13 Swing all three forks as far as possible away from the selector drum and refit the separate roller to each fork's guide pin; retain the roller with a dab of grease.
14 Fit the five selector pins and the small locating pin to the selector drum front end, refit the selector cam aligning its keyway with the locating pin and insert the drum assembly, pressing back the claw arm to permit this.
15 Rotate the drum until the cam neutral detent recess is approximately in the 12 o'clock position from the drum centre, ie in the neutral position. Swing the forks back into contact with the drum, engaging each fork's guide pin roller in its respective drum groove. Lubricate and refit the selector fork shafts, ensuring that each is pressed fully home in its original location.
16 Ensuring that the correct number and thickness of shims are used, refit the output shaft and layshaft shims to their respective bearing housings in the front cover. Press the shims fully into place and use grease to retain them.
17 Referring to the accompanying photograph make up a stop from a suitably-sized rod (a convenient bolt was used for the photograph, with a flat ground on one side to ensure that it would not slip) or similar to hold the detent roller arm clear of the selector drum cam while the front cover is refitted. Apply a thin smear of Loctite 573 or similar jointing compound to the degreased mating surfaces. Make a final check that all components have been refitted and that all shafts are free to rotate.
18 BMW recommend that the front cover is heated evenly, in an oven or similar, to approximately 100°C (212°F) to permit refitting. This was found not to be necessary since the cover could be removed and refitted quite easily by hand. If it is necessary to heat the cover, take great care to avoid the risk of personal injury when heating components or when handling components that have been heated. Remember also to remove first components such as oil seals which will be damaged by the heat, and to place the shims on the bearings, not in the front cover bores.
19 Press the cover into place, then refit and tighten to the specified torque setting the cover retaining screws. Pull out the roller arm stop; a distinct click should be heard as the arm contacts the cam.
20 Rotating the input shaft, and if necessary the output shaft, check that the shafts rotate smoothly and that all gears can be selected with reasonable ease. If all is well, drift the locking plug into the small orifice drilled next to the detent roller arm pivot.
21 Refit the ball and spring of the neutral detent assembly, apply a few drops of Loctite 242 or a similar thread locking compound to its threads, and refit the neutral detent plug, tightening it to the specified torque wrench setting.
22 Refit any oil seals which have not yet been installed, and install the gear position indicator switch on the gearbox housing rear face; do not overtighten its retaining screws or the switch may crack. Position the switch carefully so that the cutaway section of the selector drum shaft aligns with that of the switch rotor.

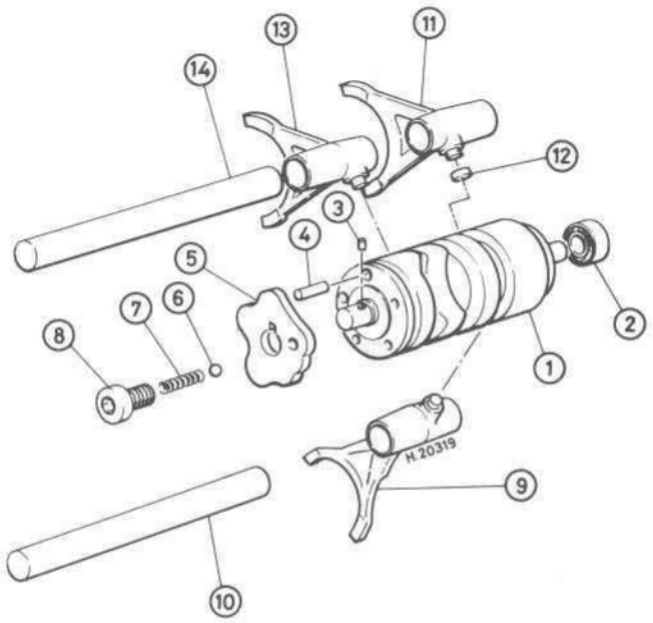


Fig. 3.3 Selector drum and forks

1 Selector drum
2 Oil seal
3 Locating pin
4 Selector pin – 5 off
5 Selector cam
6 Ball
7 Spring
8 Neutral detent plug
9 3rd/4th gear selector fork
10 Selector fork shaft
11 5th gear selector fork
12 Roller – 3 off
13 1st/2nd gear selector fork
14 Selector fork shaft

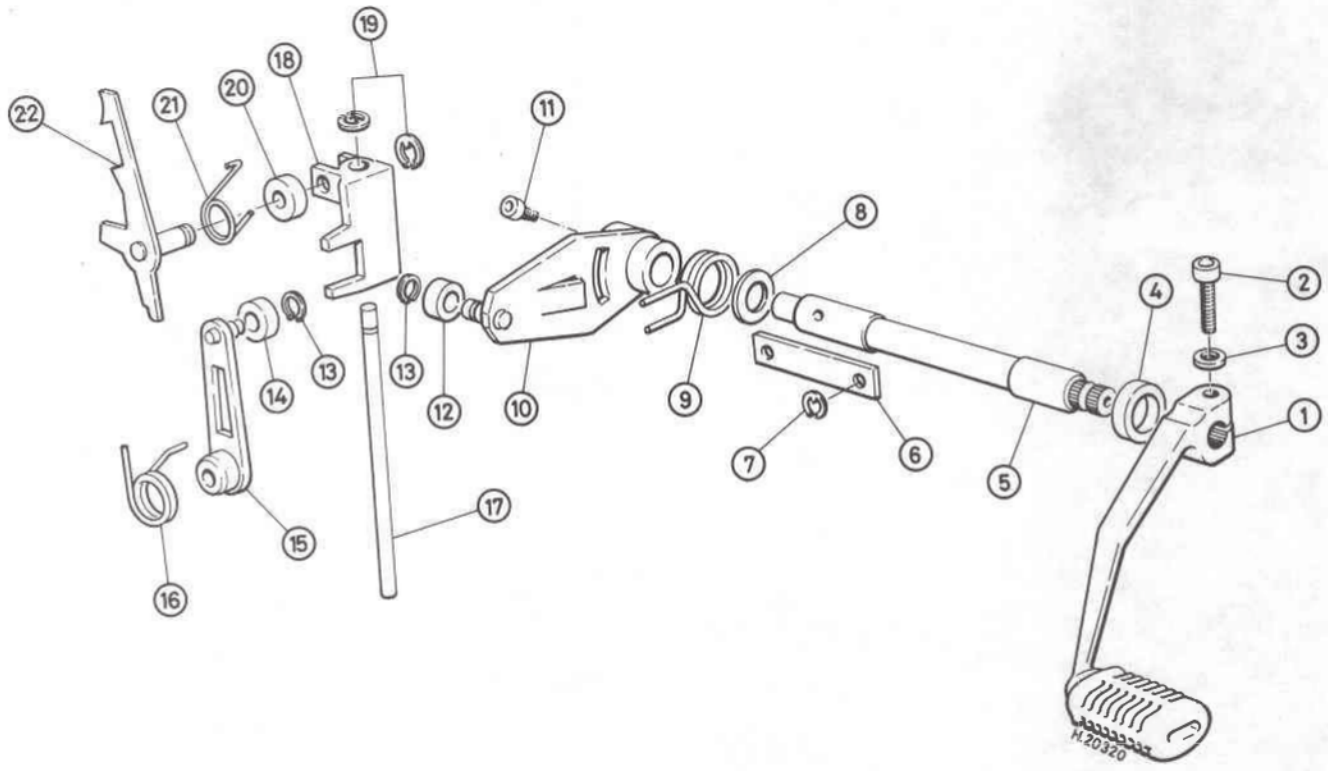
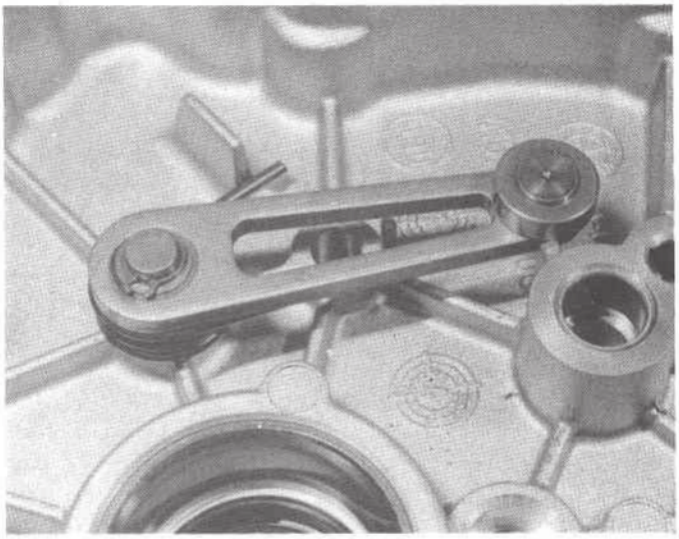
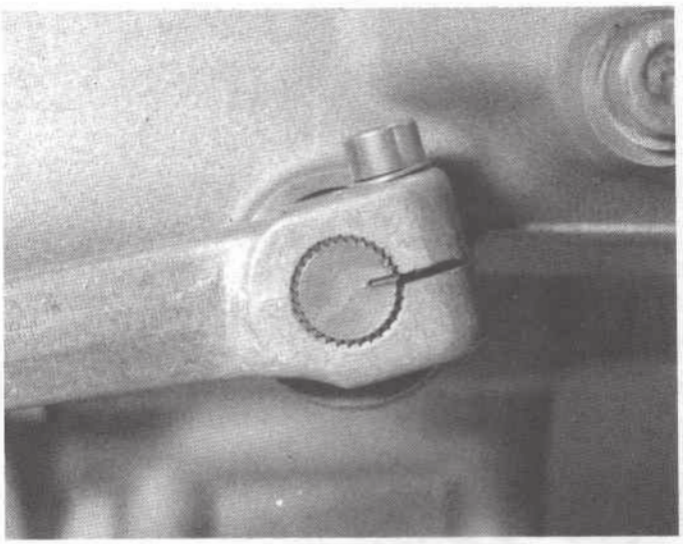


Fig. 3.4 Selector mechanism

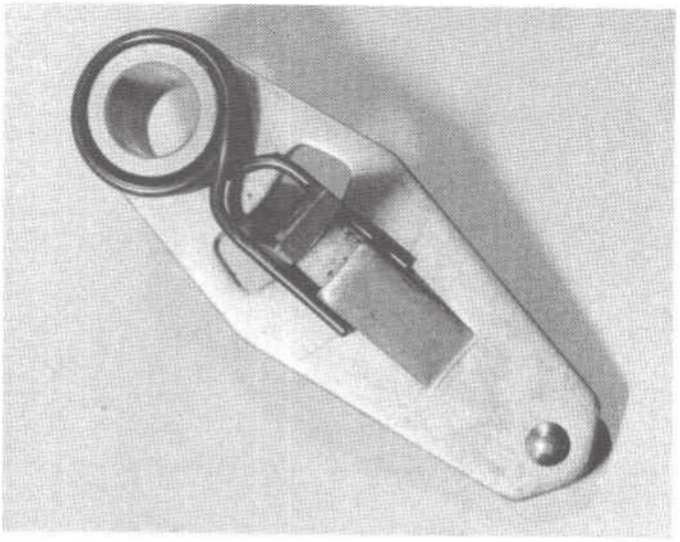
1 *Gearchange pedal*
2 *Pinch bolt*
3 *Wave washer*
4 *Oil seal*
5 *Gearchange pedal shaft*
6 *Locating plate*
7 *Circlip – 2 off*
8 *Shim*
9 *Gearchange return spring*
10 *Selector lever*
11 *Tapered grub screw*
12 *Roller*
13 *Circlip – 2 off*
14 *Roller*
15 *Detent roller arm*
16 *Detent spring*
17 *Guide rod*
18 *Claw arm mounting*
19 *Circlip – 2 off*
20 *Spacer*
21 *Spring*
22 *Selector claw arm*



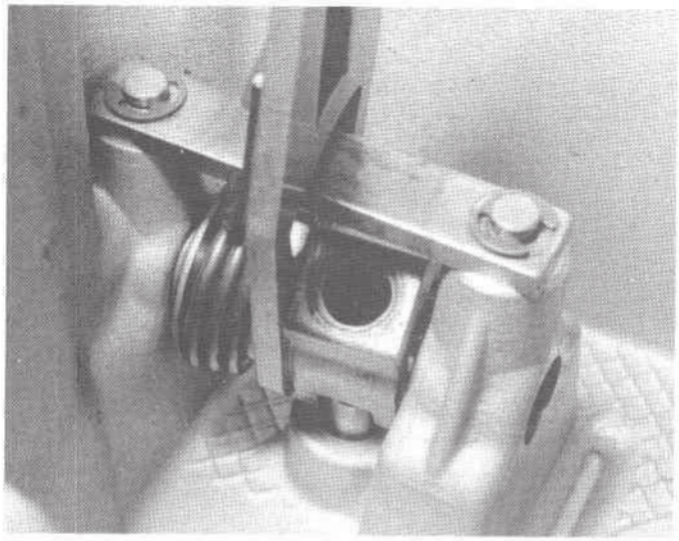
8.2 Refit detent roller arm with return spring as shown



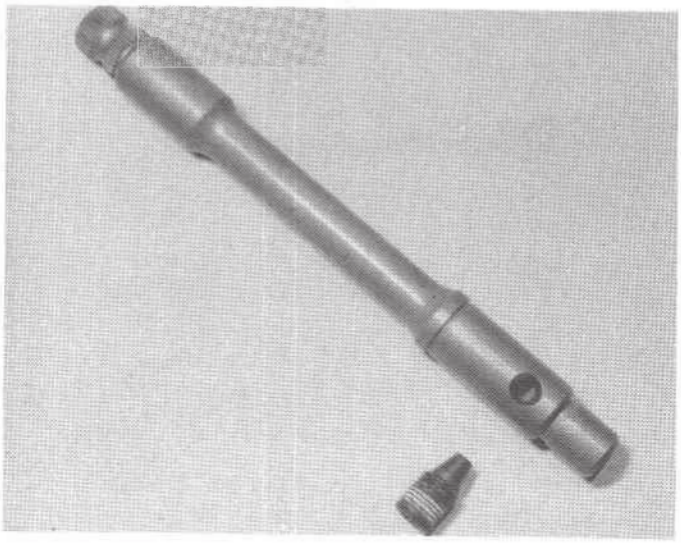
8.3 Mark made before removal will ensure gearchange pedal is refitted correctly to shaft



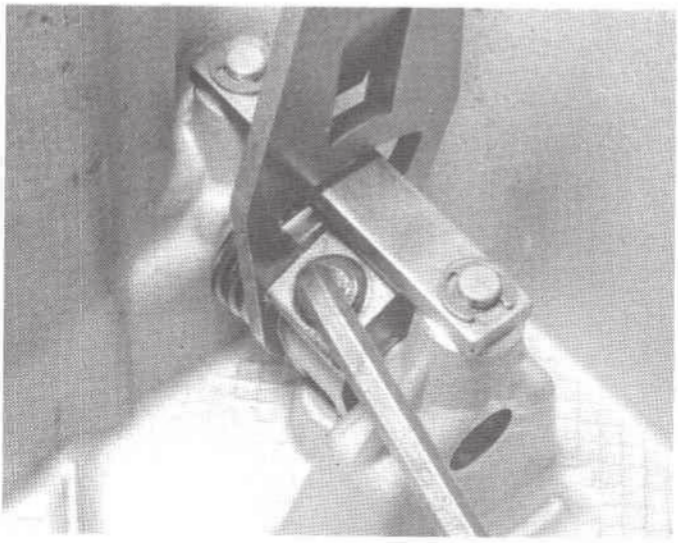
8.4a Fit selector lever return spring and locating plate to selector lever as shown



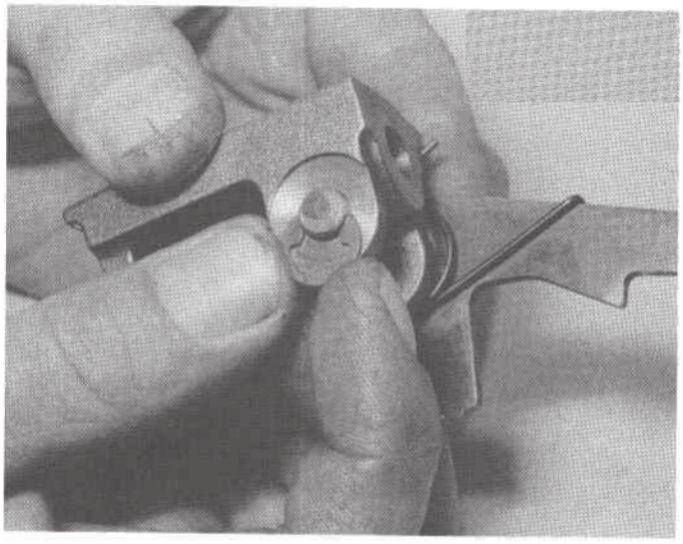
8.4b Note shim between selector lever assembly and housing wall



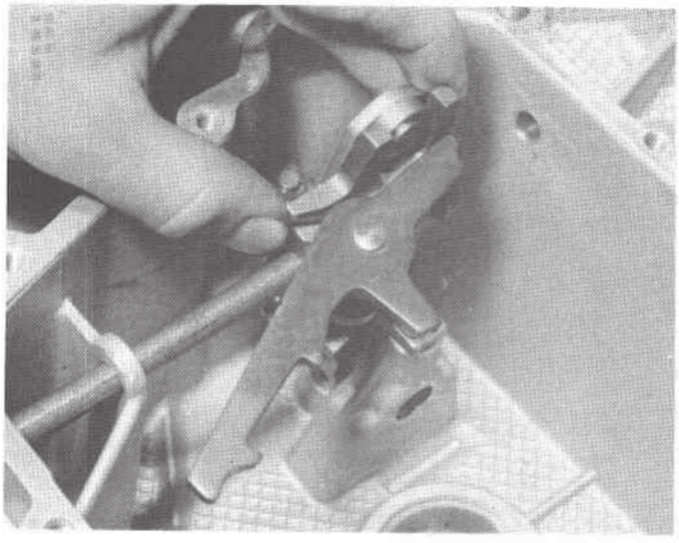
8.4c Gearchange pedal shaft will fit only one way – note tapered grub screw



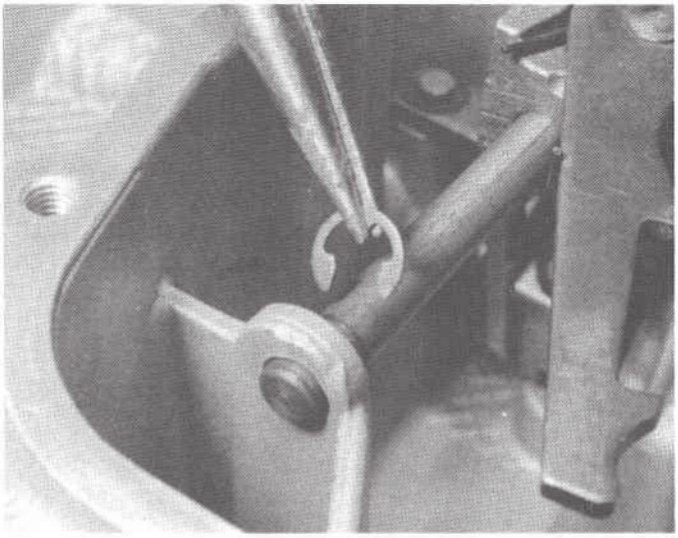
8.4d Tighten grub screw securely to retain gearchange pedal shaft – use thread locking compound



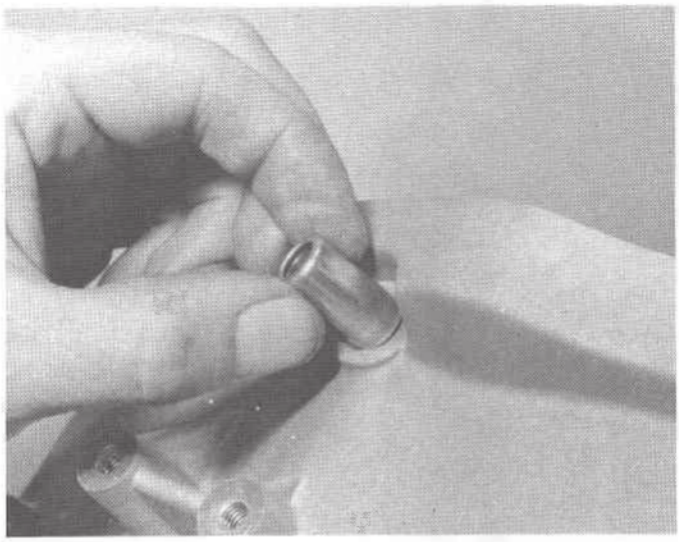
8.5a Fit claw arm spring and spacer to claw arm as shown – refit pivot retaining circlip to secure to claw arm mounting



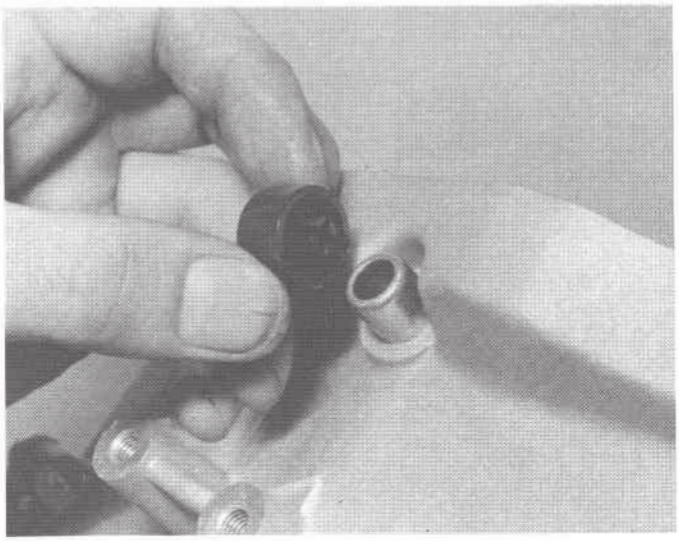
8.5b Position claw arm mounting as shown and refit guide rod ...



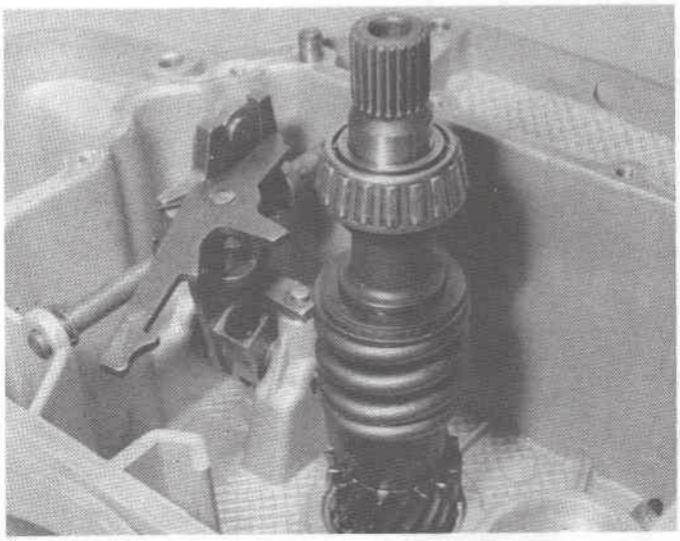
8.5c ... which is secured by a circlip



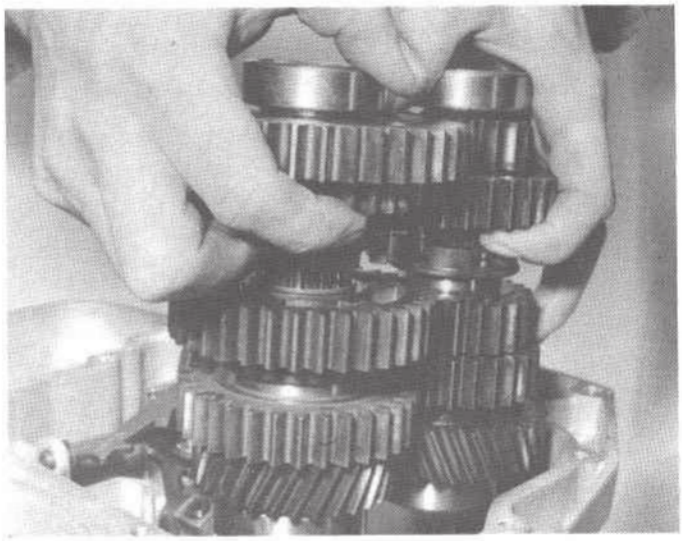
8.5d Breather sleeve must be carefully installed – see text ...



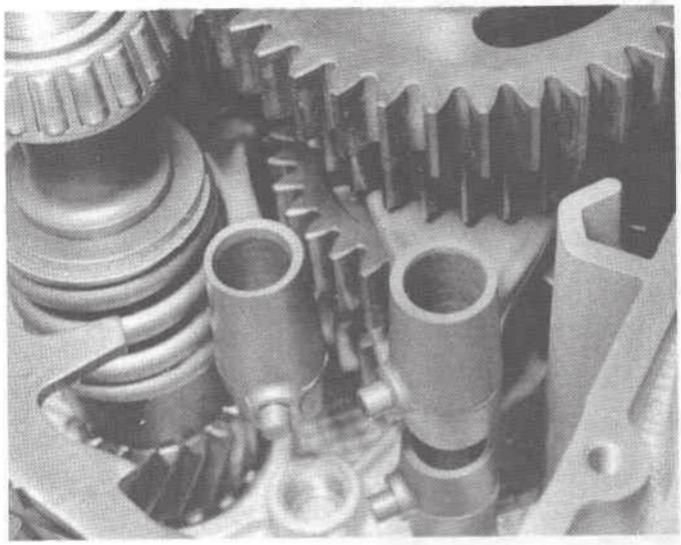
8.5e ... do not forget plastic breather cap



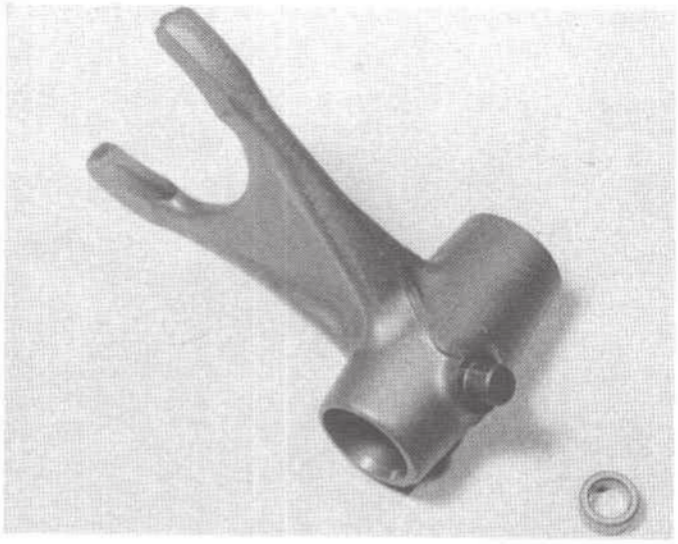
8.6 Lubricate bearings before installing input shaft



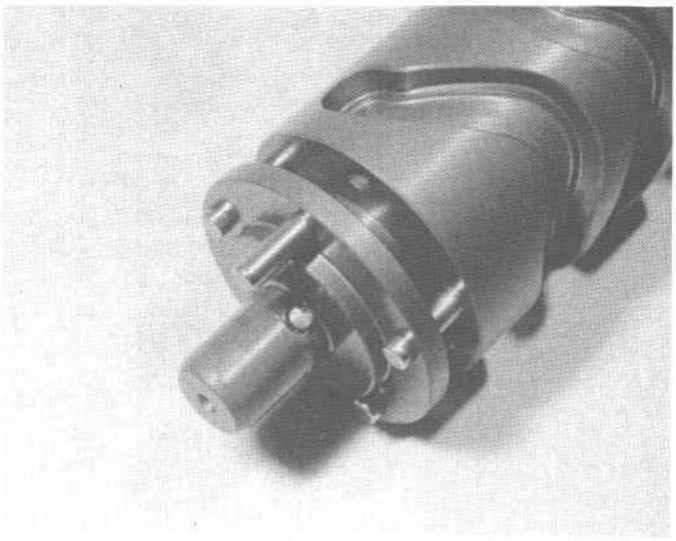
8.7 Layshaft and output shafts are installed as a single unit – lubricate thoroughly



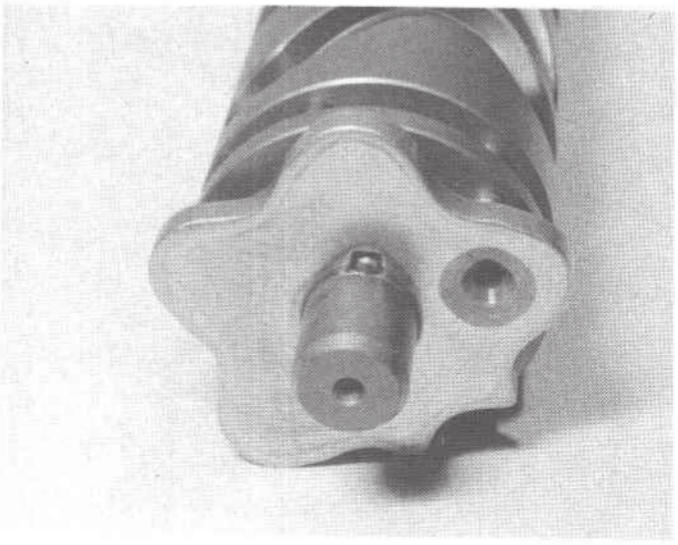
8.9 Fit selector forks as described in text



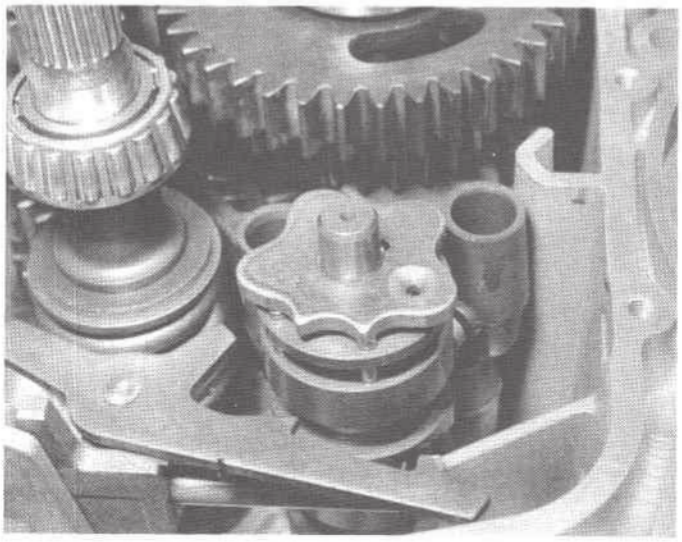
8.13 Do not forget roller fitted to each fork guide pin – use grease to retain while reassembling



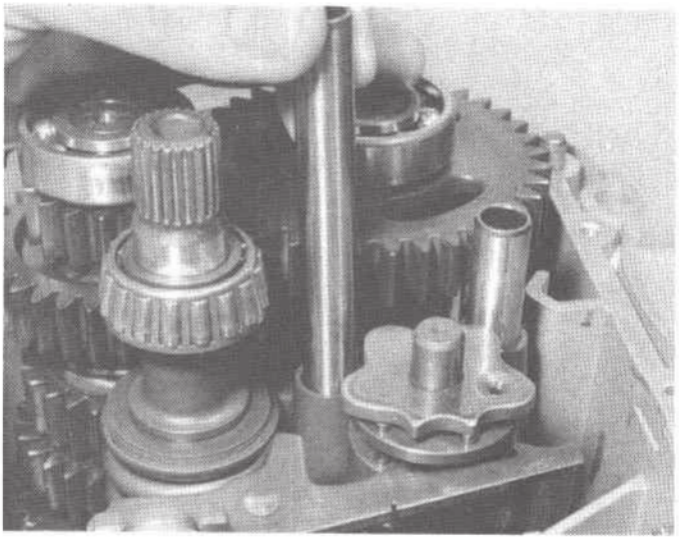
8.14a Fit selector pins and locating pin to drum front end ...



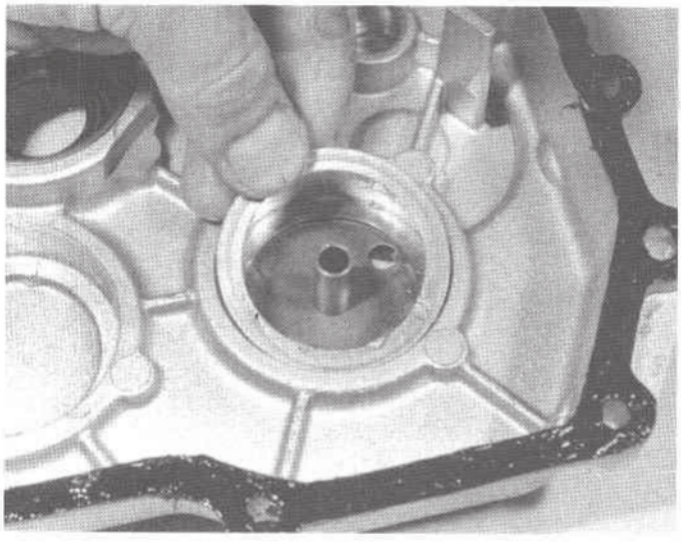
8.14b ... followed by selector cam – note neutral detent recess



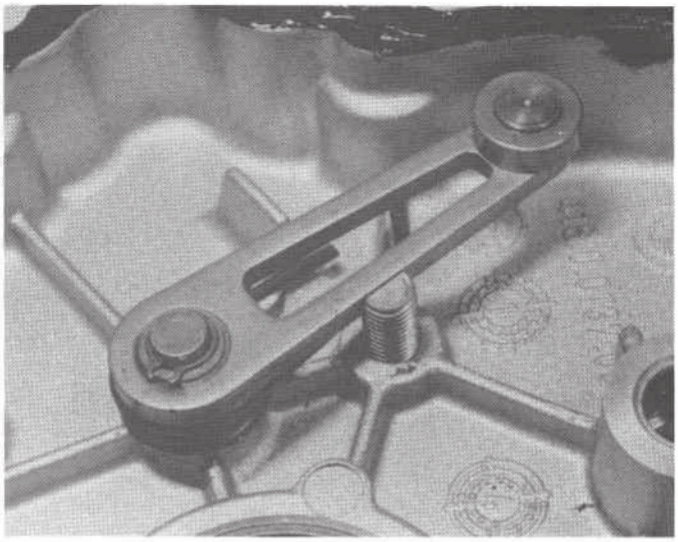
8.14c Press back claw arm to fit selector drum assembly



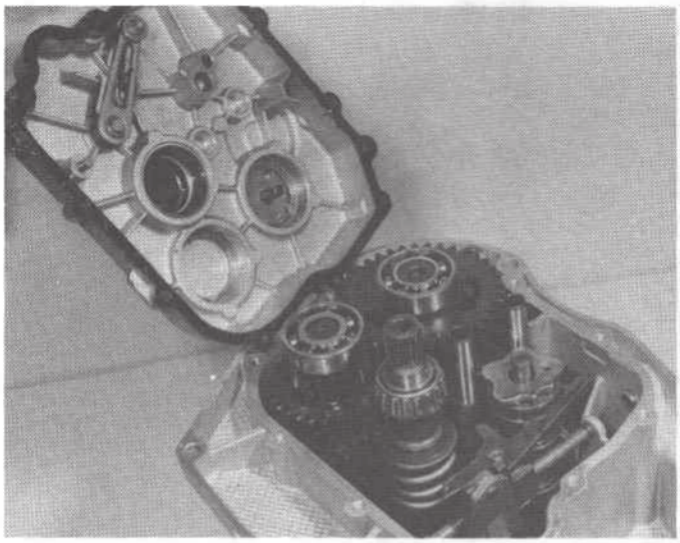
8.15 Rotate drum to neutral position as shown, align forks and refit fork shafts



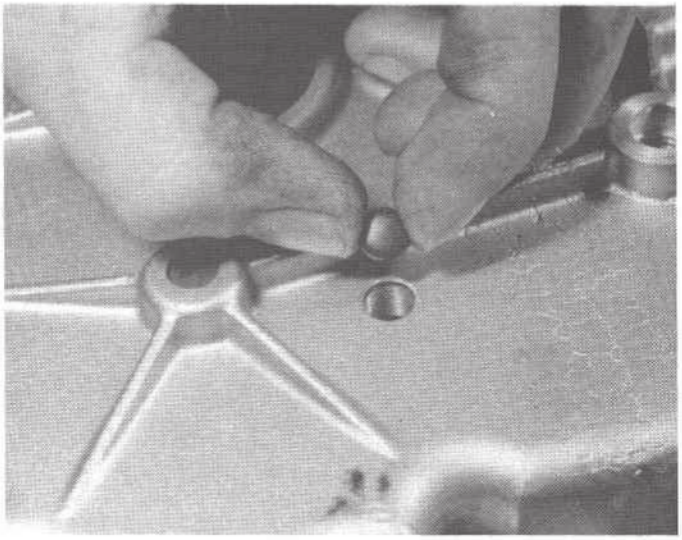
8.16 Unless cover is to be heated to refit, use grease to stick shims into bearing locations



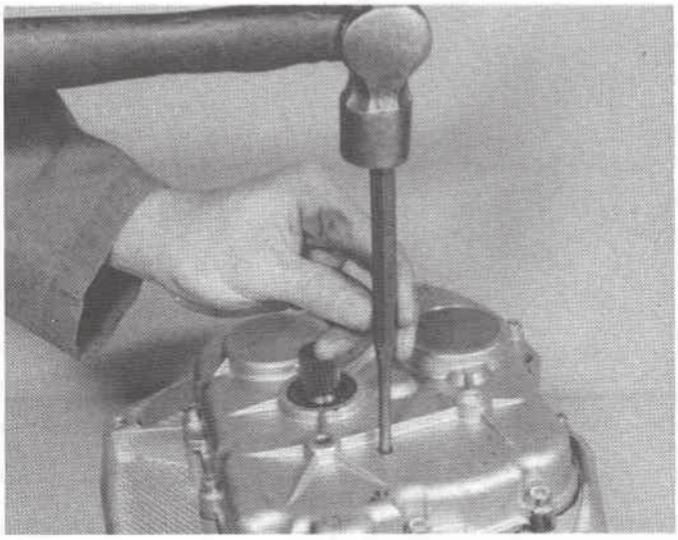
8.17a Note stop fabricated to retain detent arm clear of selector cam



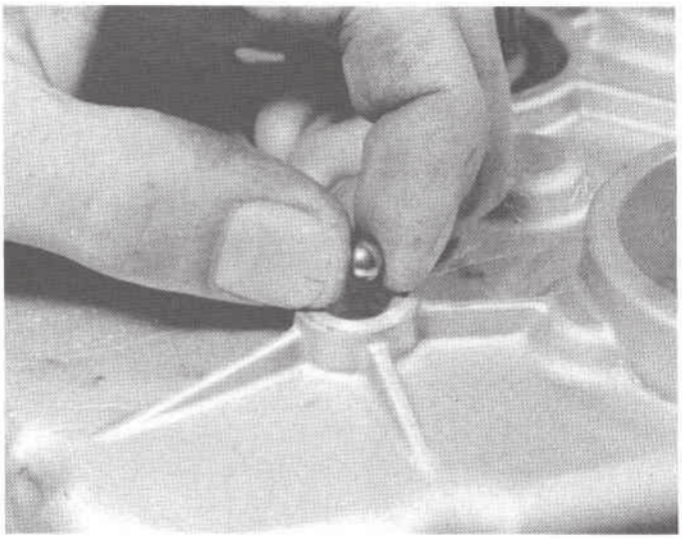
8.17b Check all components are correctly installed before refitting front cover



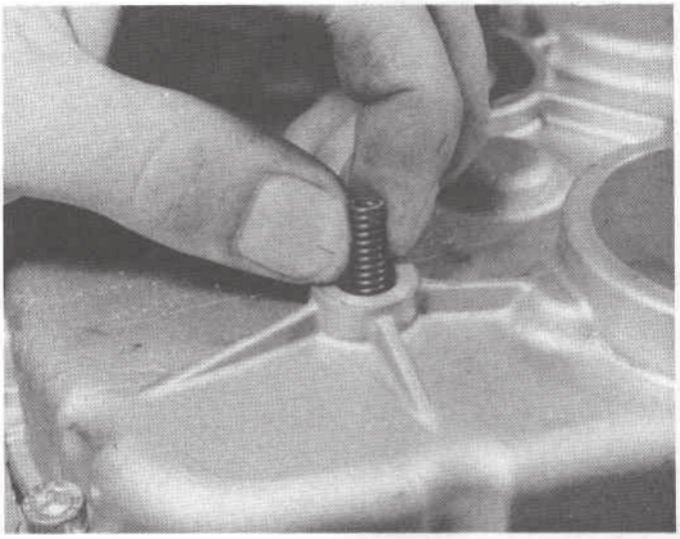
8.20a Insert locking plug into drilled orifice ...



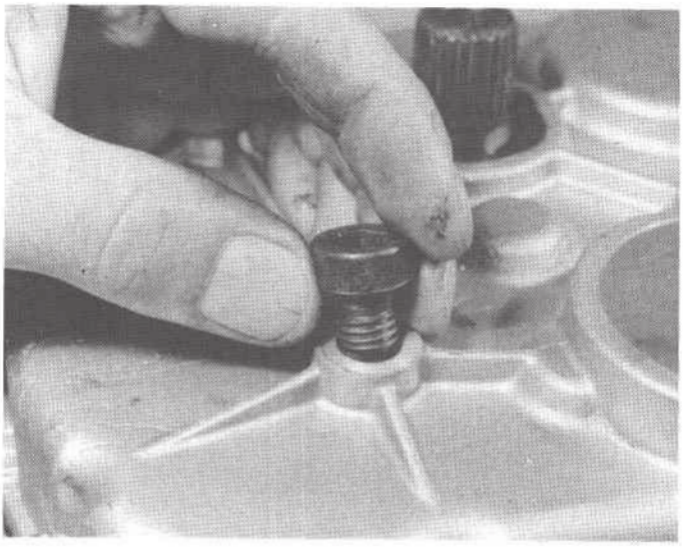
8.20b ... and secure with a hammer and drift



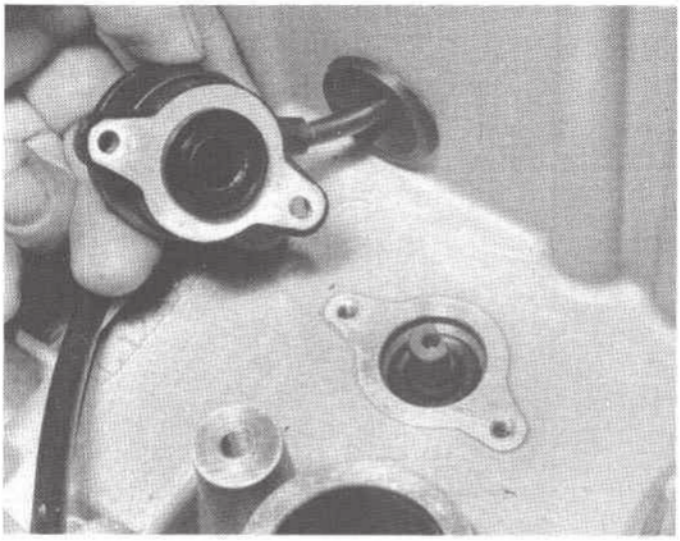
8.21a Refit neutral detent ball – drop into selector cam recess ...



8.21b ... followed by coil spring ...



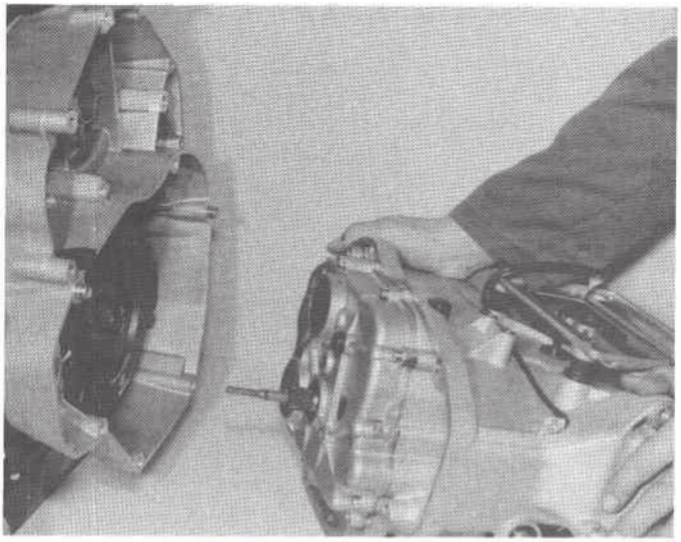
8.21c ... and plug – secure with thread locking compound



8.22 Ensure flat on selector drum rear end engages with switch rotor when refitting switch

9 Refitting the gearbox to the frame

1 If the gearbox has just been dismantled make a final check that all components have been refitted and secured correctly, that all shafts are free to rotate and that all gears can be selected with reasonable ease. On 75 models, and 100 models if required, lubricate and install the clutch pushrod. See Chapter 2.
2 Apply a thin coat of the specified lubricant to the splines of the clutch friction plate and the gearbox input shaft, also to the various components of the clutch release mechanism. See Chapter 2.
3 If any problems were encountered due to corrosion when separating the gearbox from the bellhousing, thoroughly clean the mating surfaces and dowels with a soft wire brush and apply a thin smear of grease to prevent corrosion in the future. Check that both dowels and the rubber fillet are refitted.
4 Offer up the gearbox to the rear of the engine, aligning the clutch/input shaft splines and the locating dowels. Although there should be no real difficulty in this, some manoeuvring may be required to get the splines to mate correctly; if necessary select top gear and rotate the output shaft back and forth to assist the input shaft in engaging.
5 When the gearbox is correctly installed, refit the six retaining Allen screws, tightening each to their specified torque setting, then refit the two gearbox/frame mounting Allen bolts and tighten them to the appropriate torque wrench settings.
6 Refit the stand assembly, tightening securely its four mounting Allen screws. Lower the centre stand and lower the complete machine until it is securely supported on the stand and front wheel. Refit the starter motor (see Chapter 10) and the clutch release mechanism components (see Chapter 2). Connect the clutch cable and adjust it as described in Routine Maintenance.
7 Working as described in Chapter 8, refit the swinging arm and final drive shaft, the final drive case and rear brake components and secure the rear suspension unit bottom mounting to the final drive case. Refit the footrest plates, the rear mudguard, the rear wheel and the number plate bracket.
8 Connect the rear brake operating rod (where appropriate), the speedometer impulse transmitter wire, the stop lamp rear switch wire and the gear position indicator switch wire.
9 Refit the exhaust system. See Chapter 5.
10 Refit the ignition HT coil and alternator covers and the battery and coolant expansion tank. Refit the fuel injection control unit and storage tray (see Chapter 5) followed by the seat and side panels.
11 Refill the gearbox with the specified amount and type of oil, then check the level. See Routine Maintenance.



9.2 Lubricate input shaft splines and clutch release on refitting – note locating dowels projecting from bellhousing rear face

Chapter 4 Cooling system

Contents

General description 1
Cooling system: draining 2
Cooling system: flushing 3
Cooling system: filling 4
Radiator: removal, cleaning and examination 5
Radiator pressure cap: testing 6
Hoses and connections: removal, refitting and checking for leaks 7
Thermostat: removal and testing 8
Water pump: removal, renovation and refitting 9
Cooling fan: removal, examination and refitting 10
Cooling system electrical components: removal and refitting 11

Specifications

Coolant	
Type	Distilled water with antifreeze
Recommended antifreeze	BMW-approved good quality long life antifreeze, glycol-based, with corrosion inhibitor, free from nitrides eg: Fricotin ICI 007 or 012 antifreeze Glycoshell P300 Hoechst Genantin VP 1719 BASF Glysantin G41/23
Mixture ratio:	
Standard (down to −28°C/−18°F)	60% water : 40% antifreeze
Alternative (down to −36°C/−33°F)	50% water : 50% antifreeze
Capacity overall:	
75 models	Approx 3.00 lit (5.3 Imp pint, 3.2 US qt)
100 models	Approx 3.25 lit (5.7 Imp pint, 3.4 US qt)
Capacity of individual components – approximate:	
Radiator – 75 models	2.50 lit (4.4 Imp pint, 2.6 US qt)
Radiator – 100 models	2.80 lit (4.9 Imp pint, 3.0 US qt)
Expansion tank	0.40 lit (0.7 Imp pint, 0.4 US qt)
Radiator	
Filler cap valve opens at	1.00 – 1.15 bar (14.5 – 16.7 psi) – approximately equal to temperature of 120°C (248°F)
Expansion tank	
Filler cap valve opens at	−0.1 bar (−1.5 psi)
Thermostat	
Opens at	85°C (185°F)
Fully open at	92°C (198°F)
Coolant overheat warning lamp	Lights at 111°C (232°F)

Torque wrench settings	75 models		100 models	
Component	**Nm**	**lbf ft**	**Nm**	**lbf ft**
Coolant drain plug	9 ± 1	6.5 ± 0.5	8.9	6.5
Water pump impeller:				
Early models – 8 mm nut	21 ± 2	15.5 ± 1.5	21	15.5
Late models – 8 mm bolt	33 ± 4	24 ± 3	33 ± 4	24 ± 3
Oil/water pump assembly mounting screws	7 ± 1	5 ± 0.5	N/Av	N/Av
Oil/water pump cover screws	7 ± 1	5 ± 0.5	N/Av	N/Av
Coolant pipe stub mounting screws	7 ± 1	5 ± 0.5	N/Av	N/Av
Radiator mounting bolt or nut	8 ± 1	6 ± 0.5	N/Av	N/Av

1 General description

The cooling system uses a water/antifreeze coolant to carry away excess energy produced in the form of heat. The cylinders are surrounded by a water jacket from which the heated coolant is circulated by thermo-syphonic action in conjunction with a water pump driven from the output shaft front end. The hot coolant passes upwards through the coolant pipe stub and top hose to the radiator which is mounted on the frame downtubes to take advantage of maximum air flow. The coolant then passes across the radiator core, where it is cooled by the passing air, through the thermostat and bottom hose and then to the water pump and engine where the cycle is repeated. A thermostatically-controlled electric fan is fitted behind the radiator to aid cooling. A wax pellet type thermostat is fitted in the system to prevent coolant flow through the radiator when the engine is cold, thereby accelerating the speed at which the engine reaches normal working temperature; coolant is routed instead from the coolant stub through a bypass hose to the thermostat housing and bottom hose.

The complete system is partially sealed and pressurised, the pressure being controlled by a valve contained in the spring loaded radiator cap. By pressurising the coolant to approximately 14.5 psi, the boiling point is raised, preventing premature boiling in adverse conditions. The overflow pipe from the radiator is connected to an expansion tank into which excess coolant is discharged by pressure. The expelled coolant automatically returns to the radiator, to provide the correct level when the engine cools again. A valve in the tank filler cap opens at the required level of outside pressure (relative to that inside the tank) to admit air as necessary.

2 Cooling system: draining

1 **Warning:** *to avoid the risk of personal injury such as scalding, the cooling system should be drained only when the engine and cooling system are* **cold**. *Note also that coolant will attack painted surfaces; wash away any spilled coolant immediately with fresh water.*

2 Place the machine on the centre stand so that it rests on level ground. To reach the radiator cap, the fuel tank and the radiator covers or fairing lower sections must be removed. Refer to Chapter 5.

3 If the engine is cold, remove the radiator cap by rotating it in an anticlockwise direction. If the engine is hot, having just been run, place a thick rag over the cap and turn it **slightly** until all the pressure has been allowed to disperse. A rag must be used to prevent escaping steam from causing scalds to the hand. If the cap were to be removed suddenly, the drop in pressure could allow the water to boil violently and be expelled under pressure from the filler neck. Apart from burning the skin the water/antifreeze mixture will damage paintwork. Where time and circumstances permit it is strongly recommended that a hot engine be allowed to cool before the cap is removed.

4 Place a receptacle below the front of the engine into which the coolant can be drained. The container must be of a capacity greater than the volume of coolant. Unscrew the drain plug underneath the water pump assembly. Allow the coolant to drain completely before refitting the drain plug. Note its specified torque setting. The coolant reservoir may be drained by removing it from the machine and tipping out the coolant.

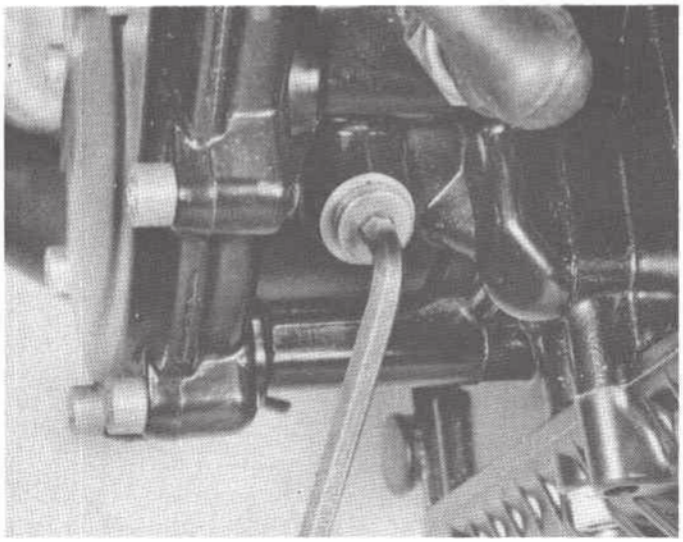
5 The manufacturer recommends that the coolant be renewed at regular intervals. (See Routine Maintenance.) If the coolant being drained is to be re-used, ensure that it is drained into a clean non-metallic container.

3 Cooling system: flushing

1 After extended service the cooling system will slowly lose efficiency, due to the build-up of scale, deposits from the water and other foreign matter which will adhere to the internal surfaces of the radiator and water channels. This will be particularly so if distilled water has not been used at all times. Removal of the deposits can be carried out easily, using a suitable flushing agent in the following manner.

2 After allowing the cooling system to drain, replace the drain plug and refill the system with clean water and a quantity of flushing agent. Any proprietary flushing agent in either liquid or dry form may be used, provided that it is recommended for use with aluminium engines. **Never** use a compound suitable for iron engines as it will react violently with the aluminium alloy. The manufacturer of the flushing agent will give instructions as to the quantity to be used.

3 Run the engine for ten minutes at operating temperature and drain the system. Repeat the procedure **twice** and then again using only clean cold water. Finally, refill the system as described in the next section.



2.4 Coolant drain plug is on underside of oil/water pump assembly

4 Cooling system: filling

1 Before filling the system, always check that the drain plug has been fitted and tightened and that the hose clips are tight.

2 The recommended coolant to be used in the system is made up of 40% corrosion-inhibited ethylene-glycol antifreeze suitable for use in aluminium engines and 60% distilled water; this gives protection against the coolant freezing in temperatures of down to −28°C (−18°F). An alternative mixture ratio of the same ingredients for lower temperatures is listed in the Specifications Section of this Chapter. To give adequate protection against wind chill factor and other variables, the coolant should always be prepared for temperatures −5°C (−9°F) lower than the lowest anticipated.

3 Use only good quality antifreeze of the type specified; never use alcohol-based antifreeze. In view of the small quantities necessary it is recommended that distilled water is used at all times. Against its extra cost can be set the fact that it will keep the system much cleaner and save the time and effort spent flushing the system that would otherwise be necessary. Tap water that is known to be soft, or rainwater caught in a non-metallic container and filtered before use, may be used in cases of real emergency only. Never use hard tap water; the risk of scale building up is too great.

4 So that a reserve is left for subsequent topping-up, make up approximately 3.5 litres (3.7 US qt/6.2 Imp pint) of coolant in a clean container. At the **standard** recommended mixture strength this will mean adding 2.1 litres (2.2 US qt/3.7 Imp pint) of distilled water to 1.4 litres (1.5 US qt/2.5 Imp pint) of antifreeze; do not forget to alter the ratio if lower temperatures are expected.

5 Having checked the system as described in the subsequent Sections of this Chapter, add the new coolant via the radiator filler neck. Pour the coolant in slowly to reduce the amount of air which will be trapped; then the level is up to the base of the filler neck, fill the

expansion tank to its upper level line. Refit the expansion tank filler cap.

6 Start the engine and allow it to idle until it has warmed up to normal operating temperature, with the temperature gauge needle (where fitted) giving its usual reading; the level in the radiator will drop as the coolant is distributed and the trapped air expelled. Add coolant as necessary. As soon as the thermostat opens, revealed by the sudden steady flow of coolant across the radiator and by a warm top hose, the level will drop again and more air will be expelled in the form of bubbles.

7 All trapped air must be expelled from the system before the radiator cap is refitted. When the level has stabilised for some time with the engine fully warmed up, and there are no more signs of air bubbles appearing, top the level up to the base of the filler neck and refit the radiator cap. Stop the engine, check that the expansion tank is topped-up to its upper level mark and refit the radiator shrouds, fairing components and side panels.

8 When the machine has been ridden for the first time after renewing the coolant and has cooled down, check the level again at the radiator cap to ensure that no further pockets of air have been expelled; top up if necessary. At all other times the coolant level should be checked at the expansion tank, as described in Routine Maintenance.

5 Radiator: removal, cleaning and examination

1 Drain the radiator as described in Section 2 of this Chapter. Remove the air intake hose.

2 Disconnect and remove the top, bottom, filler and bypass hoses from the radiator. Remove the radiator top mounting bolt or nut, withdrawing the insulating material (where fitted) to reach it.

3 Tilt the radiator forwards, disconnect the fan motor lead at its connector and withdraw the radiator.

4 Inspect the radiator mounting rubbers for perishing or compaction. Renew the rubbers if there is any doubt as to their condition. The radiator may suffer from the effect of vibration if the isolating characteristics of the rubber are reduced.

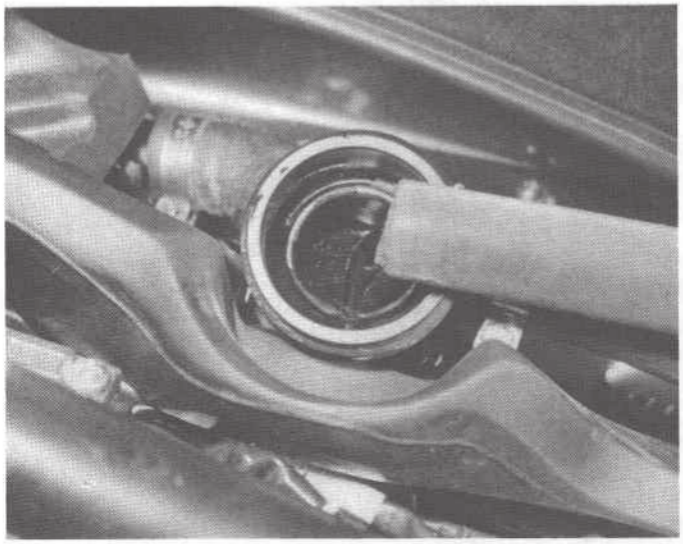
5 Remove any obstructions from the exterior of the radiator core, using an air line. The conglomeration of moths, flies, and road dust usually collected in the radiator matrix severely reduces the cooling efficiency of the radiator.

6 The interior of the radiator can most easily be cleaned while the radiator is on the motorcycle, using the flushing procedure described in Section 3 of this Chapter. Additional flushing can be carried out by placing a hose in the filler neck and allowing the water to flow through for about ten minutes. Under no circumstances should the hose be connected to the filler neck mechanically as any sudden blockage in the radiator outlet would subject the radiator to the full pressure of the mains supply (about 50 psi). The radiator should not be tested to greater than 17 psi.

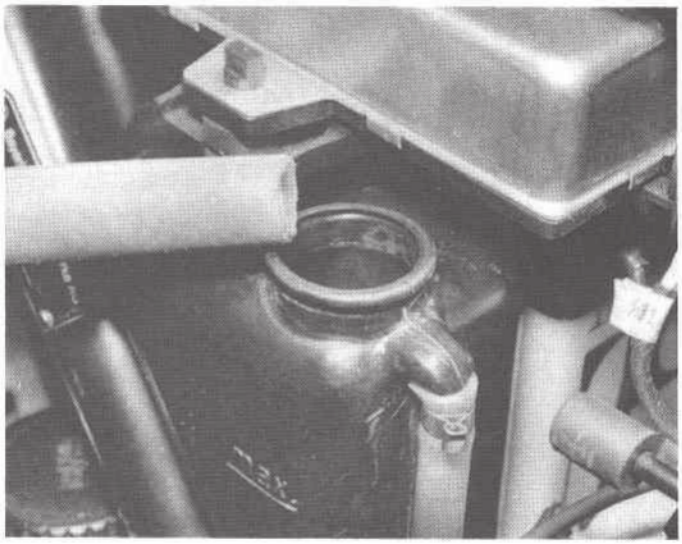
7 Bent fins can be straightened, if care is exercised, using two screwdrivers. Badly damaged fins cannot be repaired; a new radiator will have to be fitted if bent fins obstruct the air flow more than about 20%.

8 Generally, if the radiator is found to be leaking, repair is impracticable and a new component must be fitted. Very small leaks may sometimes be stopped by the addition of a special sealing agent in the coolant. If an agent of this type is used, follow the manufacturers instructions very carefully. Soldering, using soft solder, may be effective for caulking large leaks but this is a specialist repair best left to experts.

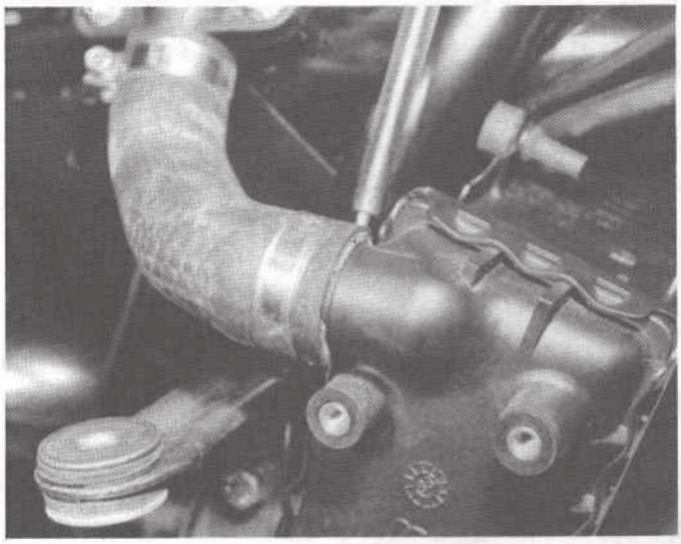
9 Refitting is a reversal of the removal procedure. Ensure that the radiator is settled securely on its mountings before tightening the mounting bolt and that the electrical lead and all hoses are correctly secured.



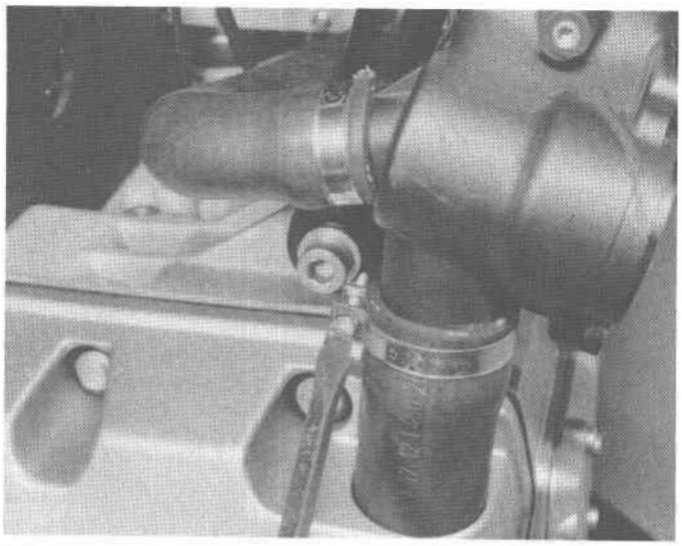
4.5 Refill cooling system at radiator filler after draining ...



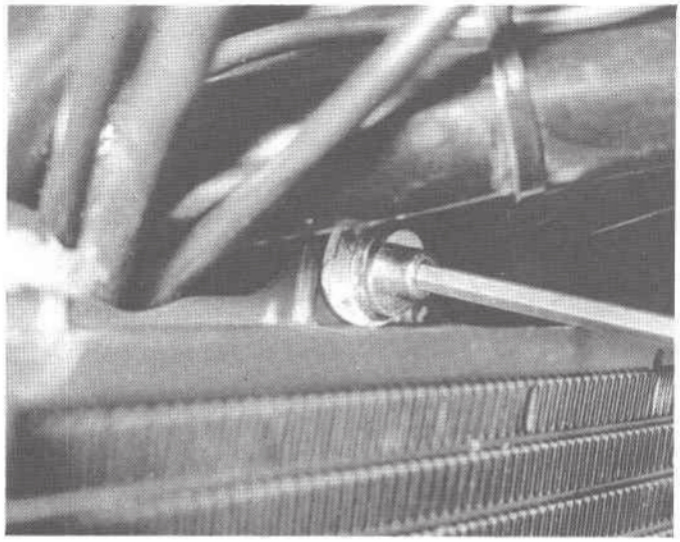
4.8 ... and top up at expansion tank afterwards



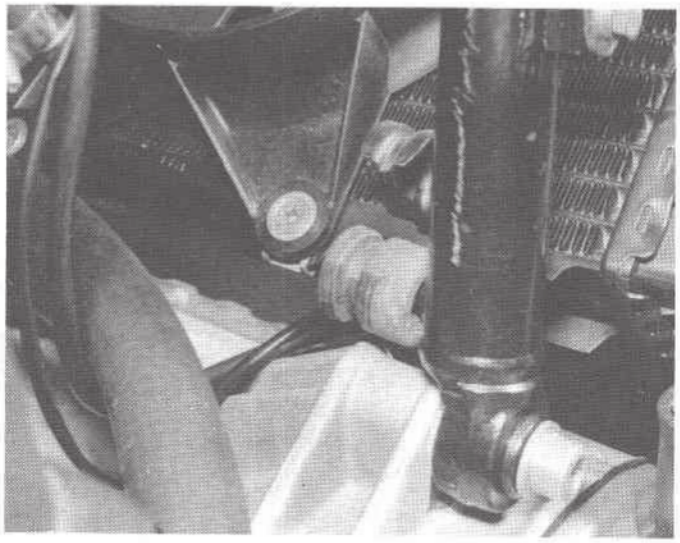
5.2a Disconnect radiator filler and top hoses ...



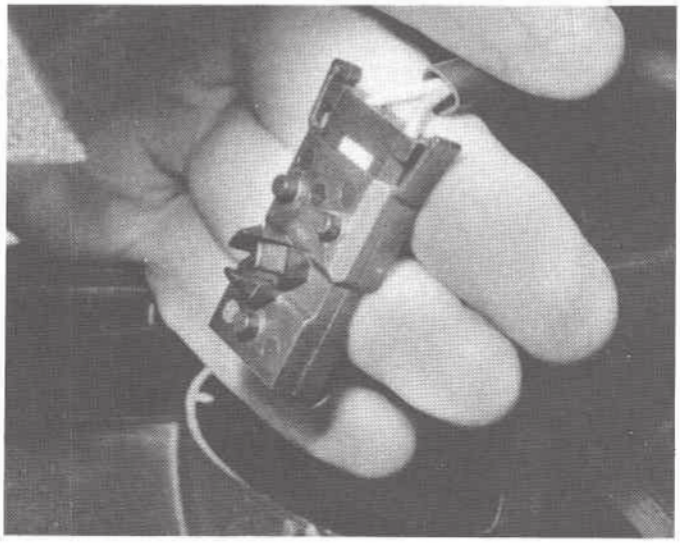
5.2b ... followed by bypass and bottom hoses ...



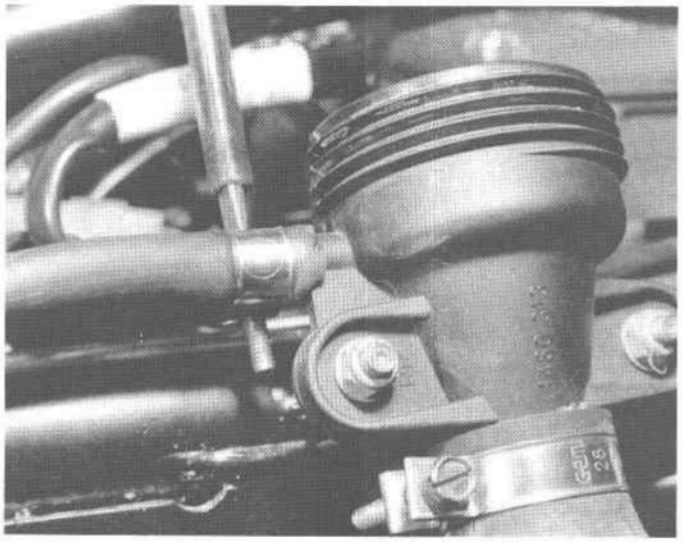
5.2c ... then release radiator top mounting bolt or nut



5.3a Tilt radiator forwards on bottom mountings ...



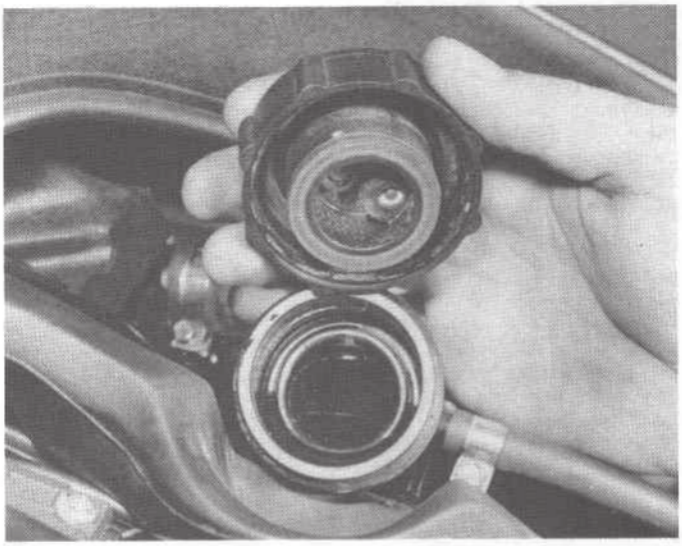
5.3b ... until fan motor lead can be disconnected



5.9 Check all hose clamps are tight on refitting

6 Radiator pressure cap: testing

1 If the valve or valve spring in the radiator cap becomes defective the pressure in the cooling system will be reduced, causing boiling over.
2 If the radiator cap is suspect, have it tested by an authorised BMW dealer. This job requires specialist equipment and cannot be done at home. The only alternative is to try a new cap since the cap has a screw thread fixing which means that most normal testing equipment cannot be applied to it unless an adapter can be devised.
3 The BMW tool is number 17 0 500 and is connected using a suitable connector/adapter. A specified pressure is applied, which must be held for at least 6 seconds; above this the cap valve will open. If it sticks or opens too early the complete cap must be renewed. Note that the cap gaskets are available separately and must be renewed if damaged or worn.
4 It should be noted that when tracing an elusive leak the entire cooling system can be pressurised to its normal operating pressure by connecting the test equipment described above to the radiator filler orifice. Remove the radiator cap, check the coolant level, topping it up if necessary, and apply a pressure of no more than 17 psi (1.15 bar) by means of the hand-operated plunger. Any leaks should soon become apparent. Most leaks will, however, be readily apparent due to the tell-tale traces of antifreeze left on the components in the immediate area of the leak.



6.1 Radiator filler cap can be tested only using special equipment

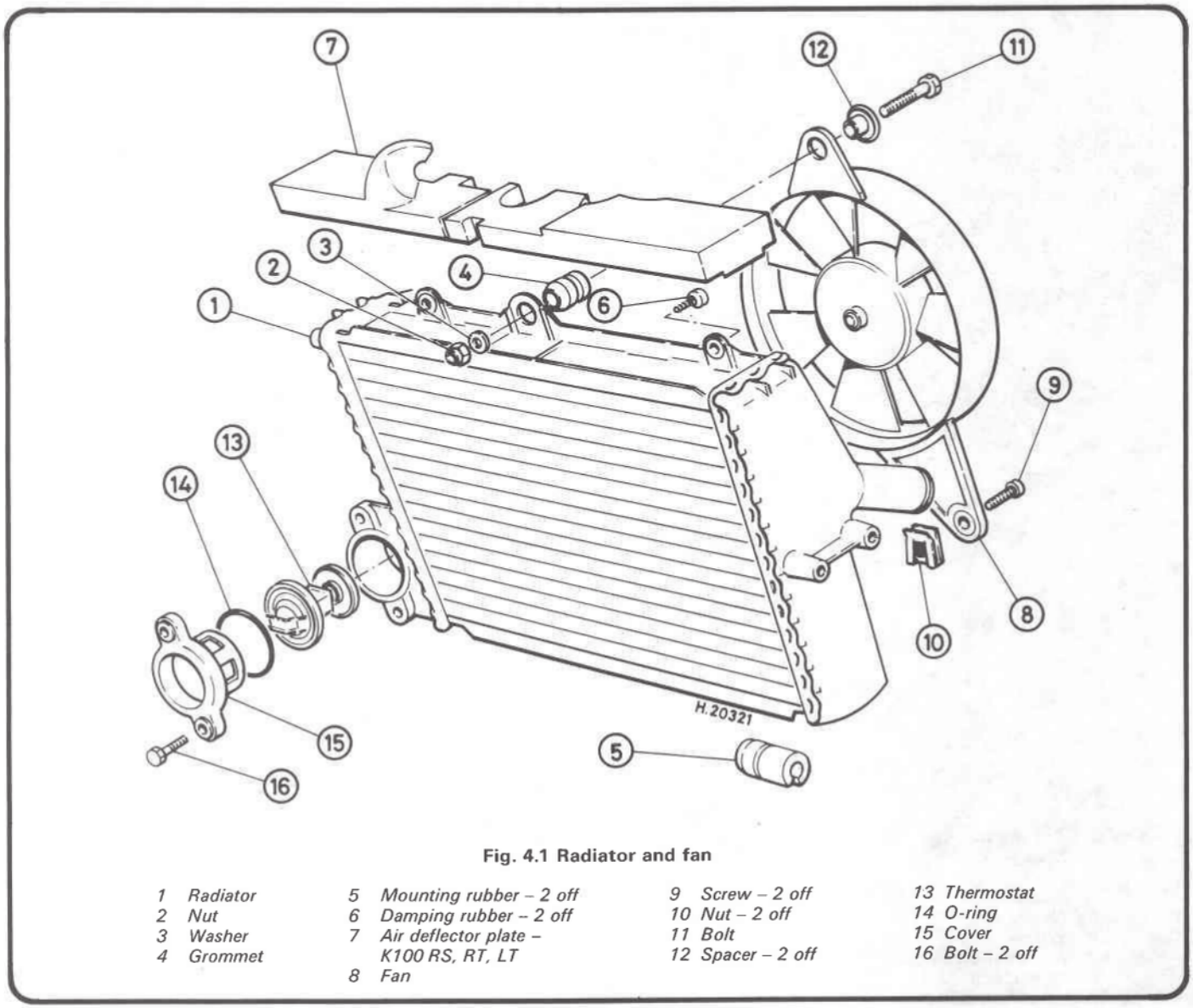


Fig. 4.1 Radiator and fan

1 *Radiator*
2 *Nut*
3 *Washer*
4 *Grommet*
5 *Mounting rubber – 2 off*
6 *Damping rubber – 2 off*
7 *Air deflector plate – K100 RS, RT, LT*
8 *Fan*
9 *Screw – 2 off*
10 *Nut – 2 off*
11 *Bolt*
12 *Spacer – 2 off*
13 *Thermostat*
14 *O-ring*
15 *Cover*
16 *Bolt – 2 off*

7 Hoses and connections: removal, refitting and checking for leaks

1 The radiator is connected to the engine unit by three flexible hoses, there being an additional hose between the coolant pipe stub and the thermostat housing. The hoses should be inspected periodically and renewed if any sign of cracking or perishing is discovered. The most likely area for this is around the clips which secure each hose to its unions. Particular attention should be given if regular topping up has become necessary. The cooling system can be considered to be a semi-sealed arrangement, the only normal coolant loss being minute amounts through evaporation in the expansion tank. If significant quantities have vanished, it must be leaking at some point and the source of the leak should be investigated promptly.

2 To disconnect the hoses, use a screwdriver to slacken the clamps then slide them along the hose clear of the union spigot. Carefully work the hose off its spigots, noting that it may be necessary to slacken, or remove fully, the radiator mounting bolt to provide room to manoeuvre. The hoses can be worked off with relative ease when new, or when hot; do not, however attempt to disconnect the system when it is hot as there is a high risk of personal injury through contact with hot components or coolant.

3 **Warning:** *the radiator hose unions are fragile;* **do not use excessive force** *when attempting to remove the hoses.* If a hose proves stubborn, try to release it by rotating it on its unions before attempting to work it off. If all else fails, cut the hose with a sharp knife then slit it at each union so that it can be peeled off in two pieces. While expensive, this is preferable to buying a new radiator.

4 Serious leakage will be self-evident, though slight leakage can be more difficult to spot. It is likely that the leak will only be apparent when the engine is running and the system is under pressure, and even then the rate of escape may be such that the hot coolant evaporates as soon as it reaches the atmosphere, although traces of antifreeze should reveal the source of the leak in most cases. If not, it will be necessary to use testing equipment, as described in the previous Section, to pressurise the cooling system when cold, thereby enabling the source of the leak to be pinpointed. To this end it is best to entrust this work to

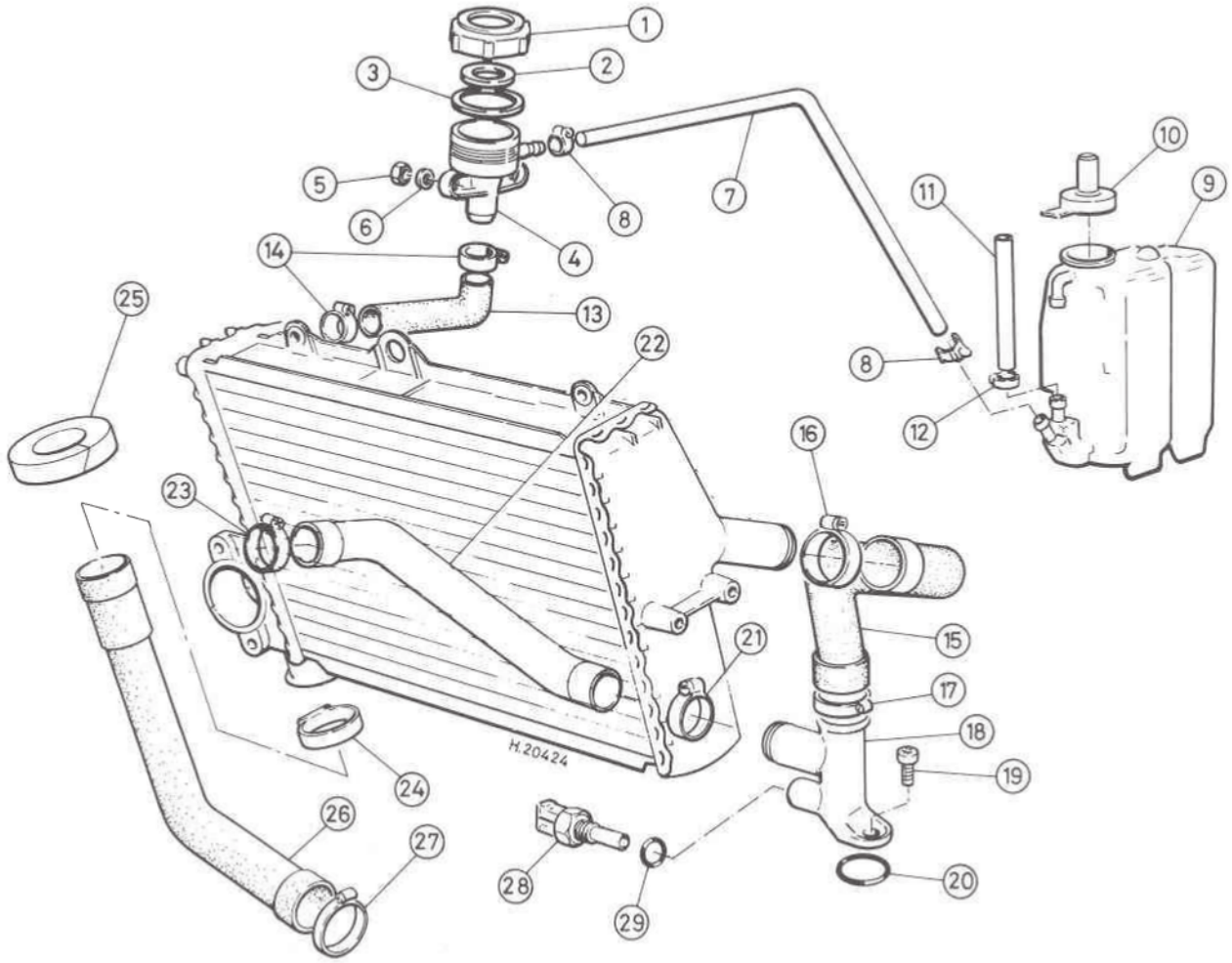


Fig. 4.2 Cooling system hoses

1 *Radiator filler cap*
2 *Sealing ring*
3 *Sealing ring*
4 *Coolant filler*
5 *Nut*
6 *Washer*
7 *Expansion tank hose*
8 *Hose clamp – 2 off*
9 *Expansion tank*
10 *Expansion tank filler cap*
11 *Level tube*
12 *Hose clamp*
13 *Filler hose*
14 *Hose clamp – 2 off*
15 *Top hose*
16 *Hose clamp*
17 *Hose clamp*
18 *Coolant pipe stub*
19 *Screw – 2 off*
20 *O-ring*
21 *Hose clamp*
22 *Bypass hose*
23 *Hose clamp*
24 *Hose clamp*
25 *Damping rubber*
26 *Bottom hose*
27 *Hose clamp*
28 *Temperature sender unit*
29 *Sealing ring*

an authorised BMW dealer who will have access to the necessary equipment.

5 In very rare cases the leak may be due to a broken head gasket in which case the coolant may be drawn into the engine and expelled as vapour in the exhaust gases. If this proves to be the case it will be necessary to remove the cylinder head for investigation.

6 Other possible sources of leakage are the O-rings sealing the water pump body/crankcase joint or the joint between the crankcase upper and lower sections, the mechanical seal and the O-ring sealing the coolant stub union. All these should be investigated and any leaks rectified by tightening the retaining screws, where applicable, or by renewing any seals which are worn or damaged.

7 On refitting hoses, first slide the clamps on to the hose and then work it on to its respective spigots. **Do not** use lubricant of any type; the hose can be softened by soaking it in boiling water before refitting, although care is obviously required to prevent the risk of personal injury when doing this. When the hose is fitted, rotate it to settle it on its spigots and check that the two components being joined are securely fastened so that the hose is correctly fitted before its clamps are slid into position and tightened securely.

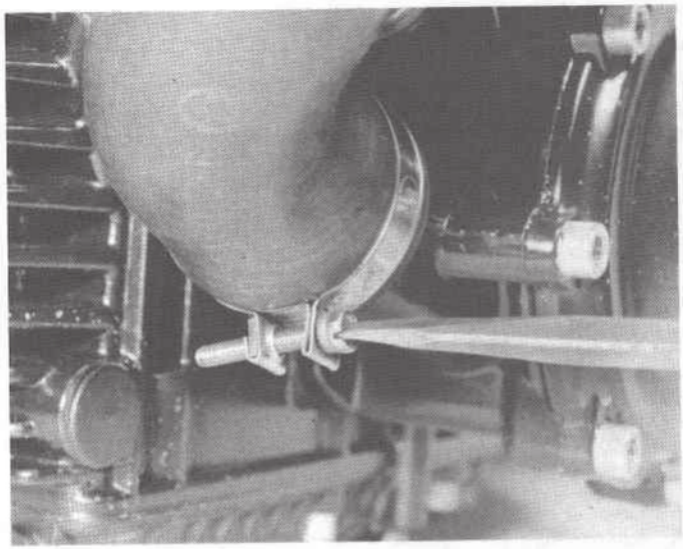
8 Thermostat: removal and testing

1 The thermostat is so designed that it remains in the closed position when it is in a normal cold condition. If the thermostat malfunctions, it will remain closed even when the engine reaches normal working temperature. The flow of coolant will be impeded so that it does not pass through the radiator for cooling and consequently the temperature will rise abnormally, causing boiling over.

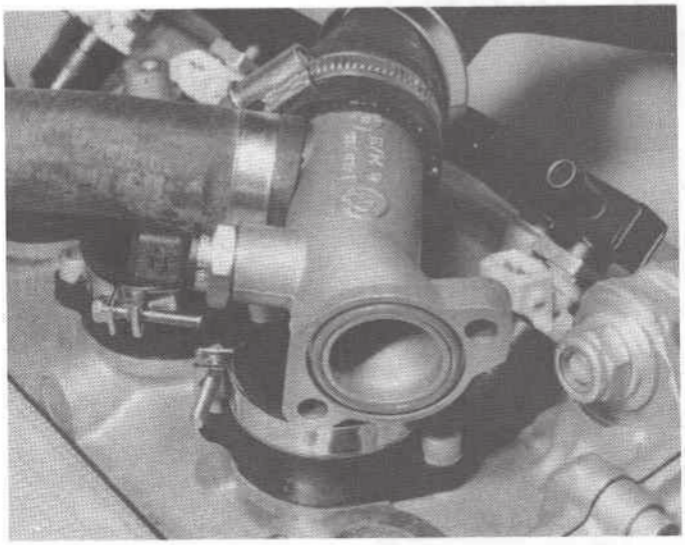
2 If the performance of the thermostat is suspect, remove it from the machine as follows and test it for correct operation. Remove the fuel tank and drain the coolant as described in Section 2. Remove its two retaining screws and withdraw the thermostat cover, noting how the sealing O-ring is fitted. Withdraw the thermostat. On refitting, note that the sealing O-ring is fitted around the cover inner boss, so that it fits inside the housing when the cover is installed; a smear of grease or similar lubricant will help the O-ring to slide into the housing.

3 Examine the thermostat visually before carrying out tests. If it remains in the open position at room temperature, it should be discarded. Suspend the thermostat by a piece of wire in a pan of cold water. Place a thermometer in the water so that the bulb is close to the thermostat. Heat the water, noting when the thermostat opens and the temperature at which the thermostat is fully open. If the performance is different from that specified, the thermostat should be renewed.

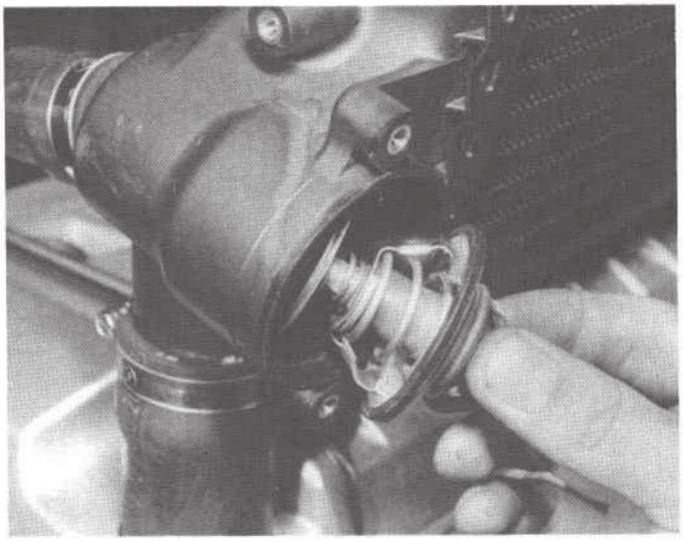
4 If the thermostat is faulty it can be removed and the machine used without it as an emergency measure only. Take care when starting the engine from cold as the warm-up will take much longer than usual, and ensure that a new unit is fitted as soon as possible.



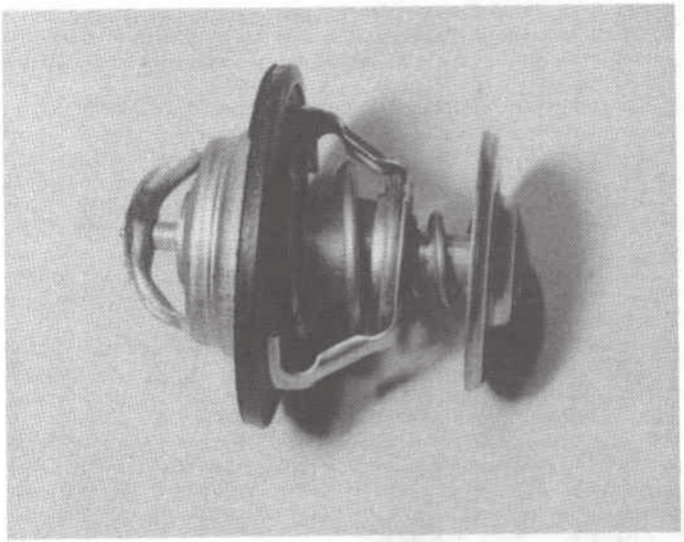
7.2 Hoses are secured by screw-type clamps at each end



7.6 Do not forget coolant stub sealing O-ring when looking for leaks



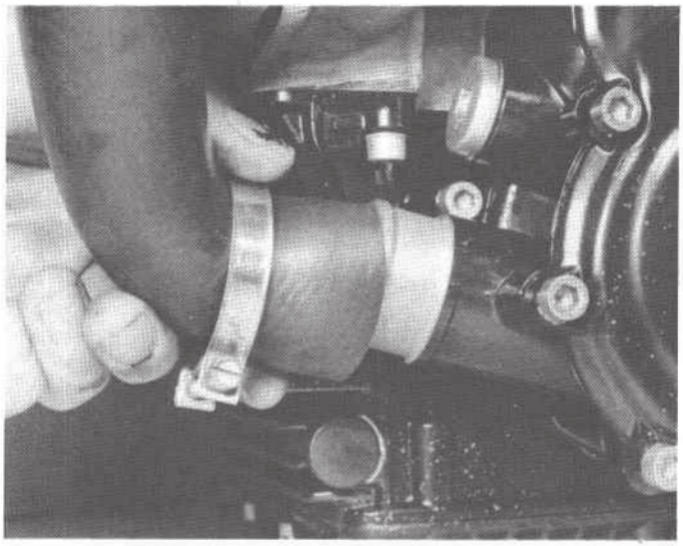
8.2 Thermostat is fitted in housing at side of radiator



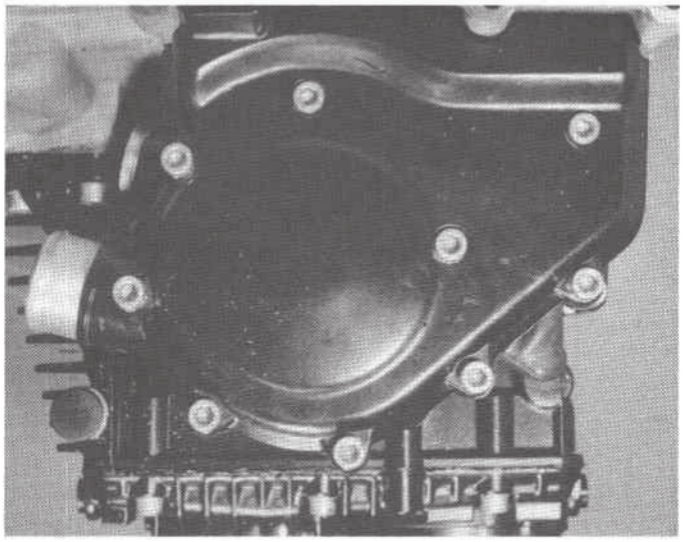
8.3 Renew thermostat if stuck or faulty

9 Water pump: removal, renovation and refitting

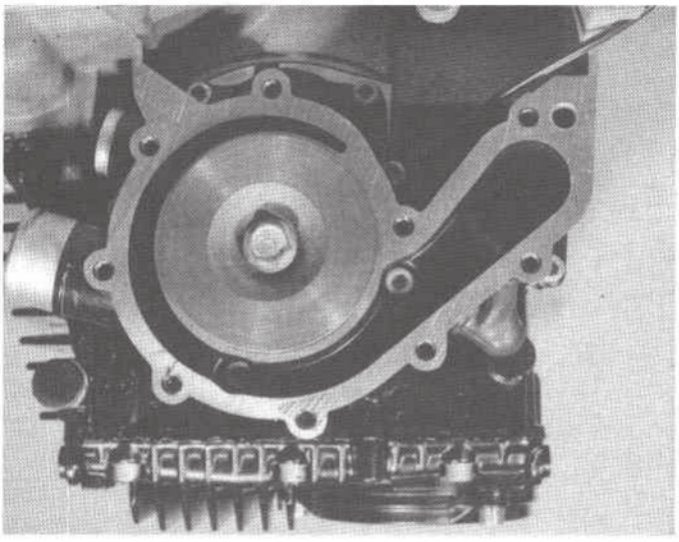
1 To prevent leakage of water or oil from the cooling system to the lubrication system and vice versa, two seals are fitted on the pump shaft. The seal on the water pump side is of the mechanical type having a spring loaded annular face which bears against the rear face of the impeller. The second seal, which is mounted behind the mechanical seal, is of the normal 'feathered' lip type. Both seals are a drive fit in the pump body.
2 Where work on the seals is required, the pump must be removed first, as follows.
3 Drain the coolant. See Section 2. Drain the engine oil, as described in Routine Maintenance. Disconnect the oil pressure switch lead and remove the radiator bottom hose.
4 Remove the pump front cover retaining screws and withdraw the cover then remove the pump body retaining screws and withdraw the pump body; a few gentle taps with a soft-faced mallet should break the joint seal. Note the O-ring sealing the coolant passage between the pump and the crankcase lower section, also the O-ring around the pump drive shaft rear end; both of these should be renewed whenever they are disturbed.
5 Remove the pump drive gear and insert a 6 mm Allen key into the pump shaft rear end. Clamp the key in a vice to hold the pump shaft and unscrew the impeller retaining nut (early models) or bolt (later models). Using a soft-faced mallet, or a hammer and a wooden or soft metal drift, tap the pump shaft out of the impeller, then withdraw the impeller and shaft.
6 Taking care not to scratch or damage the pump body, pull or lever the mechanical seal out of its housing and use a slim (5 mm/0.20 in blade width) screwdriver to drive out the rear seal working from the pump's rear face.
7 Carefully clean all components and check those of the oil pump for wear; see Chapter 5. Renew both seals whenever they are disturbed, also the O-rings.
8 On reassembly, fit first the rear seal, with its manufacturer's marks or numbers facing forwards, using a hammer and a tubular drift such as a socket spanner which bears only on the seal hard outer edge. Drive the seal in until it seats against its locating shoulder. A smear of grease around its outside edge will help the procedure.
9 The mechanical seal is fitted in the same way, using a 22 mm socket spanner and 1/2 inch drive to drive it in until it seats. However, it must be kept completely free from grease and must be washed in a methylated spirit/water mixture to degrease it before installation.
10 Insert the pump shaft into the rear of the pump body. The mechanical seal centre is a very tight fit on the pump shaft; to refit the shaft rest its rear end against the work surface, apply both thumbs to the mechanical seal centre and press the seal (and pump body) over the shaft end.
11 Tighten the impeller retaining nut or bolt to its specified torque setting then refit the pump drive shaft with a new O-ring. Installing an O-ring around the coolant passage, apply a thin smear of Three Bond 1207 B sealant to the pump/crankcase mating surfaces and refit the pump ensuring that the drive shaft engages correctly in the output shaft.
12 Rotate the crankshaft to centralise the pump gears while tightening the pump body mounting screws to the specified torque setting (where given). Connect the oil pressure switch lead to the switch terminal and carefully refit the switch cover. Apply a thin smear of Three Bond 1207 B sealant to the mating surfaces and refit the pump front cover, tightening its retaining screws to the specified torque setting, where given.
13 Fill the cooling system again. See Section 4. Refill the engine with oil as described in Routine Maintenance. Refit all other disturbed components.
14 In the event of seal failure, the inter-mixing of oil and water in the engine will cause sludge to form. The extent of sludging will depend on the quantity of contaminant and the length of time during which contamination has taken place. Before the machine is returned to service, when new coolant and lubricant should be used as a matter of course, it is strongly recommended that the engine be flushed out thoroughly using a proprietary flushing oil. Furthermore, where extensive contamination is evident, an additional oil change is recommended approximately 500 miles after seal renewal. It should be noted that the presence of water in the lubricating oil will reduce its lubricating properties dramatically and may cause permanent damage.



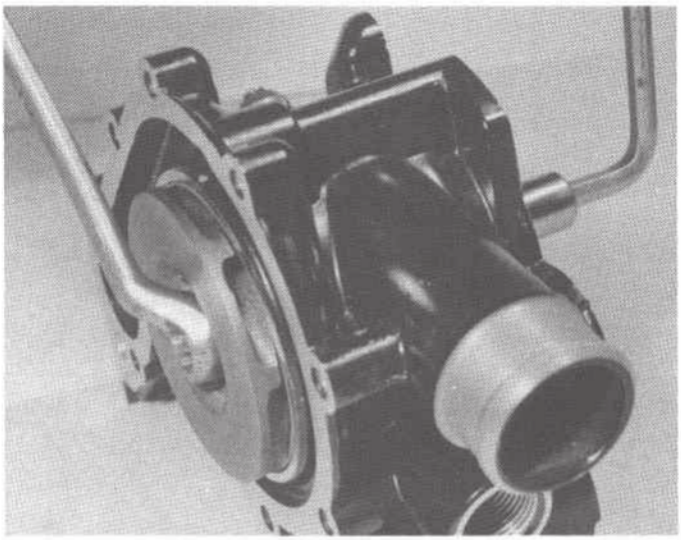
9.3 Remove bottom hose prior to oil/water pump removal



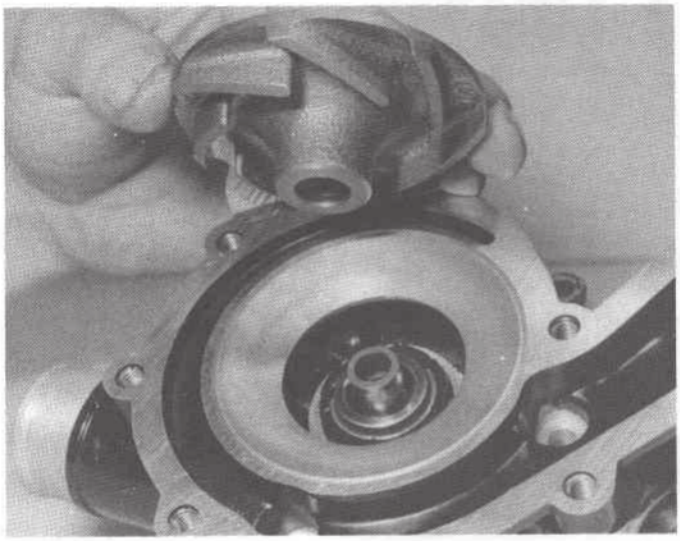
9.4a Remove pump front cover retaining screws ...



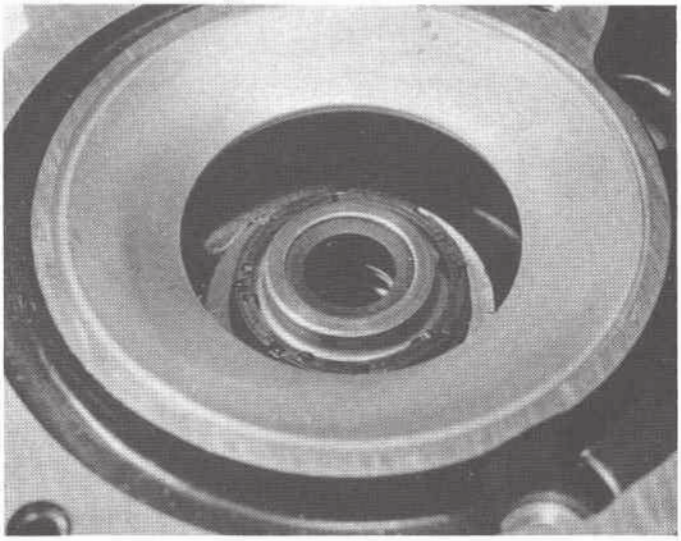
9.4b ... to expose pump body mounting screws



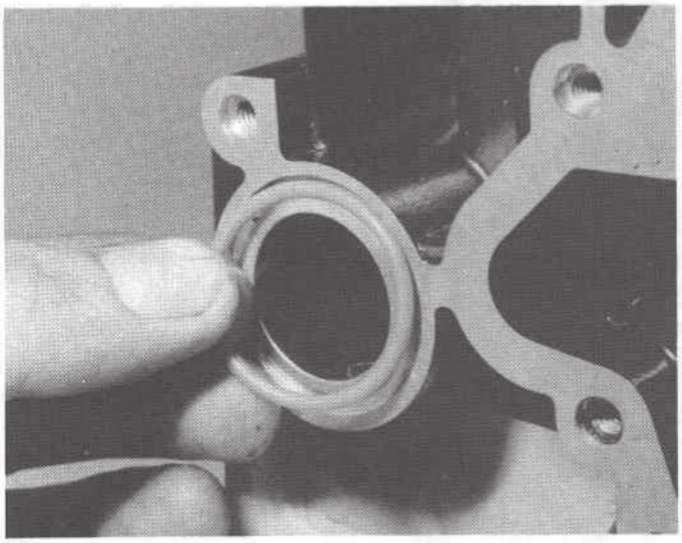
9.5a Use an Allen key to hold pump shaft when slackening impeller nut or bolt



9.5b Remove impeller to release pump shaft



9.6 Pump mechanical seal is fitted behind impeller



9.11 Always renew O-ring around coolant passage

10 Cooling fan: removal, examination and refitting

1 The fan and motor assembly are automatically removed and refitted with the radiator. See Section 5 of this Chapter.
2 If the fan fails to work, connect a fully-charged 12 volt battery directly to the fan motor; for safety's sake this must only be done while the fan assembly is still attached to the radiator (on or off the machine) so that it is still enclosed by its protective shroud. If the fan motor works, the fault is in the thermostatic switch or in the main wiring loom; check for faults as described in Chapter 10.
3 If the fan motor does not work, it must be renewed. Remove the shroud mounting bolts or screws and withdraw the fan from the radiator.
4 If the fan ever comes on with the engine still cold, this is probably due to a poor earth connection between the engine and the frame. Clean the engine/frame bellhousing mounting point as described in Chapter 1, Section 36, also the frame earth point behind the steering head. Both must be cleaned back until metal-to-metal contact is restored to ensure a good earth; apply a thin coat of silicone grease to prevent corrosion and tighten the mounting bolts securely.

11 Cooling system electrical components: removal and refitting

1 Since no test data is available, none of the electrical components can be checked except in the most general terms. See Chapter 10.

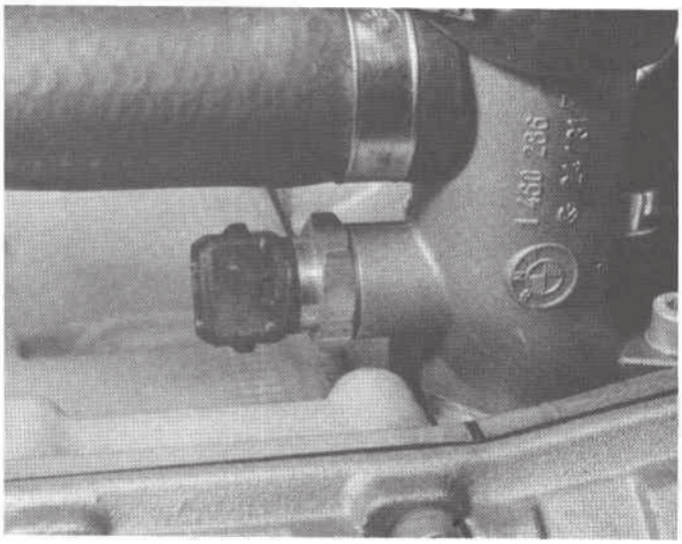
Coolant temperature sensor
2 This unit is screwed into the right-hand side of the coolant pipe stub; it is therefore necessary to drain the coolant (Section 2) and to remove the radiator (Section 5) to gain access to it. Unplug its connector and unscrew the unit to remove it; apply a smear of sealant to its threads and renew its sealing washer on refitting.
3 The unit is connected directly to the fuel injection control unit and to the temperature sensing switch unit which controls the fan motor and the coolant overheat warning lamp. If it is thought to be faulty it can be tested only by substitution.

Temperature sensing switch unit
4 This unit controls the coolant overheat warning lamp and the fan motor. It is mounted by one or two screws in the electrical components

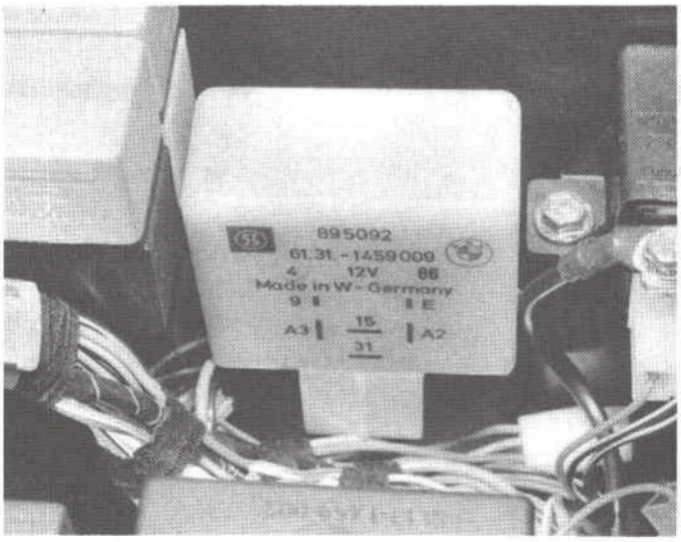
box underneath the rear of the fuel tank. If thought to be faulty it can be tested only by substitution.

Coolant overheat warning lamp

5 This is merely a bulb which is renewed if faulty as described in Chapter 10. However, if it should light when the engine is still cold, the fault is most probably due to a poor earth connection between the engine and frame. Clean the bellhousing/frame mounting point as described in Chapter 1, Section 36, also the frame earth point behind the steering head. Both must be cleaned back until metal-to-metal contact is restored to ensure a good earth; apply a thin coat of silicone grease to prevent corrosion and tighten the mounting bolts securely.



11.2 Coolant temperature sensor is mounted in coolant pipe stub



11.4 Temperature-sensing switch unit is mounted in electrical components box

Chapter 5 Fuel system and lubrication

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Specifications

Fuel tank capacity	
100 models	22 litre (4.84 Imp gal, 5.81 US gal)
75 models	21 litre (4.62 Imp gal, 5.55 US gal)
No reserve supply fitted, low level warning by system of warning lamps – see Chapter 10	
Recommended fuel grade – see Section 21 for full information	
Early 100 models	Leaded premium*
Later 100 models	Unleaded or leaded regular*
UK 75 models, early US 75 models	Unleaded or leaded premium*
Later US 75 models	Unleaded or leaded regular*
*Premium is defined as:	
Leaded	Premium (super, 4-star) grade petrol (gasoline) to German DIN 51600 standard or equivalent, minimum octane rating 98 Research Method (RM/RON), 88 Motor Method (MM/MON)
Unleaded	Premium (super, 4-star) grade petrol (gasoline) to German DIN 51607 standard or equivalent, minimum octane rating 95 Research Method (RM/RON), 85 Motor Method (MM/MON)
*Regular is defined as:	
Leaded	Regular (2-star) grade petrol (gasoline) to German DIN 51600 standard or equivalent, minimum octane rating 91 Research Method (RM/RON), 82.5 Motor Method (MM/MON)
Unleaded	Regular (2-star) grade petrol (gasoline) to German DIN 51607 standard or equivalent, minimum octane rating 91 Research Method (RM/RON), 82.5 Motor Method (MM/MON)

Note: *Information is correct at time of writing – for confirmation of details check with rider's handbook supplied with machine, or with a local BMW dealer or the BMW importer*

Fuel system

Type	Bosch LE-Jetronic
Fuel pump pressure approximate	2.5 bar (36 psi)
Regulator safety valve opens at	4.7 bar (68 psi)
Idle speed	950 ± 50 rpm
Maximum permissible CO value	2.0 – 2.5% (by volume) at idle speed
Injectors shut off at:	
75 models	8905 rpm
100 models	8770 rpm

Engine oil

Quantity:	
At oil change	3.50 lit (6.2 Imp pint, 3.7 US qt)
At oil and filter change	3.75 lit (6.6 Imp pint, 3.9 US qt)
Recommended oil	Good quality HD oil suitable for 4-stroke spark ignition engines, API classification SE or SF
Viscosity	See chart in Routine Maintenance

Engine lubrication system

Relief valve opens at	5.4 bar (78 psi)
Oil pressure warning lamp lights below	0.2 – 0.5 bar (3 – 7 psi)
Filter bypass valve opens at pressure differential of	1.5 bar (22 psi)

Torque wrench settings

Component	75 models		100 models	
	Nm	lbf ft	Nm	lbf ft
Intake stub mounting bolts	7 ± 1	5 ± 0.5	N/Av	N/Av
Fuel rail mounting bolts	7 ± 1	5 ± 0.5	N/Av	N/Av
Pressure regulator mounting nut	25 ± 3	18.5 ± 2	N/Av	N/Av
Air filter lower section mounting bolts	21 ± 1	15.5 ± 0.5	N/Av	N/Av
Exhaust pipe retaining nuts	21 ± 2	15.5 ± 1.5	16.5	12
Exhaust pipe/silencer clamp bolt	21 ± 2	15.5 ± 1.5	N/Av	N/Av
Silencer/footrest mounting bolt	9 ± 1	6.5 ± 0.5	N/Av	N/Av
Silencer cover mounting screws	6 ± 1	4.5 ± 0.5	N/Av	N/Av
Oil/water pump assembly mounting screws	7 ± 1	5 ± 0.5	N/Av	N/Av
Oil/water pump cover screws	7 ± 1	5 ± 0.5	N/Av	N/Av
Oil pump pickup mounting screw	7 ± 1	5 ± 0.5	N/Av	N/Av
Oil pressure switch	40 ± 5	29.5 ± 4	44	32.5
Oil pressure relief valve plug	35 ± 4	26 ± 3	24	18
Oil pan (sump) and filter cover screws	7 ± 1	5 ± 0.5	6	4.5
Engine oil drain plug	32 ± 4	23.5 ± 3	32	23.5
Oil filter – all models:				
1st stage	Lightly oil filter seal, screw on by hand until seal seats on machined surface			
2nd stage	Tighten through 1/2 turn **maximum** (10 – 12 Nm/7.5 – 9 lbf ft)			

1 General description

The Bosch LE-Jetronic fuel injection system is easiest to understand if each of its sub-systems are considered separately. These can be divided into three; the fuel delivery system, the air metering or induction system and the electrical components. Refer to the accompanying illustration for details.

The fuel system starts with the fuel tank in which is housed the electric roller-cell fuel pump. This is protected by a gauze filter on its pick-up side and a full-flow filter on its delivery side. When the ignition is switched on and the starter button operated, the pump supplies fuel to the fuel rail only while the engine is running. The pressure of fuel is controlled by the vacuum-operated pressure regulator which returns fuel continuously to the tank via a check valve or, on later models, a long stack pipe. Although the regulator relies on induction manifold depression for normal operation, it also incorporates a spring-loaded safety valve. The injectors are solenoid-operated and are opened and closed by electrical impulses from the injection control unit; the correct moment is signalled by the ignition control unit based on the information it is receiving from the trigger assembly. Actuating an injector solenoid pulls back a needle valve against spring pressure and allows a controlled amount of fuel to pass from the fuel rail via a small filter, through each injector, and to spray out into the intake port.

The induction system takes cool air from next to the radiator and passes it upwards through the pleated-paper air filter element and into the airflow meter. This device measures the temperature of the incoming air, via a sensor in its intake, and also its volume. The force of the incoming air is used to deflect a sensor flap which converts this movement into voltage by a potentiometer; the information from these two sensors is fed to the injection control unit. The sensor flap is spring-loaded to provide controlled operation and is L-shaped so that pressure variations can be damped out by the movement of the other flap arm in a secondary damping chamber. To permit adjustment of the air/fuel mixture at idle, a bypass duct is fitted into the airflow meter and controlled by a metering screw. By controlling the amount of un-metered air which is allowed to bypass the sensor flap, the screw effectively provides a form of mixture control. From the airflow meter the air passes via a plenum chamber into the intake tracts, in which are situated the throttle butterfly valves which enable the rider to control engine speed via the twistgrip. To overcome the increased friction of a cold engine, a handlebar-mounted lever is provided which opens the throttle butterflies a small amount to give an increased idle speed when the engine is started from cold. A switch mounted on the end of the throttle shaft provides the injection control unit with information on the throttle position. The throttle bodies incorporate air bypass ducts which are controlled by metering screws to provide a measure of air flow adjustment so that the throttle valves, and therefore their respective cylinders, can be synchronised or balanced.

The heart of the electronic system is the control unit which uses microprocessors to collate information about the volume and temperature of the incoming air (airflow meter), the engine speed (ignition system), the throttle butterfly position (throttle valve switch), and the engine temperature (coolant temperature sensor); it then transmits the

appropriate control impulses to the injectors each time an ignition pulse is detected. The opening time and duration of the injectors can be altered by the control unit to vary the volume of injected fuel and thus vary the air/fuel mixture according to the engine's needs; the surplus of fuel stored in the fuel rail ensures that an adequate supply is always present. To save fuel, the control unit shuts off the injectors when the engine is on the overrun (ie throttle switch in the closed position but ignition system still indicating a high engine speed) until the engine speed has fallen to 2000 rpm or less, when the injectors are reactivated so that the engine does not stall. The control unit also has two safety functions; the first is to shut off the fuel supply if the ignition is switched on but the engine ceases to run or the ignition system fails, and the second is to shut off the fuel supply if engine speed exceeds a set limit, thus preventing engine damage through excessive speed.

All 1985 on models sold in California and all 1986 on models sold in the other 49 states are fitted with an Evaporative Emission Control System to minimise the escape into the atmosphere of unburned hydrocarbons produced by evaporation. When the machine is at a standstill, heat from the sun or from the engine causes the fuel in the tank to expand, thus increasing the pressure inside the tank. If this increased pressure exceeds 0.1 bar (1.5 psi) a pressure relief valve in the tank vent hose opens and allows the surplus gases into the crankcase and via the crankcase breather into the induction system and the engine itself; the tank cap is sealed and will not allow vapour to vent into the atmosphere unless a pressure of 0.2 bar (2.9 psi) is exceeded, in which case a safety valve fitted in the cap will open to disperse the surplus pressure. When the engine is started again, the reduced pressure in the intake tract draws the fuel vapour into the induction system where it is burnt by the engine in the first few seconds of running. An air bleed valve fitted in the fuel tank cap opens at a vacuum of – 0.1 bar (– 1.5 psi) to admit air and replace the fuel consumed as the engine is running.

The engine lubrication system is a semi dry-sump type in which oil is contained in a reservoir formed by the crankcase lower section, thus minimising the heat build-up and frictional losses that would result from major engine components running submerged in oil. The gear-type oil pump, mounted in a single assembly with the water pump and driven off the forward end of the engine output shaft; draws oil through a mesh filter set in the pick-up and forces it through a full-flow filter element into a main gallery. From here it is fed to the crankshaft main and big-end bearings and into the camshafts, which are hollow but plugged at their rear ends so that oil is positively supplied to all camshaft bearings and then out on to the lobes and cam followers; a supply is also taken from the camshaft gallery to operate the hydraulic cam chain tensioner. The teeth of the crankshaft/output shaft primary drive gears are lubricated by a supply passed through the output shaft itself. All other components are lubricated by splash, the surplus oil falling down into the crankcase lower section. Oil pressure is controlled by a plunger-type relief valve set in the pump housing and a bypass valve in the filter ensures that the oil supply is maintained even if the filter is clogged through neglect, to the point where it cannot pass sufficient oil for the engine's needs. If pressure difference exceeds the set amount, the bypass valve opens and allows unfiltered oil to circulate around the engine. A pressure switch set in the pump housing causes a warning lamp to light in the instrument panel if the oil pressure is dangerously low.

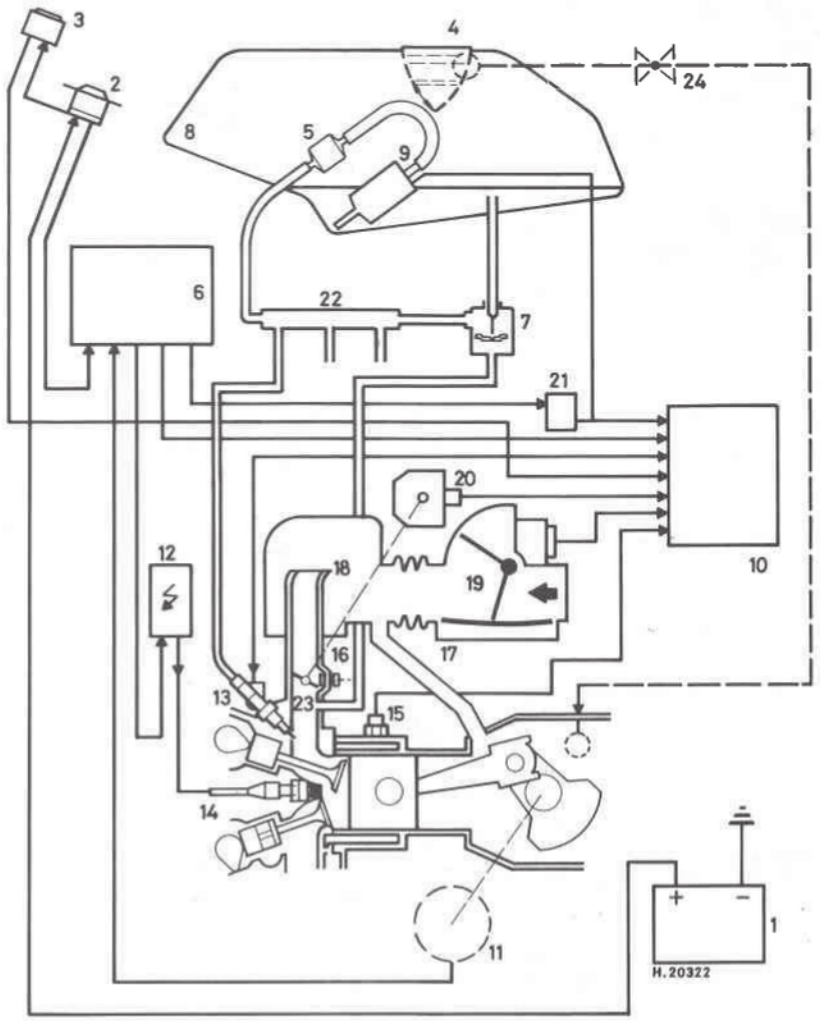


Fig. 5.1 Fuel system components

1 *Battery*
2 *Ignition switch*
3 *Starter button*
4 *Filler cap*
5 *Fuel filter*
6 *Ignition control unit*
7 *Pressure regulator*
8 *Fuel tank*
9 *Fuel pump*
10 *Fuel injection control unit*
11 *Ignition trigger assembly*
12 *Ignition HT coil*
13 *Injector*
14 *Spark plug*
15 *Coolant temperature sensor*
16 *Air bypass adjuster screw – throttle butterfly synchronisation*
17 *Air bypass adjuster screw – idle mixture setting*
18 *Plenum chamber*
19 *Airflow meter*
20 *Throttle butterfly switch*
21 *Injection relay*
22 *Fuel rail*
23 *Throttle butterfly*
24 *Pressure relief valve – California and late US models*

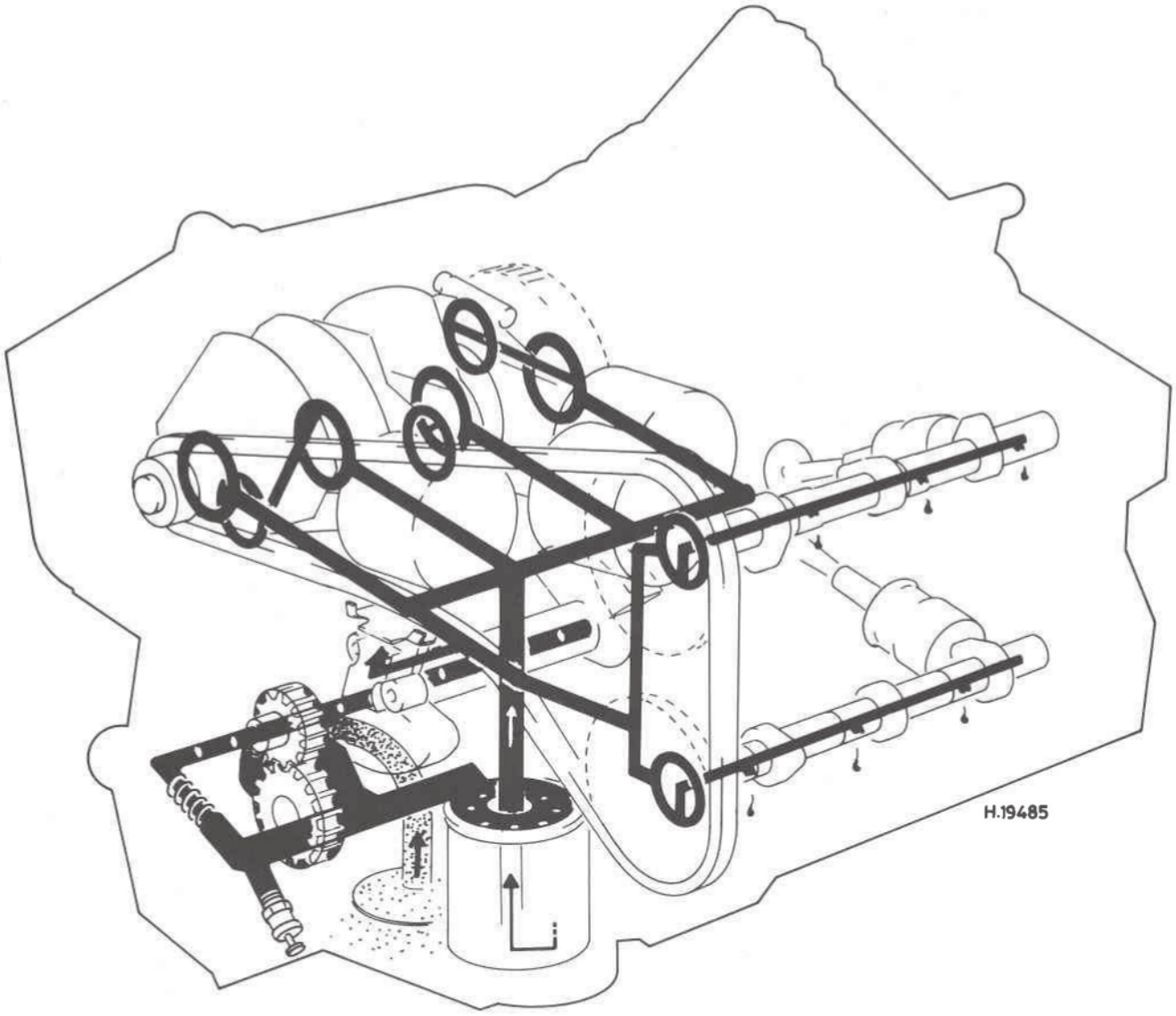


Fig. 5.2 Lubrication system

2 Precautions to be observed when servicing the fuel system

Warning: *Petrol (gasoline) is extremely flammable, particularly when in the form of vapour. Precautions must be taken, as described below, to prevent the risk of fire or explosion when working on any part of the fuel system. Note that gasoline vapour is heavier than air and will collect in poorly ventilated corners of buildings. Avoid getting gasoline in the eyes or mouth and try to avoid skin contact. In case of accidents flush the affected area immediately with copious quantities of water and seek prompt medical advice.*

1 Always perform service procedures in a well-ventilated area to prevent the build-up of fumes.

2 Never work in a building containing a gas appliance with a pilot light, or any other form of naked flame. Ensure that there are no naked light bulbs or any sources of flame or sparks nearby.

3 Do not smoke (or allow anyone else to smoke) while in the vicinity of petrol or of components containing petrol. Remember the possible present of petrol vapour from these sources and move well clear before smoking.

4 Check all electrical equipment belonging to the house, garage or workshop where work is being carried on (see the Safety First section of this manual). Remember that certain electrical appliances such as drills, cutters etc create sparks in the normal course of operation and must not be used near petrol or any component containing petrol. Again, remember the possible presence of petrol fumes before using electrical equipment.

5 Always mop up any spilt fuel and safely dispose of the shop towel or rag used.

6 Any stored petrol, or petrol that is drained off during servicing work, must be kept in sealed containers that are suitable for holding petrol and clearly marked as such; the containers themselves should be kept in a safe place. Note that this last point applies equally to the fuel

tank, if it is removed from the machine; also remember to keep its cap closed at all times.
7 Note that the fuel system consists of the fuel tank, with its cap and related vent hoses, the fuel pump and filters, the fuel feed and return hoses, the fuel rail, the pressure regulator, the injectors and any other related components. On US models, this includes the components of the Evaporative Emission Control System.
8 Most of the above components contain fuel under pressure in normal use; always relieve any residual pressure (Section 3), then wrap a shop towel or clean rag around the joint to prevent fuel spraying out whenever any component is disturbed, and wear suitable eye protection to prevent personal injury.
9 Before working on any part of the fuel system always switch off the ignition at the very least; preferably disconnect the battery (negative terminal first) to prevent the risk of sparks due to short circuits or to improperly-connected components. If test procedures require the use of electricity be careful to check all connections before starting work.
10 Read carefully the Safety First section of this manual before starting work.
11 Owners of machines used in the US, particularly in California, should note that their machines must comply at all times with Federal or State legislation governing the permissible levels of noise and of pollutants such as unburnt hydrocarbons, carbon monoxide etc that can be emitted by those machines. All vehicles offered for sale must comply with legislation in force at the date of manufacture and must not subsequently be altered in any way which will affect their emission of noise or of pollutants.
12 In practice this means that adjustments may not be made to any part of the fuel, ignition or exhaust systems by anyone who is not authorised or mechanically qualified to do so, or who does not have the tools, equipment and data necessary to properly carry out the task. Also if any part of these systems is to be renewed it must be replaced only by genuine BMW components or by components which are approved under the relevant legislation, and the machine must never be used with any part of these systems removed, modified or damaged. Owners **must** consult the local enforcement agency (CARB and/or EPA) for full details of local legal requirements **before** attempting any of the servicing procedures described in this Chapter or in the relevant Sections of Routine Maintenance.

3 Relieving fuel system pressure

1 Owners should remember that all components of the fuel system from the tank to the fuel rail and injectors contain fuel which is under pressure when the engine is running.
2 The pressure will remain for some time after the engine has been switched off and must be relieved before any of these components is disturbed for servicing work.
3 The first method is simply to exhaust the supply of fuel remaining in the system. Start the engine, remove the right-hand side panel and disconnect the fuel tank wiring connector plug. The pump will then cease to operate and the engine will run only while fuel remains under pressure. Switch off the ignition and re-connect the tank wiring as soon as the engine stops.
4 The second method can be used if the engine has just been switched off. Disconnect the pressure regulator vacuum hose (usually identified by its protective coil spring) from the rearmost throttle body vacuum stub and suck as hard as possible to open the regulator diaphragm. The pressure will then disperse into the fuel tank. Re-connect the vacuum hose.
5 **Note:** with both of these methods fuel will still be present in the system components; it will merely no longer be under pressure. Take all suitable precautions (see Section 2) to prevent the risk of fire or of personal injury when working on any part of the fuel system.

4 Fuel system: fault-finding

1 As will be clear from the general description, the fuel injection system is not, to use modern jargon, user-serviceable. While the fuel injection and ignition system are not of the fullly-integrated engine management type that is being fitted to some cars and, in prototype form, to one or two motorcycles, they are interconnected to an extent previously unknown in the motorcycling world; this makes accurate fault diagnosis very difficult. Also their components cannot be repaired and due to the lack of any useful information or test data, they cannot easily be tested by the ordinary private owner.
2 This means that emphasis must be more on preventing faults from arising in the first place than on actual remedial repair work. The simplest approach can be summed up as follows:

a) If the system is working properly, leave it alone.
b) Prevention (in the form of preventive maintenance) is better than cure.
c) In the event of a fault, take the machine to an expert.

3 The first of these is obvious, but worth stressing. **Do not attempt** to tune, modify or improve the system in any way. The only maintenance necessary is set out below and in the Routine Maintenance section of this manual; at all other times the system should not be disturbed.
4 The second is by no means as contradicting as it might first appear; the electronic components themselves are generally very reliable and any faults are usually caused by disruption of the current flow between the various components or by external factors such as excessive heat, vibration or attack by foreign matter or corrosive chemicals. Therefore anything that can be done to ensure that all components receive a stable supply of the correct amount of electrical current, that they are kept clean and properly secured to protect them from excessive heat and/or vibration, and that they are kept free of dirt, corrosion and substances such as water, coolant, brake fluid, battery acid or engine oil which might cause damage, must help to minimise the risk of a fault in the fuel injection system.
5 Preventative measures can be summed up as follows:

a) Ensure that the battery electrolyte levels are correct and that the terminal connections are clean and securely fastened at all times. If the machine is not used for any length of time, ensure that the battery is given refresher charges to keep it in good condition.

b) Working through the relevant wiring diagram to ensure that all components (including individual connectors) are treated, carefully clean back to bare metal all connections and terminals (finishing off with proprietary contact cleaner to remove any grease or oil) then pack them with silicone grease to exclude water and dirt and to prevent corrosion. On reassembly, ensure that, where applicable, the waterproof cover is correctly refitted over each connector plug and that the retaining clip is secured.

c) Ensure that all frame earths and earth connections are completely clean and securely fastened. Where wires are connected to the frame earth point, or at the bellhousing/frame mounting joint, ensure that the frame paint is scraped away to provide a clean metal-to-metal joint and that silicone grease or similar is applied to prevent corrosion.

d) Ensure that all components are correctly positioned and securely fastened at all times, also that all are as clean and dry as possible.

e) All wiring must be correctly routed so that it runs in smooth loops but avoids all possible contact with sharp edges, control cables or components which move or become hot, and must be secured out of harm's way using plastic cable clips or insulating tape. Remember that wires which are too tight or sharply kinked may fail due to the effects of vibration, whilst wires which are too slack may foul other components.

f) Be careful never to knock , drop, or otherwise mishandle any of the components; all are extremely sensitive and easily damaged. Note that this particularly applies to the injection control unit; always ensure that it is properly secured and that any tools etc carried in the storage compartment above it are well wrapped in rag and secured so that they cannot cause vibration by rattling around. BMW specify that tools are to be carried only in the tail compartment; the underseat compartment is for lightweight items only, such as the first-aid box.

g) If any component is found to be worn or damaged at any time, repair or renew it immediately, before the damage has a chance to affect any other component.

h) Whenever any part of the induction system (ie air filter, airflow meter, throttle valve assembly, as opposed to the purely electronic components) is disturbed, always ensure that all joints are sealed airtight on reassembly so that there are no air leaks to upset the mixture balance. All soft rubber seals or hoses should be refitted with great care and retaining clips or hose clamps should be correctly positioned and securely fastened; do not overtighten any clamp or there is a grave risk of distorting the components being secured.

i) Whenever any part of the fuel system (ie fuel feed and return pipes, fuel rail or injectors) is disturbed, always ensure that all joints are

securely fastened on reassembly to prevent the possibility of fuel leaks and of the resulting drop in pressure.

j) Always clean or renew (as applicable) the fuel filters exactly at the intervals specified in Routine Maintenance or earlier, if necessary; the system is extremely vulnerable to the presence of dirt or water and the engine may stop completely if one or more fuel passages become obstructed by particles of foreign matter. Keeping the filters clean is the only way of preventing this, although great care should always be taken not to allow dirt or water into the fuel tank whenever the cap is opened.

6 If a fault does arise, some clue to the reason may be given by its symptoms; if not consider the problem in a logical manner is an attempt to isolate the fault. In the first place check that there is a good quantity of clean fuel in the tank and that the battery is in good condition and fully charged (check that all other electrical systems are working normally as a quick test of battery condition). It should be possible to hear the fuel pump working, if not check the pump circuit fuse. If the pump is working, check that fuel is present under pressure in the fuel rail and that the surplus is returning via the pressure regulator to the tank. Check also that none of the fuel tank vent hoses are blocked by kinks or foreign matter.

7 If the fault occurs only while the engine is running, there is not a great deal that the ordinary owner can do to isolate it. Checking the appearance of the spark plug electrodes will reveal whether the mixture is excessively rich or lean, but the possible causes of either of these conditions are far too many and varied to be checked without the correct test equipment. Check the components of the fuel and induction system (see above) for air or fuel leaks, check the exhaust system for holes or other damage and check the valve clearances and engine compression to ensure that the engine is mechanically sound. As far as is possible, check that the ignition system is in good order.

8 When all other possibilities have been eliminated (as far as the ordinary owner can check them) the fault must be assumed to be in the electronic components of the fuel injection system. At this stage the machine should be taken to a good authorised BMW dealer who has the BMW/Bosch diagnostic unit. This equipment is connected to the machine by a set of adapter leads and should be capable of checking the function of the entire ignition and fuel injection systems; in skilled hands it should be able to trace faults very quickly and easily.

9 Unfortunately there is no alternative to the use of this equipment; while this manual contains all the test data that can be gleaned from BMW's service literature, nothing is available which will allow the checking of the system's components using ordinary equipment. Since all other available data is related specifically to the Bosch diagnostic unit it is of no use to anyone who does not have access to one of these units. **Do not attempt** to test any components using equipment which has its own power source (eg multimeters, ohmmeters, meggers or battery and bulb test circuits) or the applied voltage may destroy one or more of their sensitive circuits.

10 The **only** permissible use for an ordinary tester is to check the wiring loom for damage. Note, however, that all the components of a particular circuit must be disconnected before the wires of that circuit are checked, to avoid any risk of the sort of damage mentioned above. Particular attention should be paid to the various connectors and any earth connections.

11 Taking all the above into account, many owners may well feel that the simplest course of action is to take the machine to an authorised BMW dealer if a fault of any sort is encountered in the fuel injection system. Compared with the time-consuming nature of the various tests and the dangers both to the machine and its owner inherent in some of them, a skilled operator will quickly and safely run through a test sequence on the diagnostic unit to check the entire system and locate any faults, even if this does mean having to pay the labour charge necessary.

5 Fuel tank: removal and refitting

1 Refer to Section 2 of this Chapter for notes on precautions to be observed when servicing any part of the fuel system.

2 Open and raise the dual seat, then remove both side panels. See Chapter 7.

3 On K100 and K75 C, K75 T and K75 models remove the radiator covers. On K100 RS models remove the left-hand knee pad. On K100 RT and K100 LT models remove the left-hand knee pad, storage compartment and compartment holder. See Chapter 7.

4 Relieve any residual fuel system pressure. See Section 3.

5 Remove from its frame clip and disconnect the fuel tank wiring connector plug.

6 On early 100 models remove the single bolt securing the tank rear end to its rubber mounting. On all other models use a pair of pliers to withdraw the flat clip securing each of the two tank mountings. Lift the tank at the rear and disconnect, on early models only, the tank vent and fuel overflow hoses; note carefully where each hose is fitted. Remove the tank wiring lead from the frame tubes.

7 Placing a rag to catch any spilt fuel as described in Section 2, disconnect the fuel feed and return hoses either from underneath the tank front left-hand side or at the fuel rail (feed hose only). Carefully lift the tank at the rear then pull it backwards to disengage the front mounting rubbers. Be very careful not to damage its paintwork, especially on machines with fairings.

8 As soon as the tank is clear of its front mountings, lift it to one side so that the pressure relief hose (US models only, where fitted) can be disconnected and removed. Withdraw the tank, taking care not to spill any fuel (later models only).

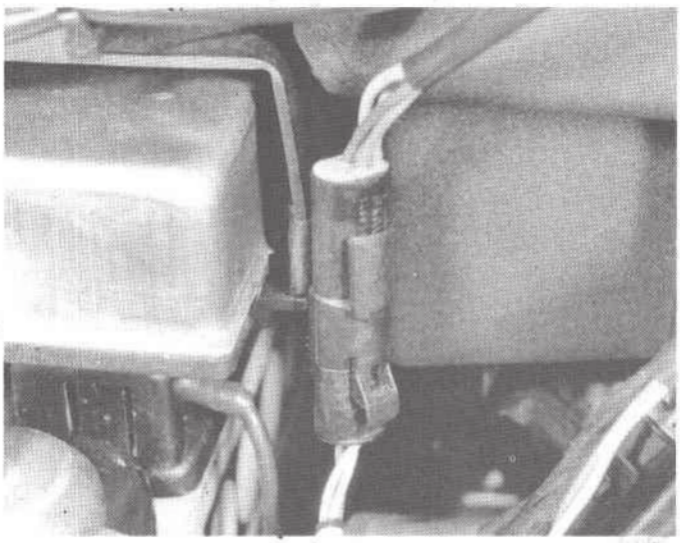
9 On refitting, be very careful to connect the various hoses to their correct stubs. On early models the overflow hose is fitted to the stub which passes up to the filter cap recess drain hole, while the vent hose is connected to the stub which exits inside the tank, at the top. The fuel return hose is connected to the front left-hand stub and the feed hose to the rear left-hand stub. On US models the pressure relief hose (where fitted) is connected to the remaining stub. Check carefully that all hose clamps are securely fastened and that all hoses are correctly routed with no kinks or sharp bends.

10 Applying a smear of lubricant to the mountings, manoeuvre the tank into place, connecting the hoses at the appropriate moment. Check that the tank is fully engaged on its front mountings, then lower it into place at the rear. Again, check carefully that the hoses are not kinked or distorted before fastening the tank rear mountings. On late models note that the overflow and vent hoses are connected to a funnel which is clipped to the frame tubes under the tank stubs.

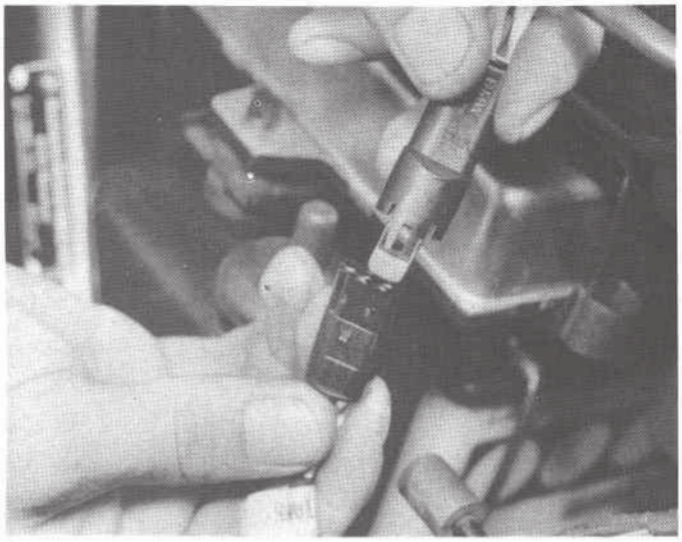
11 Ensuring that it is correctly routed, refit the fuel tank wiring lead and connector plug to the frame clip.

12 Check that all hose clamps are securely fastened before starting the engine.

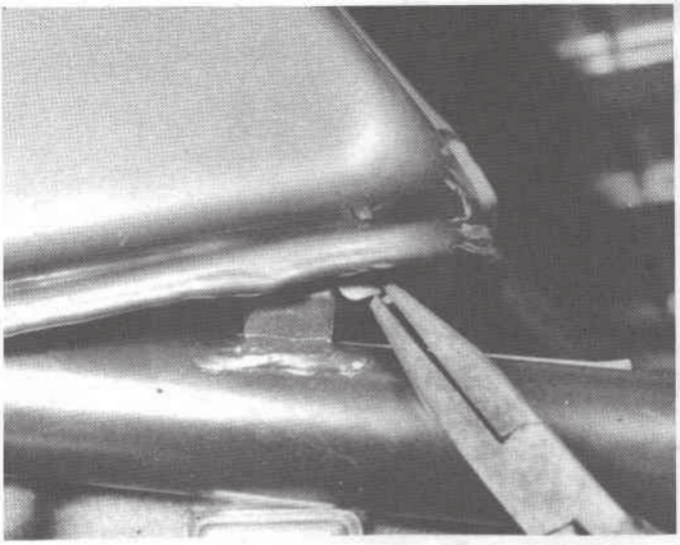
13 **Note:** If the vent hoses are blocked through obstructions or through being kinked or trapped due to careless installation, pressure can build up in the tank to the point where the tank bulges outwards on the left-hand side, fuel sprays out whenever the filler cap is opened and the engine performance is affected. Be very careful to check that all hoses and vent tubes are correctly re-routed whenever the tank is disturbed.



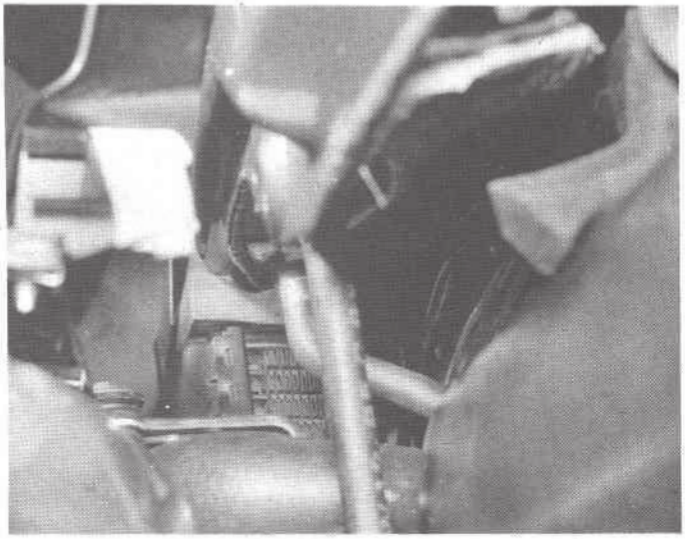
5.5a Remove fuel tank wiring connector from its retaining clip ...



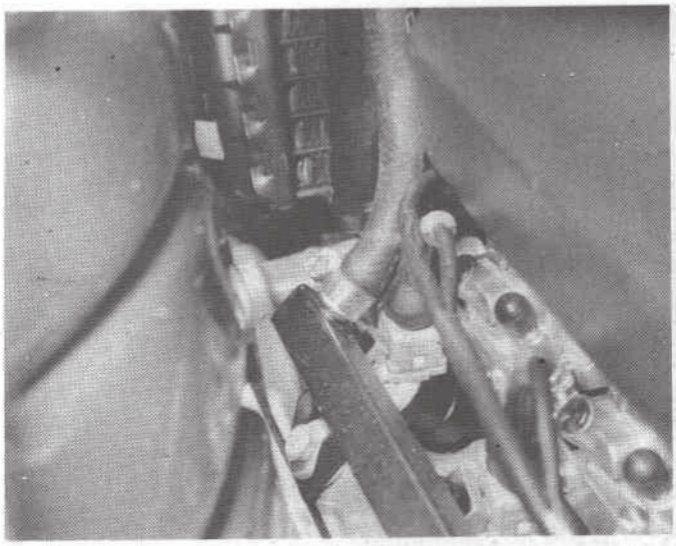
5.5b ... and disconnect to release tank wiring – ensure catch is fastened correctly on refitting



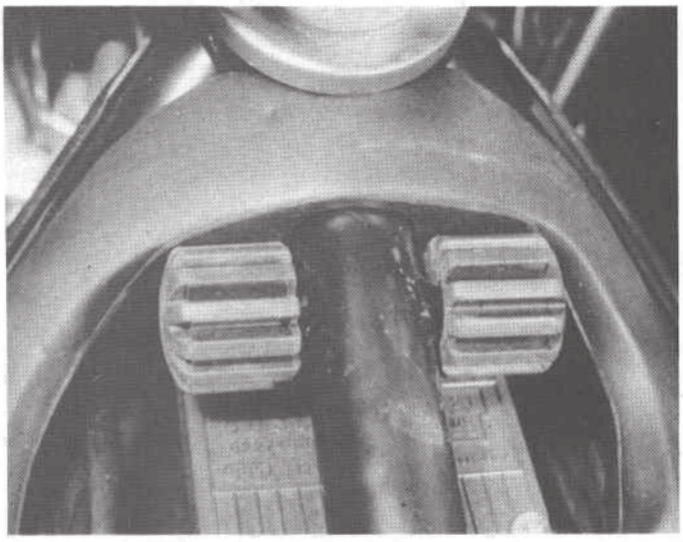
5.6 Remove clips securing tank rear mountings on later models – early models use single bolt



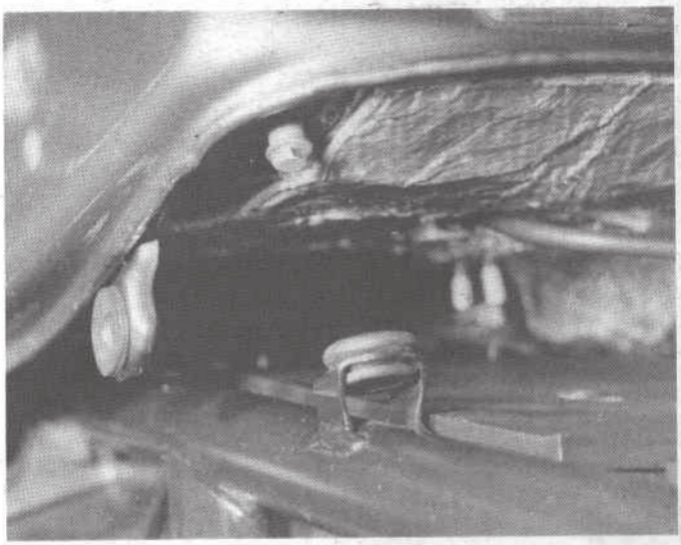
5.7a Disconnect fuel feed and return hoses from unions under tank front left-hand end



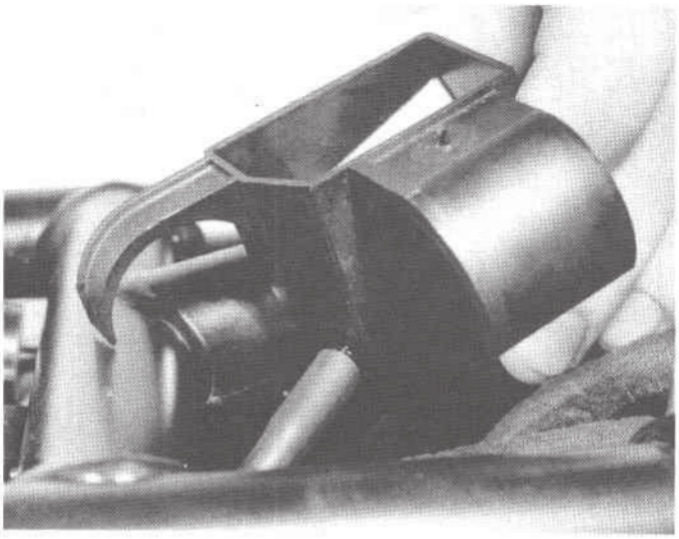
5.7b Note that fuel feed hose can also be disconnected at fuel rail, if required



5.7c Check tank front mounting rubbers and insulating material whenever tank is removed



5.10a Lubricate tank mounting rubbers on reassembly

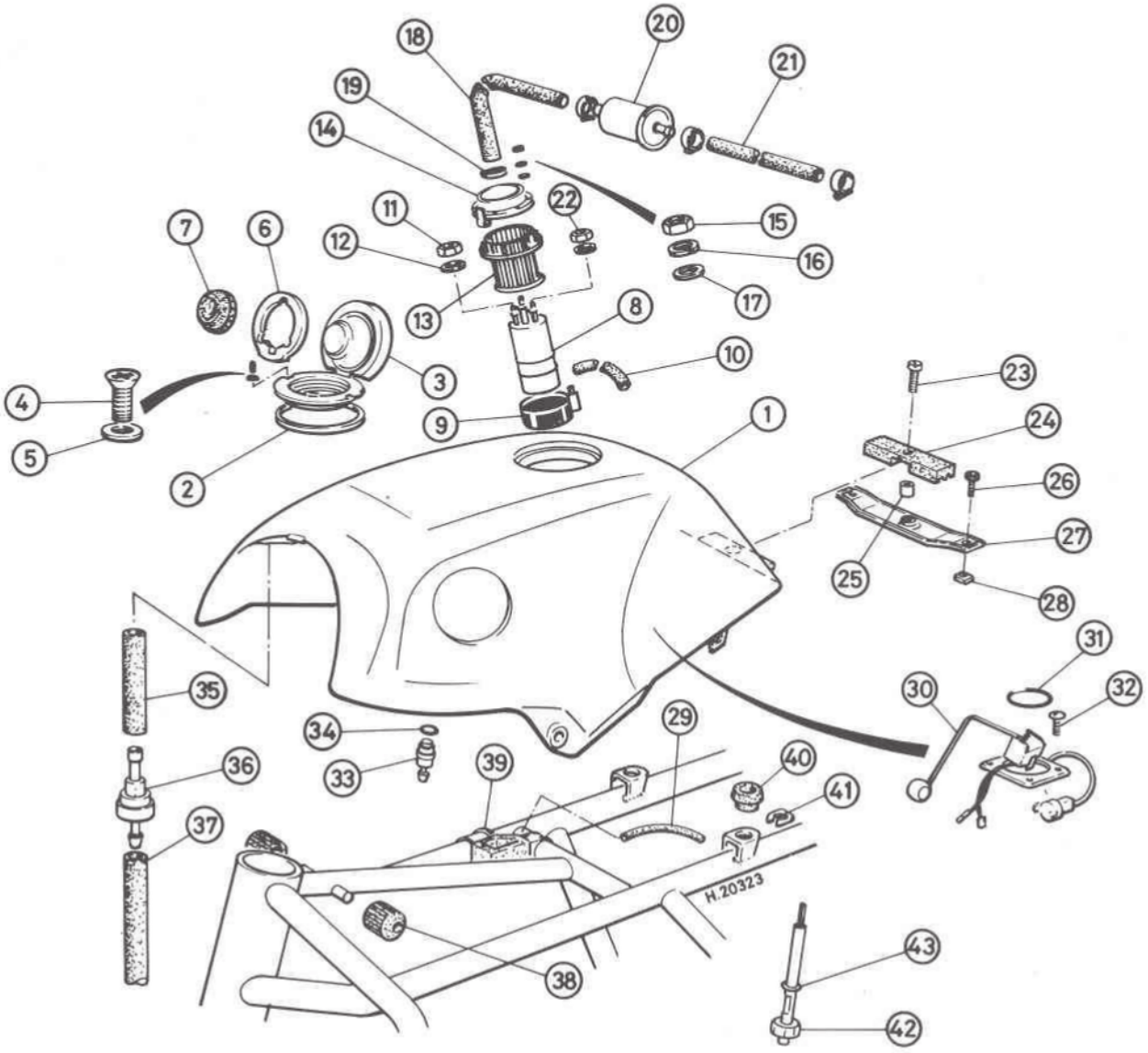


5.10b Check very carefully routing of tank hoses – overflow and vent hoses are directed into a funnel on later models

Fig. 5.3 Fuel tank assembly

1 *Fuel tank*
2 *Sealing ring*
3 *Filler cap and insert*
4 *Screw – 4 off*
5 *Washer – 4 off*
6 *Additional seal* △
7 *Gasket*
8 *Fuel pump*
9 *Filter gauze*
10 *Breather tube* △
11 *Negative terminal nut*
12 *Washer*
13 *Rubber sleeve*
14 *Retaining ring*
15 *Nut – 6 off*
16 *Spring washer – 6 off*
17 *Washer – 6 off*
18 *Pressure hose*
19 *Clamp – 4 off*
20 *Fuel filter*
21 *Pressure hose*
22 *Positive terminal nut*
23 *Bolt* ▲
24 *Mounting rubber* ▲
25 *Spacer* ▲
26 *Bolt – 2 off* ▲
27 *Mounting bracket* ▲
28 *Nut – 2 off* ▲
29 *Drain tube* △
30 *Fuel gauge sender unit* △
31 *O-ring* △
32 *Screw – 4 off* △
33 *Fuel return valve* ▲
34 *Sealing washer* ▲
35 *Vent tube* *
36 *Pressure relief valve* *
37 *Vent tube**
38 *Mounting rubber – 2 off*
39 *Vent funnel* △
40 *Mounting grommet – 2 off* △
41 *Clip – 2 off* △
42 *Fuel gauge sender unit* ▲
43 *Sealing washer* ▲

△ *later models only*
▲ *early models only*
* *US models, where fitted*



6 Fuel tank components: general

Note: *Refer to the warnings given in Section 2 of this Chapter before working on any part of the fuel system.*

Filler cap

1 The tank filler cap is removed by unlocking it, raising the flap and by removing the four screws which retain it to the tank; note the sealing ring between the filler cap insert and the tank. Renew the ring if it is damaged or worn in any way, ensuring that the modified type is used.

2 On refitting, the sealing ring must be positioned so that it does not block the overflow hole; do not overtighten the retaining screws or the tank sealing lip will cut into the ring and damage it.

3 Note that the pressure of fuel around the filler cap recess is usually due to a faulty cap sealing ring but may also be due to a build-up of pressure as a result of blocked or kinked vent and drain hoses; check that these are clear.

4 The filler cap was modified in late 1984; the original pushbutton release being deleted in favour of a cap which springs up automatically when unlocked. At the same time the sealing lip was raised and a new sealing ring introduced, so that any water that collected in the filler cap recess or was forced into it by a pressure washer, was directed into the drain hole. This component was fitted to all 100 models from that date onwards and to all 75 models. Subsequently an additional gasket was introduced which can be fitted to all later-type caps; the gasket is fitted underneath the cap by removing the three screws which secure the cap lower part to the top. If owners of earlier models encounter persistent problems with water getting into the tank, an authorised BMW dealer will have all the necessary details of the modifications.

5 Note that new locks and replacement keys are available from authorised BMW dealers, also a blank lock which can be coded to match the key already in use on the machine so that only one key is still needed if the lock has to be renewed.

6 On US models fitted with the EEC system, the filler cap assembly incorporates a flap which is pushed aside by the pump nozzle on filling the tank but which is deliberately designed to prevent the tank from being filled to the brim. This is to allow room for the expansion of the fuel when warm and to prevent neat fuel from passing into the crankcase via the vent hose; if the engine were started with a quantity of petrol (gasoline) in the crankcase the resulting engine damage could be very severe indeed, also the possible personal injury that might result. **Do not** remove or modify the filler flap in any way.

Internal hoses and pipes

7 Reference to the text and illustration in this Chapter will show the number and layout of the pipes inside the fuel tank. Blow through all vent pipes, drain pipes etc to check that all are clear whenever the tank is removed.

8 On very early 100 models low fuel pressure may be due to loose hose connections inside the tank. To check the security of the connections, disconnect the fuel feed hose from the fuel rail and plug it with an 8 mm (0.32 in) rod clamped securely by a hose clamp. Run the starter motor for approximately 15 seconds, by which time the pressure will be at the maximum possible. If the hose connections are intact, they will be serviceable in normal use. If any have given way, renew the hose if split or damaged and secure it with a (smaller) 12 mm clamp. Note that on all connections the hose should be pushed fully on to the metal pipe stub so that the clamps locate securely behind the pipe flared ends. Although the smaller clamps were fitted to all later models, this point should be checked carefully on any machine which loses fuel pressure.

External hoses

9 Note that all fuel feed and return hoses have a petrol (gasoline) resistant inner layer surrounded by a tough outer layer which is designed to give protection against cleaning detergent, salt etc. Since this outer layer is not fuel-proof if the hose clamps are not securely fastened, fuel can work its way between the two layers causing the outer layer to swell and then deteriorate. Always ensure that all hose clamps are securely fastened and that the fuel return valve (where fitted) is securely fastened and that its gasket is not leaking.

Fuel return valve

10 On the original 100 models a spring-loaded ball valve was fitted in the fuel return hose to seal off the passageway whenever the tank was removed. This was found to be annoyingly noisy in operation however, especially from just above idle speed, and so the valve was modified on 1985 models, The modification, which consists of removing the spring, can be carried out as follows on earlier models.

11 Remove the tank, drain the fuel into a suitably-marked container and unscrew the valve. Lever up its top rim and prise out the cover disc, withdraw the spring and refit the cover disc, then carefully peen over the top of the valve to secure the disc again. Refit the valve, ensuring that its gasket is not forgotten and that it is securely fastened. Note that fuel may drip from the valve from now on whenever the tank is removed; the valve lower end should be plugged or capped to prevent this.

12 With the introduction of the K75 S models in mid-1986 the return valve was deleted completely and replaced by a long stack pipe which passes up to the top of the tank; be very careful not to tilt the tank on removal or fuel may be spilt.

Tank insulation

13 Note that under certain weather and traffic conditions it is possible for the temperature in the vicinity of the engine to rise to extremely uncomfortable levels, especially in the case of fully-faired models such as the K100 RS, K100 RT and K100 LT.

14 When these machines are ridden in hot weather the heat build-up, apart from being very unpleasant, can cause fuel starvation due to evaporation in the fuel feed hose and fuel rail. Paradoxically US models fitted with the EEC system can suffer from excessive mixture richness since the rate of evaporation inside the tank is so high and all the vapours are sucked into the engine via the crankcase and breather.

15 To effect a cure, BMW lined the underside of all tanks with a layer of reflective insulating material. On the fully-faired 100 models a modification was introduced to improve the flow of air through the fairing. The gaiters are removed and replaced by deflectors which actively scoop cold air into the fairing, the metal fairing inner panels being modified to deflect the hot air away from the rider's legs and outwards through the fairing vents. Also pre-cut knee pads are supplied which are to be glued to the sides of the tank to protect the rider's legs from its heat and a higher output pump is fitted.

Evaporative Emission Control System

16 The system's components and layout are explained in Section 1 of this Chapter. The system requires no maintenance beyond a quick check that the hoses are clear and the valve is working properly whenever the tank is removed.

17 To remove the hose and pressure relief valve the tank should first be withdrawn so that the hose lower end can be released from the union on the crankcase next to the coolant pipe stub. On refitting, note that the arrow on the valve body indicates which way up it is to be fitted.

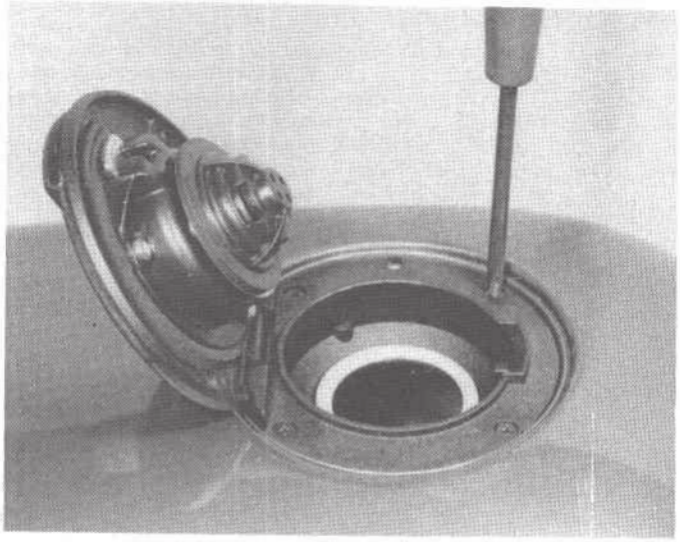
18 If any part of the system is found to be damaged or faulty, it must be renewed; use only genuine BMW replacement parts.

19 If the machine seems to be running rich, especially when the weather is hot or if the machine is used extensively in heavy traffic, the EEC system may be the cause of the problem; take the machine to an authorised BMW dealer for careful checking. For machines used outside California it may be possible to modify the system, but this must be done only if necessary and in accordance with EPA regulations.

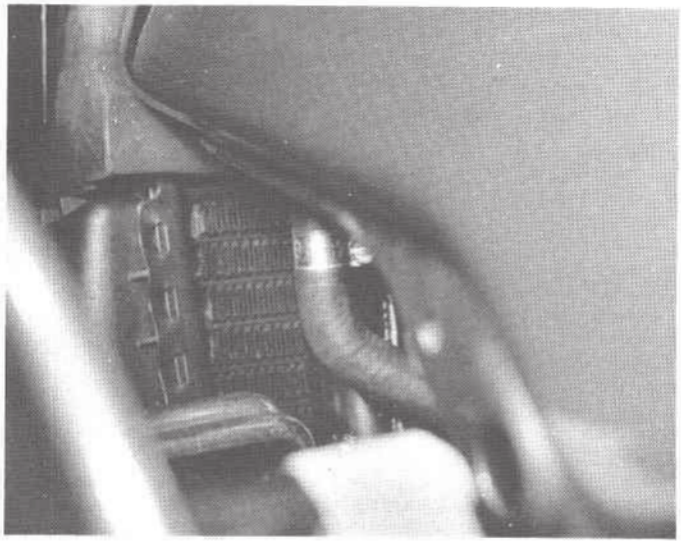
Fuel tank – general

20 Whenever the tank is removed, check that there is no dust or water inside and flush it out if any is found; not only is the fuel system as susceptible as any other to the presence of water but the pump (especially later types) can be seriously damaged if dirt is allowed to enter it.

21 Note that the tank is constructed of aluminium alloy; this makes its repair a task for the expert alone. An authorised BMW dealer should be able to advise you of the nearest person able to undertake such work. Due to the number of internal pipes and passageways, the tank must be flushed out even more carefully than normal before it is taken for repair. Make sure that the repairer is aware of the tank's complex construction so that all breather and vent passages, for example, are kept clear.



6.1 Remove retaining screws to release filler cap assembly – check gaskets carefully



6.9 Check all external hoses regularly for security and condition

7 Fuel gauge sender unit: removal and refitting

1 The low fuel level warning lamp system is operated by a float-type level sensor mounted in the base of the fuel tank. Check the system as described in Chapter 10. Note: Refer to the warnings given in Section 2 of this Chapter before starting work on any part of the fuel system.
2 If the sender unit is to be removed, withdraw the fuel tank and drain the fuel into a suitably-marked container. See Section 5 of this Chapter.
3 Remove the fuel filler cap. See Section 6. Check that the ignition is switched off.
4 Disconnect the fuel pump wires, noting which wire is attached to which pump terminal, then invert the tank on to a layer of clean cloth to protect its paintwork and peel back the flap of insulating material which covers the sender unit undersides (later models only).
5 On early models unscrew the gland nut and withdraw the sender unit from its location on the rear of the pump. On later models remove the four retaining screws and withdraw the sender unit, taking care not to bend the float arm.
6 As mentioned in Chapter 10, the sender unit cannot be repaired or adjusted and must be renewed if faulty.
7 On reassembly, always renew the sealing washer or O-ring to prevent leaks and tighten securely the gland nut or mounting screws. Note that the later type of sender unit is refitted with the (smaller thread size) yellow wire on the left-hand side of the tank so that the electrical lead projects to the rear. Be careful to connect the wires correctly to the pump.

8 Fuel filter: removal and refitting

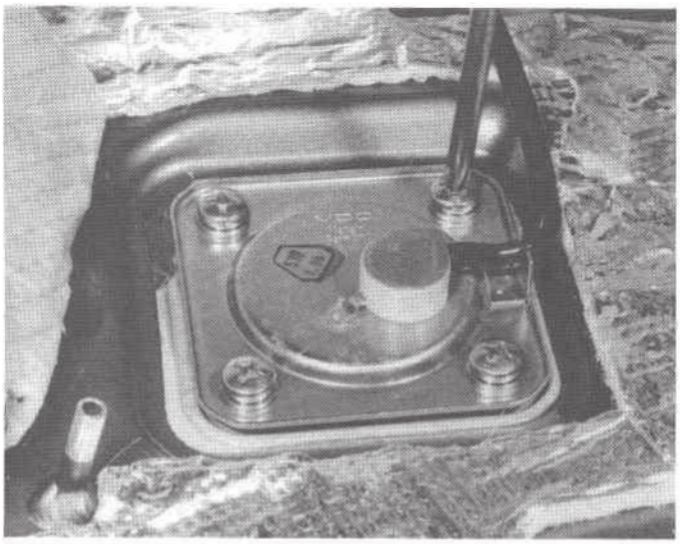
Note: *Before starting work on any part of the fuel system, read the notes given in Section 2 of this Chapter concerning safety precautions.*

1 Unlock and raise the filler cap, then remove it as described in Section 6. Relieve any residual fuel system pressure. See Section 3.
2 Using a long-bladed screwdriver, slacken the clamp securing the filter short hose to the metal pipe, carefully pull the filter assembly off the metal pipe stub and withdraw the filter from the tank; there should be sufficient length in the long filter/pump hose to permit this. Slacken the clamps and withdraw the filter from the hoses. If the clamps are not the smaller (12 mm) type they should be discarded and the modified item fitted.
3 Discard the old filter, disposing of it tidily and safely, then install the new component, using the markings on the filter housing to ensure that the fuel flow direction is correct.
4 **Note:** The filter has been modified; the old unit, which can be identified by the manufacturer's marks being stamped into it, was found on occasions to crack around the stamp marks, thus causing a significant loss of pressure and hard starting. The modified component has a thicker housing and can be identified by the manufacturer's marks which are now inked on. Always use the modified component.
5 On refitting, slide the hoses fully on to their metal stubs and slide down the clamps until they are located behind the metal pipe flared ends; tighten the clamps securely.
6 Refit the filler cap. See Section 6. Ensure that its seal is of the modified type (where applicable) and refitted correctly to prevent water from leaking in.

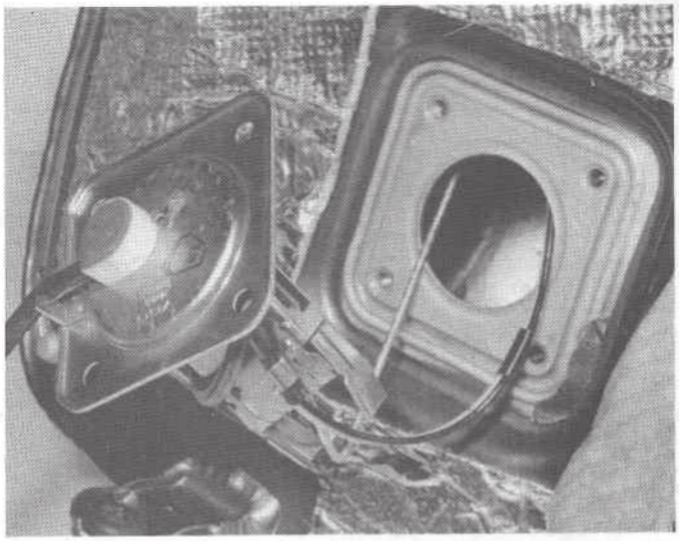
9 Fuel pump: removal and refitting

Note: *Before starting work on any part of the fuel system, read the notes given in Section 2 of this Chapter concerning safety precautions.*

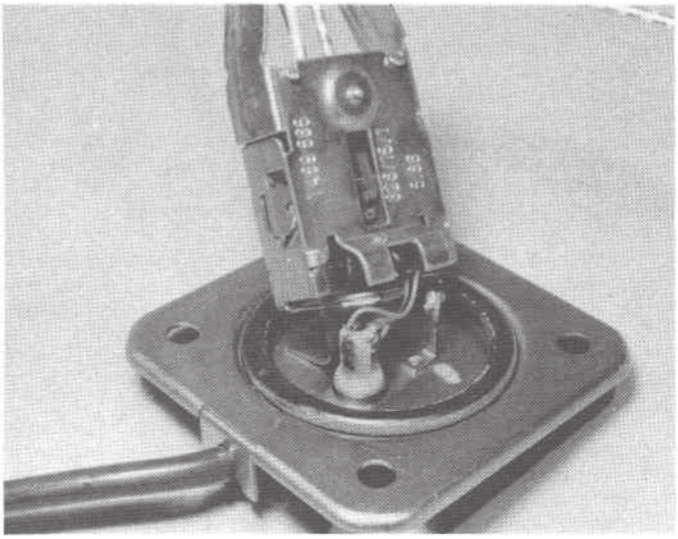
1 Remove the filler cap. See Section 6. Check that the ignition is switched off.
2 Disconnect the fuel pump wires by unscrewing the terminal nuts; although there should be no possibility of confusion since the terminals are of different sizes, note which wire is attached to which terminal. Relieve any residual fuel system pressure, see Section 3.
3 Disconnect the fuel pump/filter hose, slackening the clamp with a long-bladed screwdriver.
4 On later models, disconnect the pump gauze filter breather hose from its stub.
5 Squeeze together the nylon ears of the pump retaining ring and withdraw the assembly.
6 On refitting, ensure that there is no dirt or water in the fuel tank and that all pump components are absolutely clean. Check that the mesh strainer is securely fastened. If the hose clamps are not the smaller (12 mm) type they should be discarded and the modified items fitted.
7 Fit the pump to its mounting bracket so that the (smaller) positive (+ve) terminal is on the left-hand side, in approximately the 10 – 11 o'clock positon. Push the pump firmly into place and check that the retaining ring ears clip into position.
8 Re-connect the mesh filter breather tube (later models only) and the pump/filter hose. Push the hose fully on to its stub and slide down the clamp until it is located behind the stub flared end; tighten the clamp securely.
9 Connect the pump wires to their terminals; the yellow wire must be connected to the smaller positive (+ ve) terminal, the black wire to the larger negative (– ve) terminal. Ensure that the terminal nuts are securely fastened.
10 Refit the filler cap.



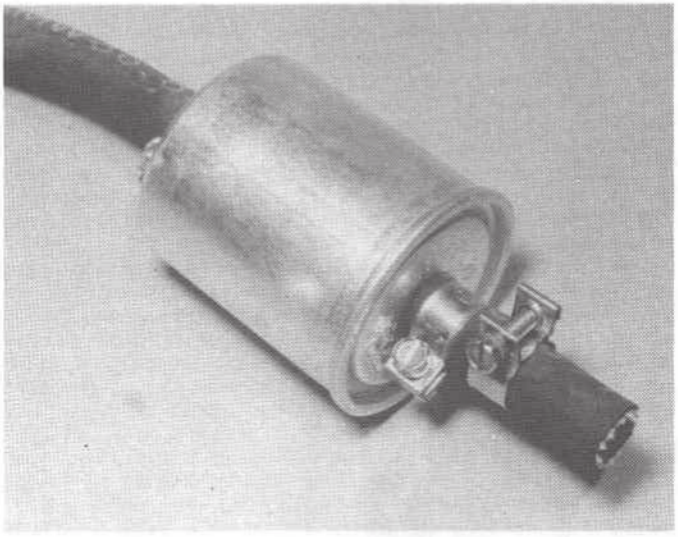
7.4 Fuel gauge sender unit is mounted in underside of tank – later type shown



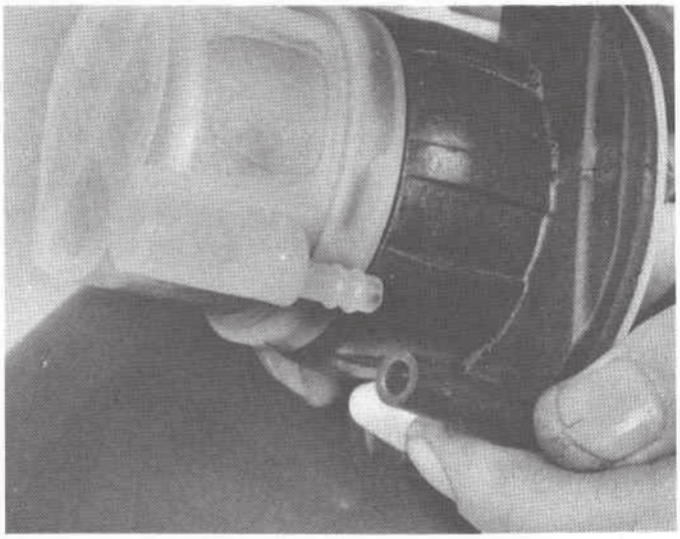
7.5 Take care not to bend float arm on later type of sender unit



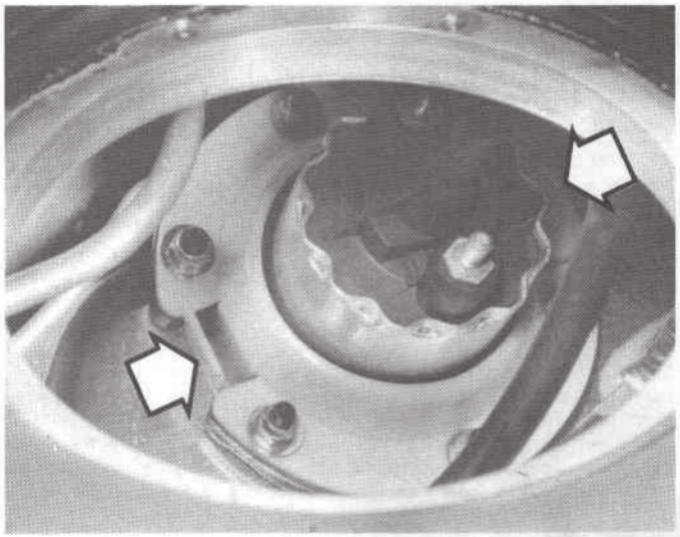
7.7 Always renew seal or O-ring to prevent risk of fuel leaks



8.3 Marks on fuel filter casing show direction of fuel flow – ensure modified type of filter is fitted on renewal



9.4 On later models, do not forget to disconnect pump filter gauze breather hose



9.5 Squeeze together mounting 'ears' (arrowed) to release pump assembly – note smaller terminal is on tank left side (uppermost in photo)

10 Fuel pump: examination and renovation

1 Note that the pump cannot be dismantled for repair or reconditioning; if it is faulty, or stops working, it must be renewed. The only effective test of the pump's condition is described in Section 11 of this Chapter, but this requires the use of a suitable pressure gauge. Ensure that the working area is absolutely clean when servicing the pump.
2 With the pump removed from the fuel tank, unscrew the nuts which clamp the rubber sleeve to the nylon retaining ring. The retaining ring should have an alignment mark (a small + symbol embossed on it) next to the smaller positive terminal; if none can be seen make your own marks before withdrawing the retaining ring and pulling the pump out of the rubber sleeve and mesh filter. Note that while it is, of course, possible merely to pull the filter off the pump lower end, the filter should be removed and refitted with care so that it is not damaged or distorted.
3 Disengage the filter from the sleeve, noting the alignment marks. Check the filter for splits or tears; if any are found or if it is a slack fit on the sleeve, the filter must be renewed. If not, swill it in high flash-point solvent to remove any particles of dirt.
4 Carefully clean all components and check for wear or damage; if any is found the component concerned must be renewed.
5 Note that the pump has been modified; since the introduction of the 75 models (ie all 1986 on models) a pump is fitted which is manufactured to tighter tolerances to ensure that the delivery rate remains correct even at high operating temperatures. This is now supplied as the replacement part for earlier models also. To prevent the formation of vapour bubbles which would otherwise interrupt the fuel supply, the new pump is fitted with a modified mesh filter and rubber sleeve, the filter being fitted with a separate breather hose.
6 While the new pump does ensure greater consistency of fuel supply, its tighter tolerances mean that it is more easily damaged by dirt. To prevent this, take great care to ensure that the pump components are kept as clean as possible at all times. Use only lint free cloths for cleaning purposes and flush out the tank immediately if any dirt or water are noticed inside it at any time.
7 On reassembly, check that all components are absolutely clean, then fit the mesh filter to the rubber sleeve, aligning their marks as shown in the accompanying photograph. Fit the retainer ring to the rubber sleeve and tighten the retaining nuts lightly, the ring will fit only the correct way due to the offset studs and mounting ear cutouts in the rubber sleeve.
8 Lubricate the pump body with a smear of fuel or a very small amount of engine oil, then press it into the rubber sleeve, taking care not to dislodge the mesh filter, until the locating ribs on the pump body snap into the grooves in the rubber sleeve. If the pump is a very tight fit, remove the retainer ring, press the pump into the rubber sleeve and then refit the ring. When the pump is fully in place, rotate it to align the retainer ring mark with the pump positive (+ve) terminal and tighten the retainer ring nuts securely. Make a final check that the mesh filter is fully and securely fixed on the rubber sleeve and that the alignment marks are in line.

11 Fuel pressure: testing

Note: *Before starting work on any part of the fuel system, read the notes given in Section 2 of this Chapter concerning safety precautions*

1 The only test of the fuel pump's and pressure regulator's performance is to measure the delivery pressure, as described below. Note however that if the fault occurs under a particular set of circumstances, for example only in very hot weather, these circumstances should be duplicated as closely as is reasonably possible when making the test. First relieve any residual fuel system pressure as described in Section 3.
2 Referring to Section 5 of this Chapter disconnect the fuel feed hose at the fuel rail and connect a suitable pressure gauge between the hose and the rail; BMW's own gauge is available under part number 16 1 500.
3 Start the engine and allow it to idle while taking pressure readings. Since fuel pressure is not related to engine speed there is no point in running the engine any faster unless the fault occurs only at higher speeds or the pressure regulator performance is to be checked. In the latter case open and close the throttle sharply once or twice to note the effect of the differing intake vacuum pressures on the fuel pressure. If the pressure regulator is faulty, it must be renewed.
4 The pressure reading obtained should be steady at approximately 2.5 bar (36 psi) although some BMW service literature does mention a figure of 2.2 bar (32 psi) at idle speed. If the reading obtained is significantly lower than that specified, check the tank hoses and pipes on the pump delivery side (Section 6), and the fuel filter (Section 8) before renewing the fuel pump as described in Section 9.
5 If the pressure recorded is significantly higher than that specified, the pressure regulator and its vacuum hose should be checked (Section 12). If the pressure exceeds 4.7 bar (68 psi) indicating that the regulator safety valve has stuck, the pressure regulator should be renewed immediately.

12 Pressure regulator: removal, examination and refitting

Note: *Before working on any part of the fuel system, read the notes given in Section 2 of this Chapter concerning safety precautions.*

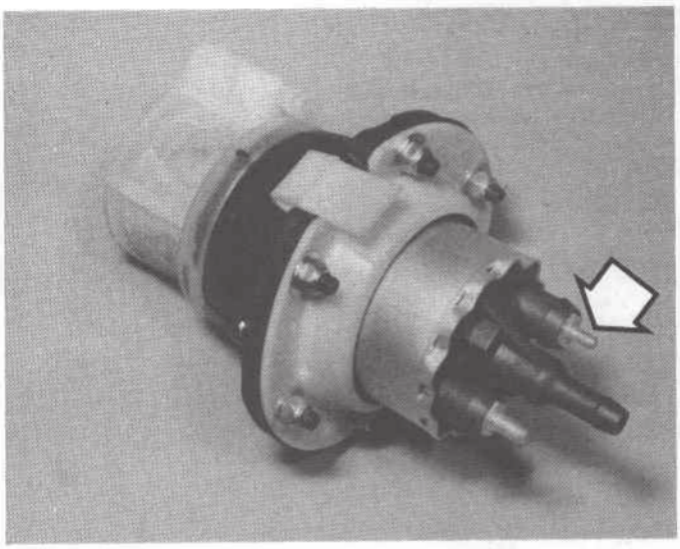
1 On K100 RS, K100 RT and K100 LT models, remove the fairing knee pads, lower side panels and radiator cover. On K75 S models owners may wish to remove the fairing side panels or at least their bottom covers to gain easier working conditions. On all other models, remove the radiator cover panels. See Chapter 7.
2 Remove the complete air filter assembly. See Section 14 of this Chapter. Relieve any residual fuel system pressure. See Section 3.
3 Using a suitable screwdriver to slacken the hose clamps (where fitted) disconnect the fuel rail/pressure regulator hose, the fuel return hose, and the vacuum hose.
4 Slacken the nut securing the regulator top to its mounting and withdraw the regulator.
5 On refitting, tighten the nut securely, to the specified torque setting, where available. Connect the fuel return hose (from the tank) to the top union, the fuel rail hose to the side union and the vacuum hose (from the rear throttle body vacuum take off-stub) to the bottom union.
6 Secure the pressure hoses by pushing them fully on to the regulator stubs and sliding each clamp down until it is behind the stub flared end, then tighten the clamp securely. Check carefully for leaks when the engine is started.
7 Examine the regulator carefully; if it is cracked, dented or damaged in any way, it must be renewed. Connect the vacuum hose to the bottom union and suck on the hose end; if there is any sign of leakage, check the hose for splits, tears or damage and renew it if necessary. If the hose is in good condition, the regulator diaphragm must be damaged; if this is the case the regulator must be renewed.

13 Fuel rail and injectors: removal, examination and refitting

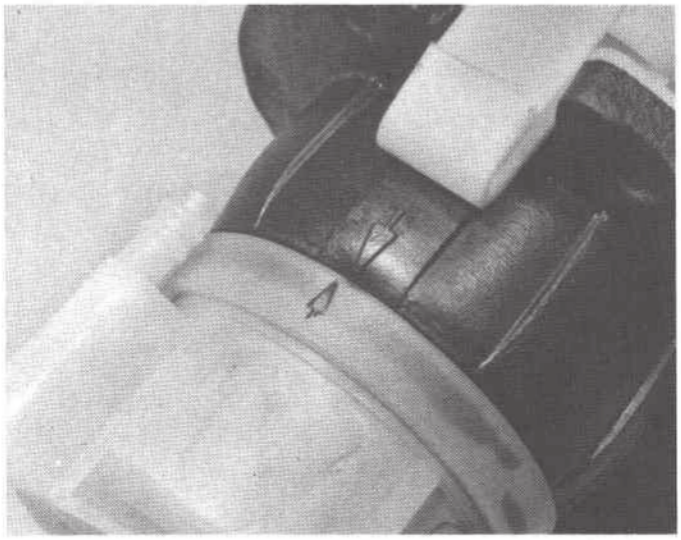
Note: *Before starting work on any part of the fuel system, read the notes given in Section 2 of this Chapter concerning safety precautions.*

1 On K100 RS, K100 RT and K100 LT models remove the fairing left-hand knee pad and lower side panel. See Chapter 7. Wash any dirt or debris away from the cylinder head.
2 Relieve any residual fuel system pressure. See Section 3.
3 Disconnect the fuel feed hose from the rail front end, and the regulator hose from its rear end. Withdraw the injector cover (where fitted).
4 Disconnect the wires from each injector, being careful to disengage the wire clips before pulling off the connector plug. Release the wires from any ties securing them to the fuel rail.
5 Remove the two bolts securing the fuel rail, noting the metal washers and rubber mounting at each point, then carefully withdraw the rail from the cylinder head, complete with the injectors. Place a wad of clean rag in each injector port to prevent the entry of dirt.

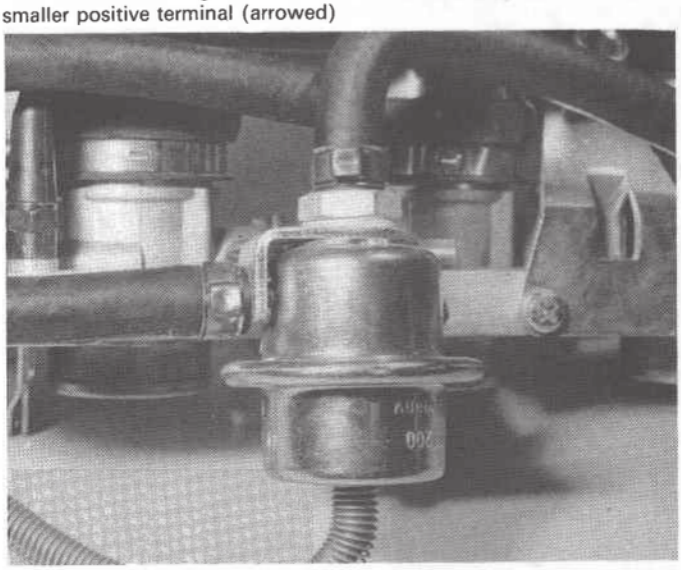
6 Use a pair of pliers to withdraw the clips securing each injector to the rail. Always renew the sealing O-rings at each end of the injectors whenever they are disturbed.
7 Check that the fuel rail is clean and free from blockages. No information is available to permit the injectors to be tested or serviced; if faulty they must be renewed.
8 On reassembly fit a new O-ring to each end of all injectors and apply a smear of grease to aid refitting. Position each injector in the rail cup and secure it with its clip. Check that the metal spacer is in place in each rail mounting grommet.
9 Remove the wads of rag and check that each injector port is completely clean, then refit the fuel rail assembly, guiding the injectors carefully into place. Fit a cupped washer over each side of each rail mounting grommet then refit the mounting bolts and their washers. Do not overtighten the mounting bolts; use the specified torque wrench setting, where available.
10 Arrange the wiring neatly along the fuel rail and refit each connector plug to its respective injector; check that the wire clips lock into place correctly. Secure the wires neatly to the rail with cable ties and refit the injector cover (where fitted).
11 Push the pressure hoses fully on to their stubs at each end of the rail, then slide each clamp down until it is located behind the stub flared end and secure it firmly.



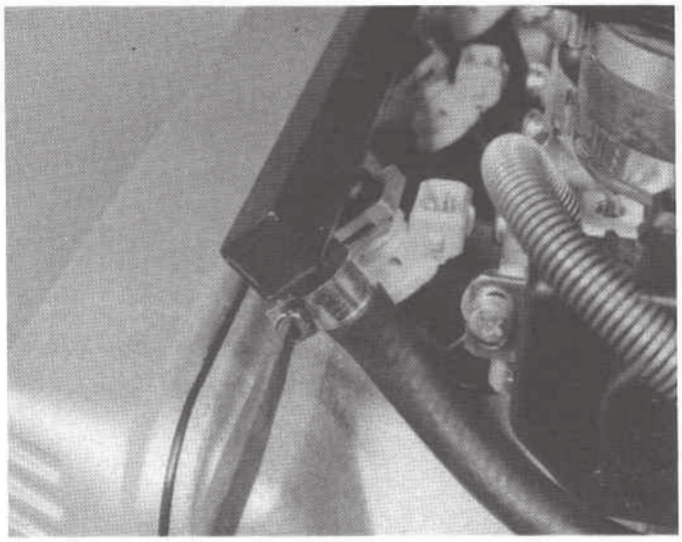
10.2 Before removing retaining ring, check for alignment marks with smaller positive terminal (arrowed)



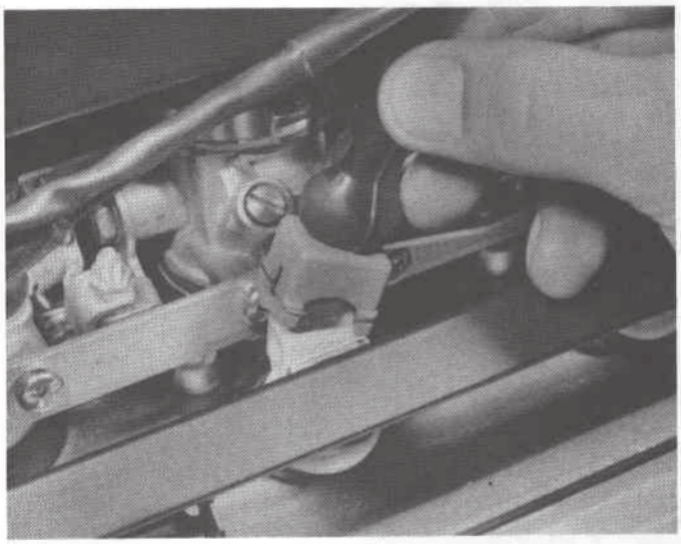
10.7 Ensure mesh filter is securely fixed on rubber sleeve, with arrow marks aligned



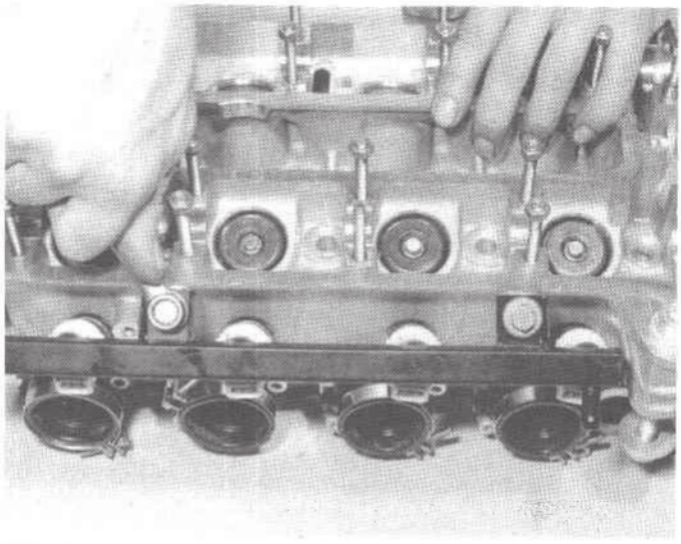
12.3 Pressure regulator is mounted on right-hand side of throttle butterfly assembly



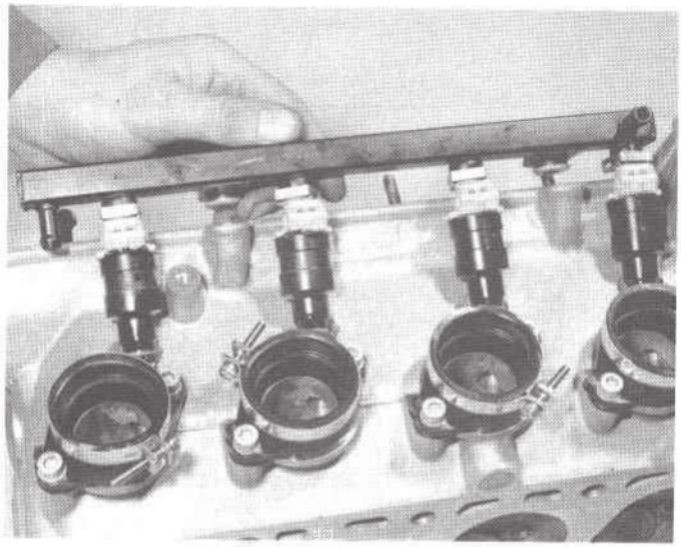
13.3 Disconnecting regulator hose from fuel rail rear end



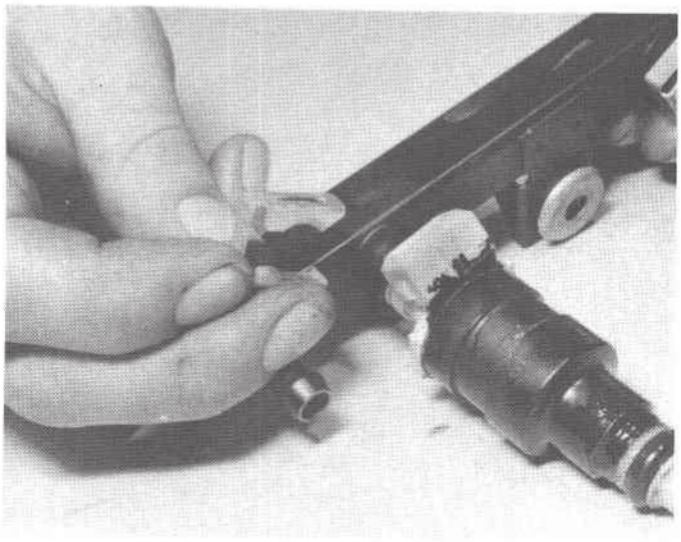
13.4 Disengage wire clip before pulling off each injector connector



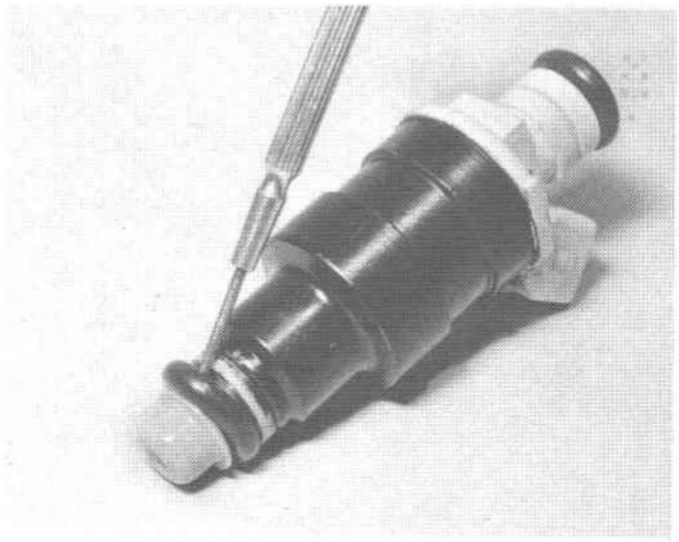
13.5a Fuel rail is secured by two bolts – note rubber mountings



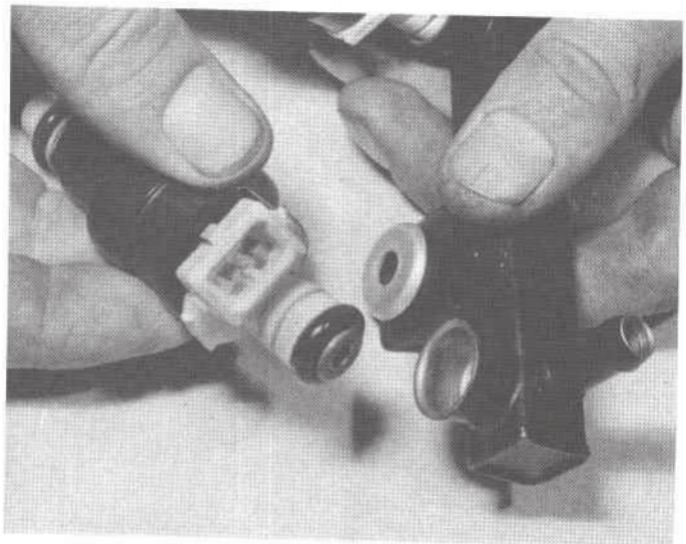
13.5b Removing fuel rail, complete with injectors



13.6 Withdraw clip to release injectors from fuel rail



13.8a Be very careful not to damage injector when renewing O-rings



13.8b Always renew sealing O-rings to prevent leaks – do not omit fuel rail mounting spacer

14 Air filter housing: removal and refitting

1 On K100 RS, K100 RT and K100 LT models, remove the fairing knee pads, radiator cover and lower side panels. On K75 S models owners may wish to remove the fairing side panels, or at least their bottom covers, to gain easier access. On all other models, remove the radiator cover panels. See Chapter 7. Removing its top retaining screw (where fitted) withdraw the air intake hose.

2 Although not strictly necessary, the removal of the fuel tank makes work so much easier that it is strongly recommended.

3 Release the three retaining clips which secure the filter assembly top and bottom halves, then withdraw the filter element; note that the single front clip is lifted upwards to release it and that the filter is withdrawn diagonally to the rear.

4 Slacken the clamp which secures the plenum chamber end of the air filter/plenum chamber hose; this is extremely awkward to reach with the fuel tank and/or radiator in place and will require the careful use of a suitable screwdriver.

5 With the clamp slackened, pull the air filter top half away from the plenum chamber. Again this is awkward due to the presence of the pieces of insulating material. To enable the filter top half to be

completely removed, the airflow meter must be detached so that its connector plug can be unfastened.

6 To remove the airflow meter, unscrew the two retaining screws in the filter top half then invert it and slacken the clamp which secures the air filter end of the connecting hose. Withdraw the meter, noting carefuly how the wiring is routed, then disengage the wire clip and unplug the meter connector. Pull the meter lead and sealing grommet through the air filter top half aperture and withdraw the filter top half. Place the airflow meter in a clean secure container where it cannot be damaged.

7 Unscrew the two Allen screws securing the filter bottom half to the crankcase and withdraw it, noting the metal washers on each side of the rubber mounting grommet.

8 On refitting, tighten the filter bottom half retaining Allen screws securely to the specified torque setting, where given.

9 Refit the electrical lead to the air filter top half and plug its connector into the airflow meter. Position the airflow meter in the filter so that the lead is correctly routed, then refit and tighten the meter mounting screws securely. Do not overtighten these screws or the mounting bracket may be cracked; note that it is available as a separate component if it is found to be cracked at any time.

10 Ensuring that the connecting hose is pushed fully into place on the mounting stubs, position and tighten the two clamps securely.

11 Refit the filter element, ensuring that its sealing lips and guide tabs engage fully with those of the filter top and bottom halves, particularly on the filter left-hand side which cannot be seen easily. Note that the side with the Top-Oben marking must be at the rear and the element must be installed so that the arrow points upwards. When the filter is securely positioned so that no unfiltered air can leak past, fasten the retaining clips.

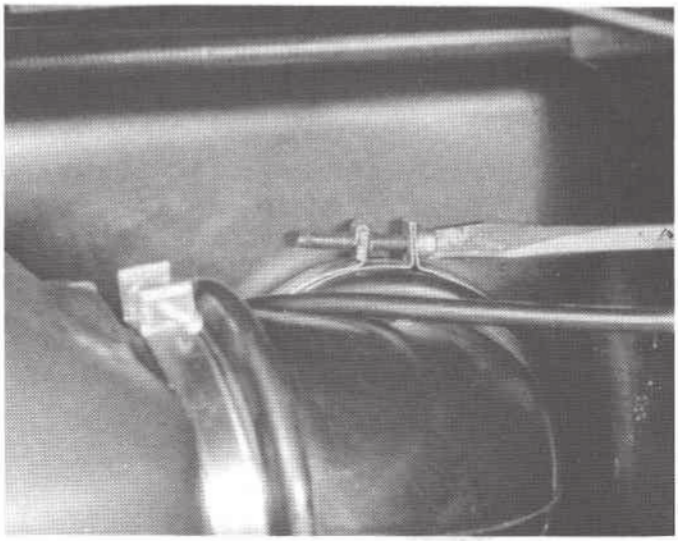
12 Refit the air intake hose and radiator cover panels or fairing components, and the fuel tank (where necessary).

13 Note that the plenum chamber can be removed either by breaking the clips securing it to the throttle butterfly assemblies, which will require new clips and the use of a special tool on reassembly, or by removing it complete with the butterfly assemblies. Refer to Section 16 of this Chapter for details.

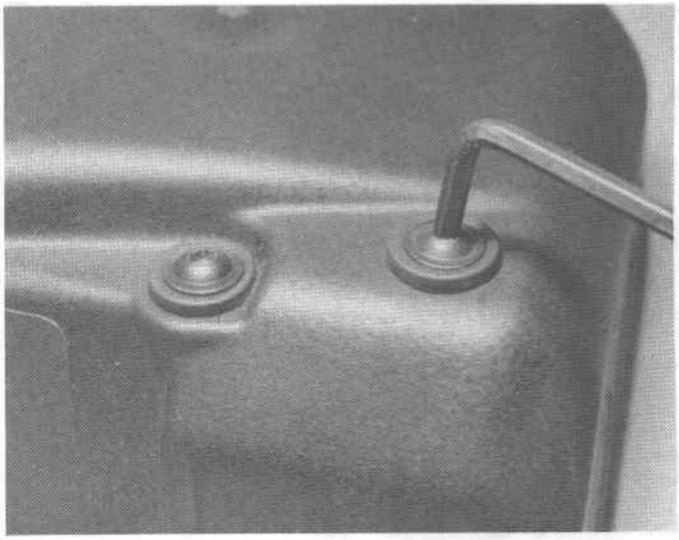
14 **Note:** The cleaning and renewal of the air filter element are covered in the Routine Maintenance section of this Manual.

15 Airflow meter: removal and refitting

Since the airflow meter is mounted in the top half of the air filter assembly it is removed and refitted as described in Section 14 of this Chapter.



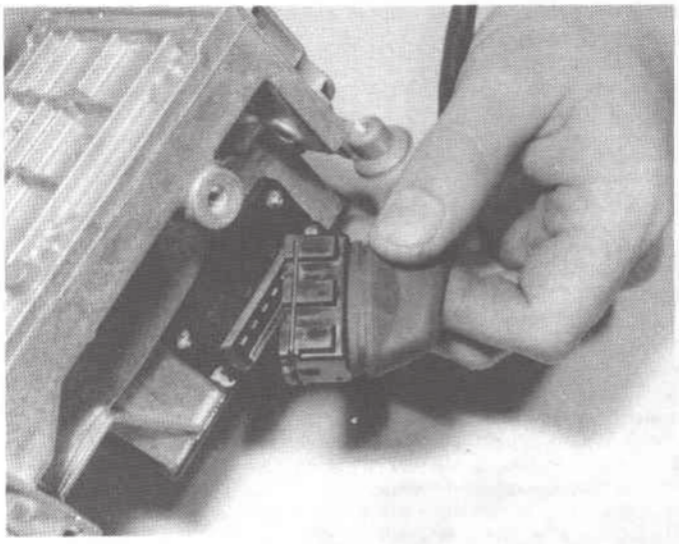
14.4 Clamp at plenum chamber end of air filter/chamber hose is very difficult to reach



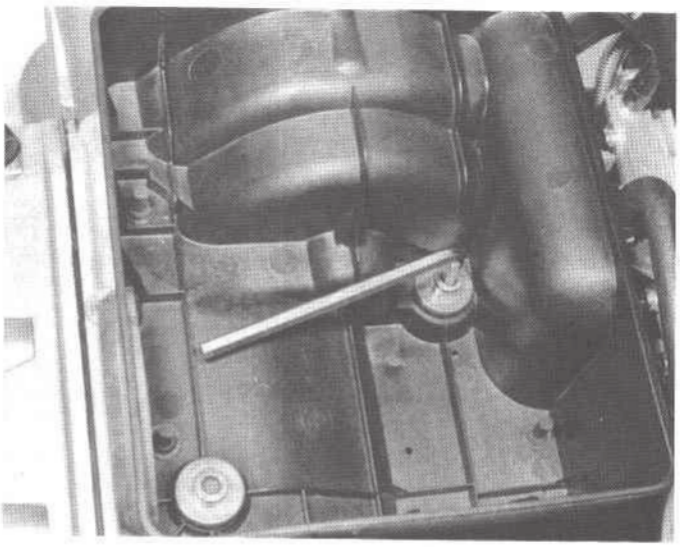
14.6a Remove two screws from top of air filter top half ...



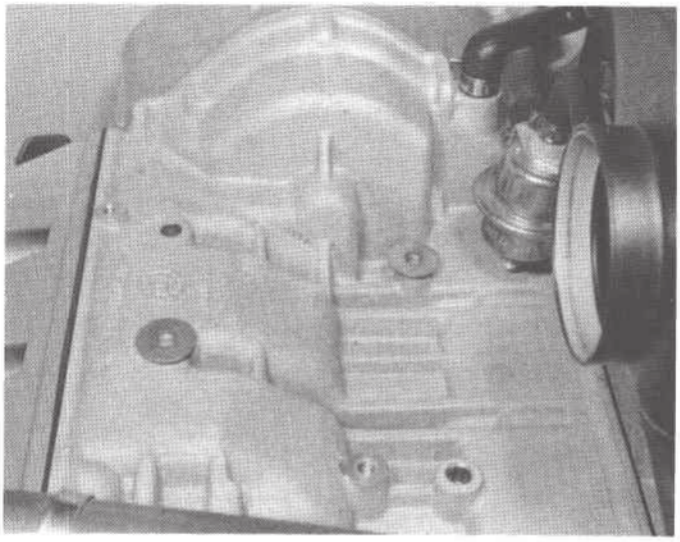
14.6b ... then slacken hose clamp to release airflow meter



14.6c Disengage wire clip before disconnecting meter plug



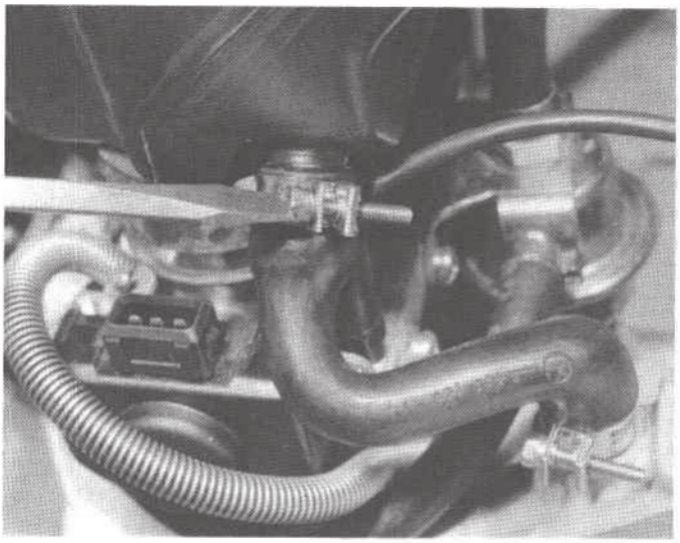
14.7a Air filter bottom half is retained by two Allen screws ...



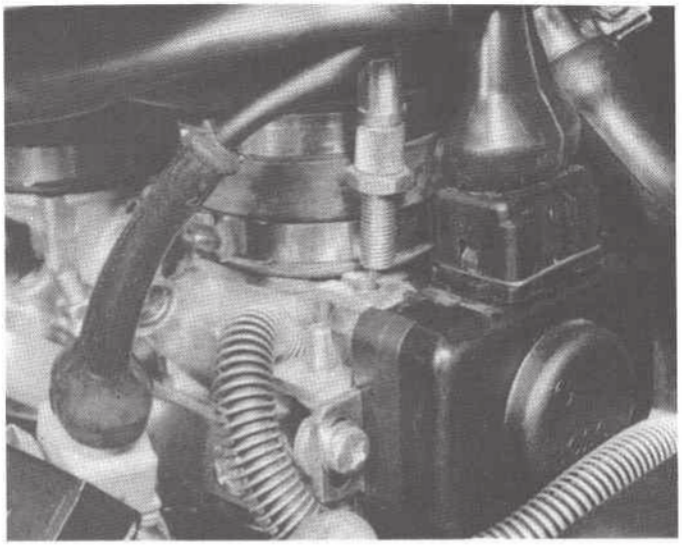
14.7b ... note metal washers fitted to crankcase mountings – do not omit

16 Throttle butterfly assembly and plenum chamber: removal and refitting

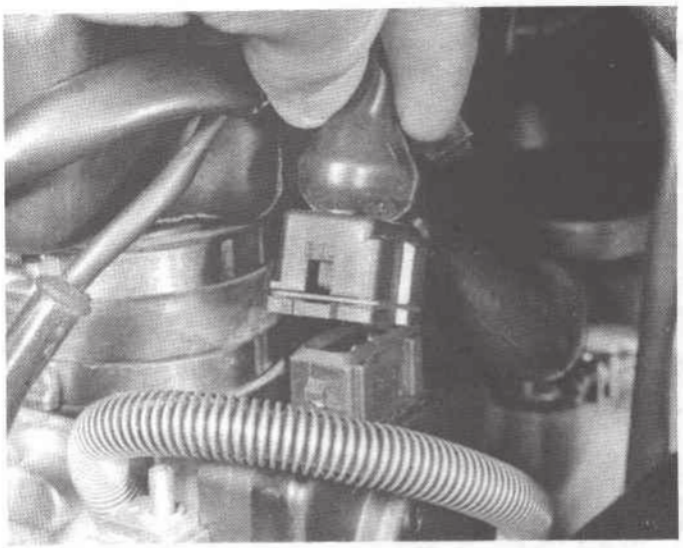
1 On K100 RS, K100 RT and K100 LT models remove the fairing knee pads, radiator cover and lower side panels. On K75 S models, owners may wish to remove the fairing side panels, or at least their bottom covers, to gain easier access. On all other models, remove the radiator cover panels. See Chapter 7.
2 Remove the fuel tank. See Section 5.
3 Note: The clips securing the plenum chamber to the throttle butterfly assembly are of a special type which must be broken to remove them and must be renewed, and fastened using a special tool, on refitting. To avoid the need for this it is recommended that the throttle butterfly assembly and plenum chamber are removed as a single unit, as described below.
4 Referring to Section 14 of this Chapter withdraw the air filter housing top half and the filter element; there is no need to separate the airflow meter connection but the connecting hose must be disconnected from the plenum chamber.
5 Slacken its clamp and withdraw the crankcase breather hose from the plenum chamber stub. Note that if its retaining clips are to be broken and renewed, the plenum chamber can now be withdrawn from the machine. On refitting, apply a smear of lubricant to the air filter connecting hose and to the rubber stubs connecting it to the throttle butterfly mouths. Ease the chamber into place, ensuring that the pieces of insulating material are correctly positioned, and settle it fully into place before securing the hose clamps. Note that those fastening the throttle butterfly assembly unions are secured with BMW tool number 13 1 500.
6 Remove the fuel rail and injectors. See Section 13.
7 Slacken their adjuster locknuts and screw in the adjusters to gain the maximum free play in the throttle and choke control cables, then disconnect the cable end nipples from their operating levers and withdraw the outer cables from their brackets. Disconnect the throttle position switch at its connector plug, then either unscrew from its mounting bracket or disconnect at the main wiring loom the choke warning lamp switch.
8 Slacken the intake stub securing clamps and withdraw the throttle butterfly assembly and plenum chamber. Note how the clamps are positioned to clear the throttle operating mechanism components. Each intake stub is secured by two screws or bolts.
9 The pressure regulator, vacuum switch (early 100 models only) and choke warning lamp switch can be removed, if required.
10 **Do not** attempt to dismantle the throttle butterfly assembly further, and **never** disturb the screws linking the butterfly operating arms. Since the bypass screws provide only a limited adjustment it will not be possible to ensure accurate synchronisation if the butterflies are disturbed; they are set at the factory and can only be renewed as a single assembly.
11 On refitting, apply a thin coat of sealant to the stub mating surfaces and tighten the mounting screws or bolts securely, to the specified torque wrench setting, where given.
12 Refit the throttle butterfly assembly to the stubs and check that the clamp screws are positioned so that they can be secured, but so that they are well clear of any part of the throttle mechanism; operate the mechanism throughout its full travel to check that it is completely clear.
13 Connect (or refit, as applicable) the throttle position switch and choke warning lamp switch.
14 Connect and adjust the throttle and choke control cables.
15 Refit the fuel rail and injectors, then connect the crankcase breather hose to its stub.
16 Refit the air filter element and housing top half, then refit the fuel tank.
17 Check the idle speed setting and the operation of the choke and throttle controls. If necessary, check the synchronisation of the throttle butterfly bypass screws.
18 Refit the radiator cover panels or fairing components as applicable.



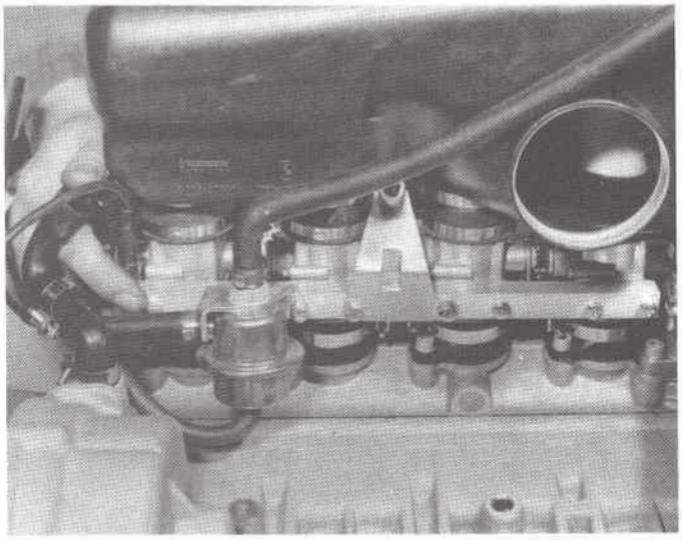
16.5 Disconnect crankcase breather hose from plenum chamber stub



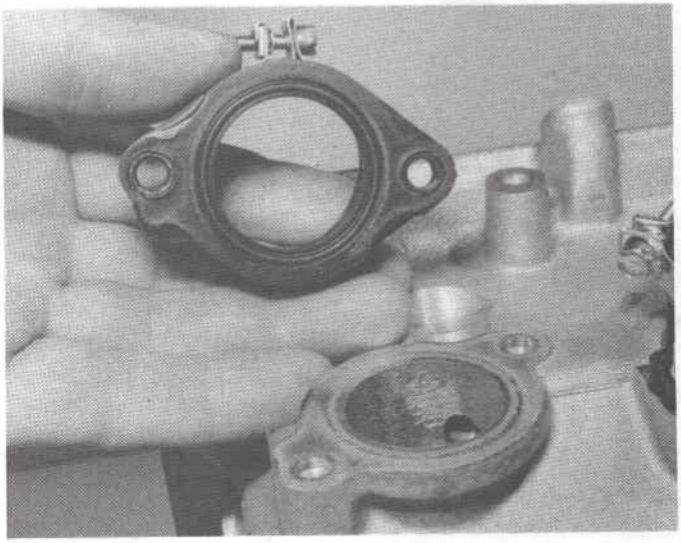
16.7a Disconnect throttle and choke control cables



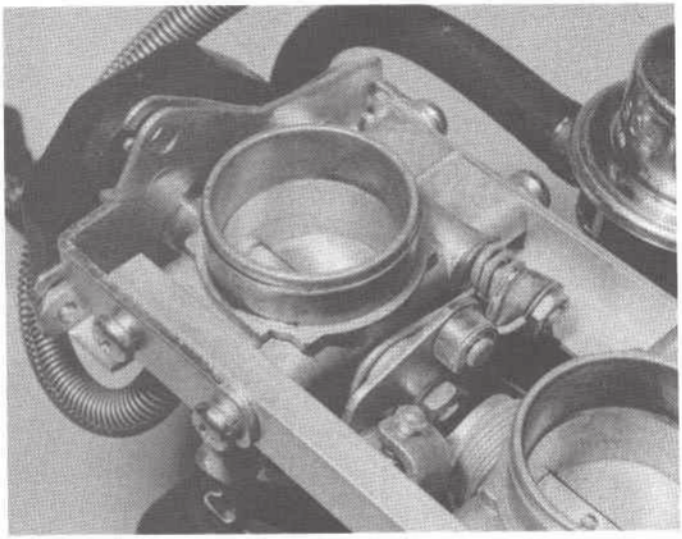
16.7b Disengage wire clip before disconnecting throttle switch plug



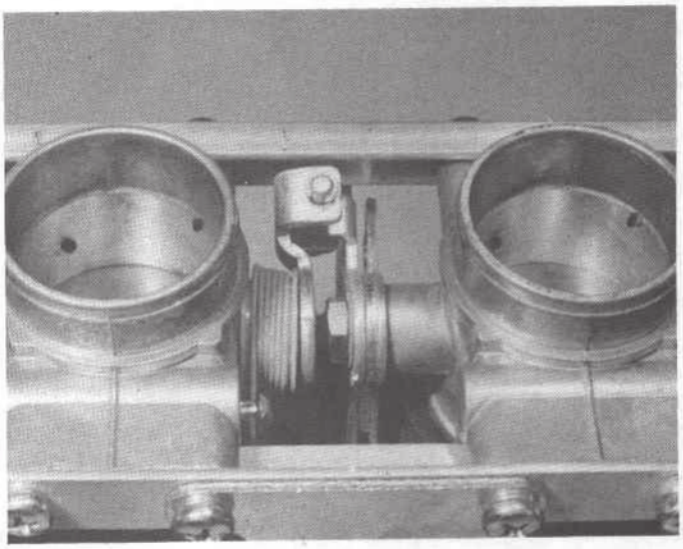
16.8a Removing the throttle butterfly assembly and plenum chamber



16.8b Check intake stubs for splits or damage – renew if necessary



16.10a Never attempt to dismantle any part of butterfly assembly ...



16.10b ... and do not disturb screws linking butterflies

17 Fuel system electrical components: removal, examination and refitting

Fuel injection relay

1 This controls the supply of current to the various components of the system and can be tested only by substituting a new component. It is situated in the electrical components box under the rear of the fuel tank and is removed and refitted as described in Chapter 10.

Airflow meter

2 This unit is situated in the top half of the air filter housing. Refer to Section 15 for details of removal and refitting.

3 No information is available to assist the ordinary owner to test this component; in the event of a fault arising the machine should be taken to an authorised BMW dealer or similar expert for checking. **Do not** attempt to test it using self-powered test circuits or testing equipment; it may be seriously damaged by the application of incorrect voltages.

4 If the unit is found to be faulty, it must be renewed; note that the mounting bracket is available separately if it has been cracked or otherwise damaged.

5 The air temperature sensor situated in the meter intake is very sensitive and must not be disturbed; it can be renewed only as a part of the meter assembly.

Throttle position switch

6 This component is mounted on the rear end of the throttle butterfly shaft. If it is to be removed, on K100 RT and K100 LT models, first detach the fairing left-hand knee pad to permit adequate working clearance.

7 Disengage the retaining wire clip and unplug the connector, then unscrew the two retaining screws and withdraw the switch.

8 On refitting, position the switch on the butterfly shaft and tighten the retaining screws lightly. Check the throttle cable adustment and rotate the switch so that a distinct click is heard from it just as the throttle cable slack is taken up and the butterlies begin to open; hold the switch in that position and tighten the retaining screws securely. Refit the connector plug, ensuring that the wire clip locks securely into place.

9 There is no information to assist the ordinary owner in testing this component; in the event of a fault arising the machine should be taken to an authorised BMW dealer for checking. **Do not** attempt to test it using self-powered test circuits or testing equipment; it may be seriously damaged by the application of incorrect voltages.

10 If the unit is found to be faulty, it must be renewed.

Fuel injection control unit

11 Unlock and raise the seat, then withdraw both side panels. See Chapter 7. Withdraw the cover from the front storage tray, also any items contained in it.

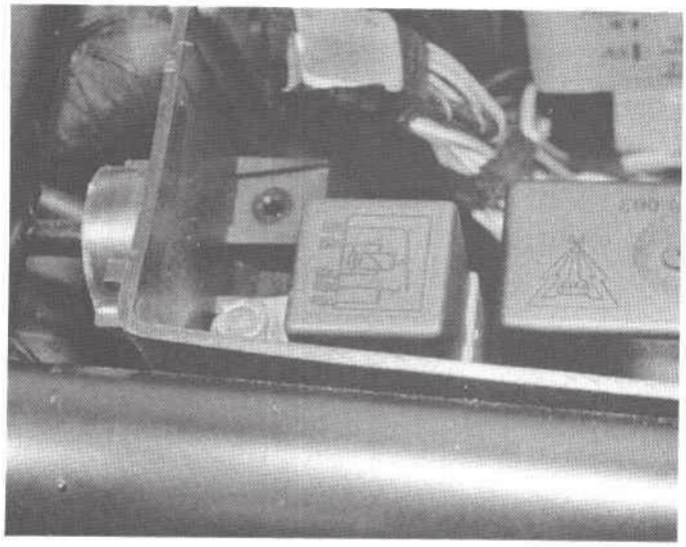
12 Gripping the tab at its front end, pull the black plastic cover sideways out of the control unit storage compartment.

13 Inserting a slim-bladed screwdriver through the access hole in the floor of the storage tray, release the locking catch by pressing it to the rear, then unplug the control unit connector plug from the rear end first and pull it out to the side.

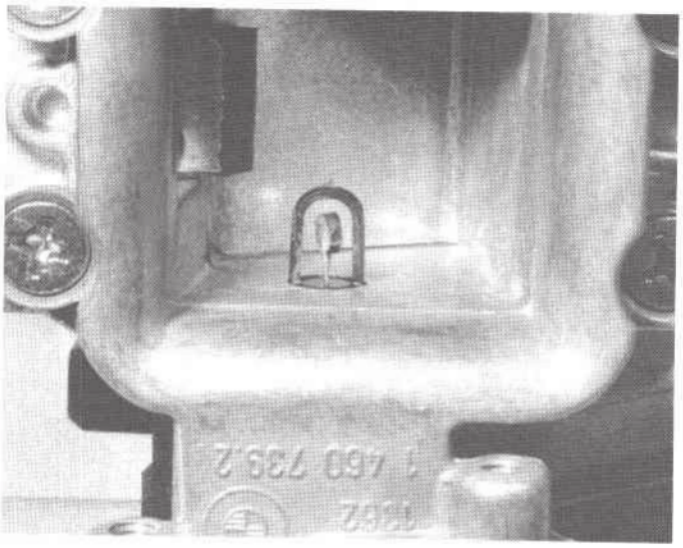
14 The control unit is secured in its compartment by the rubber mountings on the left-hand side, and by a locking pin on the right-hand side; to extract the locking pin, grip its flattened end with a pair of pliers and pull it upwards. The control unit can be removed from the storage tray while it is in place on the machine, or the two can be removed together and separated, if necessary. Ensure that the rubber mountings are located securely in their grooves on reassembly, and check that the locking catch snaps back into place as the connector plug is refitted.

15 The unit cover is retained by clips around its edge and by the two rubber mountings on the left-hand side. If the unit has become saturated with water it may be permissible to remove the cover to assist in drying out, but at all other times the cover **must not** be disturbed. If the unit is thought to be faulty, take the machine to an authorised BMW dealer for expert attention. Do not undertake any form of testing or repair work with anything other than the BMW test equipment. If the unit is faulty, it must be renewed.

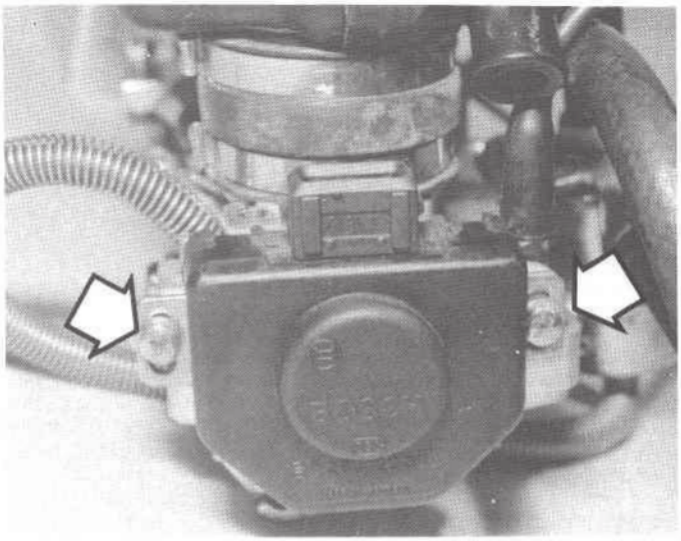
16 The unit is extremely sensitive and must never be knocked, dropped or otherwise mishandled. Note that it can be upset even by tools or similarly heavy objects rattling around in the storage tray; any items carried in the tray should therefore be either very light in weight (as recommended by BMW) with all tools carried in the tail compartment, or they should be well-wrapped in thick cloth so that they cannot move or vibrate when the machine is in motion.



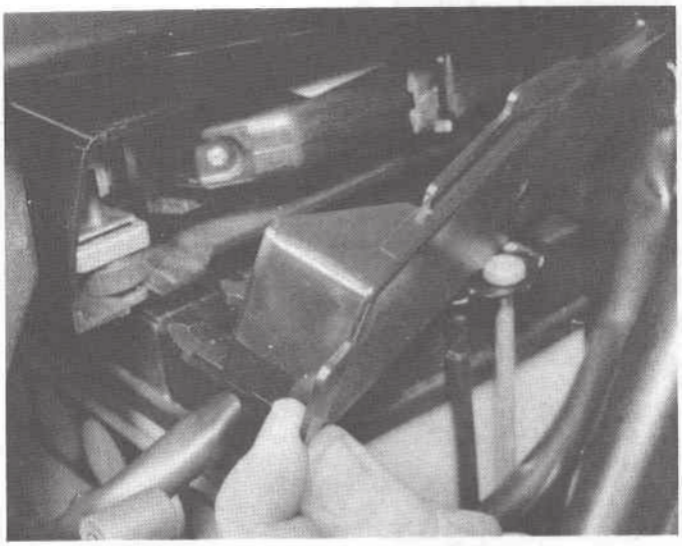
17.1 Location of fuel injection relay



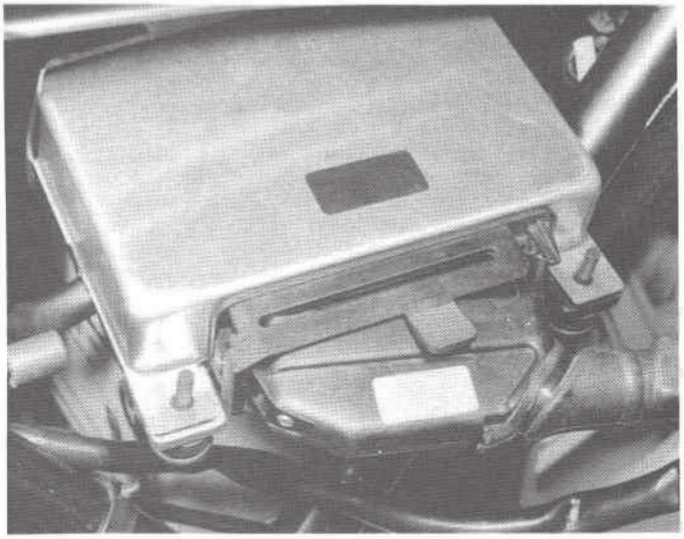
17.5 Note air temperature sensor in mouth of airflow meter – do not disturb



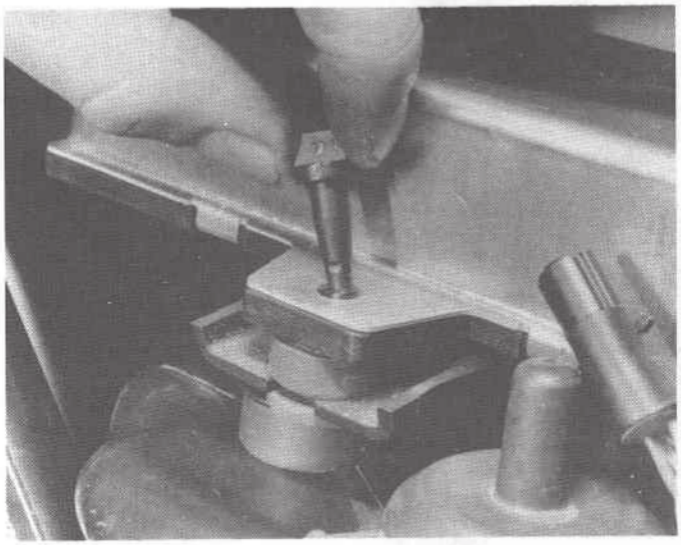
17.6 Throttle position switch is situated on rear end of butterfly assembly – note adjusting screws (arrowed)



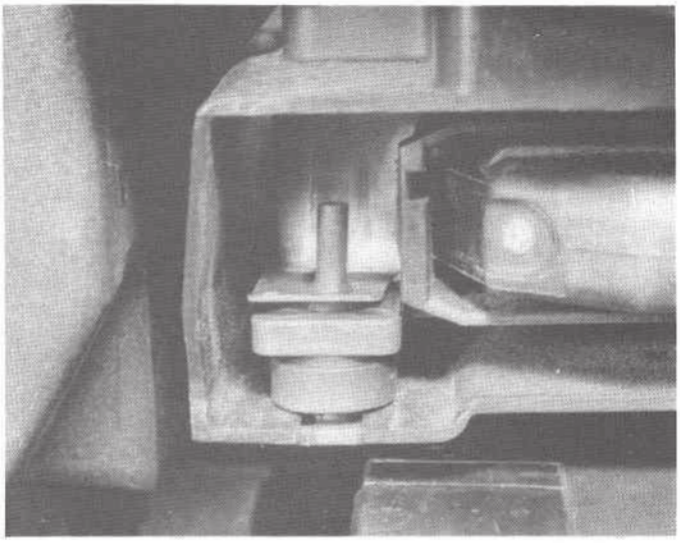
17.12 Removing fuel injection control unit – withdraw compartment cover as shown ...



17.13 ... then disconnect control unit connector plug



17.14a Control unit is retained by locking pin on right-hand side and by ...



17.14b ... rubber mountings on left – note that these also retain unit cover, but that the mounting shown is incorrectly fastened – always check that cover is secure

18 Fuel system: adjustments and checks

Fast idle speed (choke) control cable

1 The throttle operating linkage is opened a small amount on starting by the application of a handlebar-mounted control lever. On K100 RS, K100 RT and K100 LT models remove the fairing left-hand knee pad to permit access to the components for adjusting.

2 Move the handlebar lever to the first detent position to engage the first stage of operation and check that the idle speed adjusting screw (see below) is raised by the specified distance from its stop, then push the lever fully across to the second position and check that the screw is raised by the specified distance for the second stage setting:

	75 models	100 models
First stage	1.5 mm (0.06 in)	1.0 mm (0.04 in)
Second stage	3.5 mm (0.14 in)	2.5 mm (0.10 in)

3 If adjustment is required, slacken the control cable adjuster locknut and rotate the adjuster, as necessary. Re-check the setting and tighten the locknut securely. Check that some free play is present between the cable outer and the adjuster when the lever is returned fully to the off position; the usual amount is 0.5 – 1.0 mm (0.02 – 0.04 in).

Idle speed and throttle cable

4 The engine idle speed is adjusted only with the engine fully warmed up to normal operating temperature (minimum coolant temperature of 85°C/185°F).

5 On K100 RS, K100 RT and K100 LT models remove the fairing left-hand knee pad and lower side panel (as desired) to gain access to the adjuster screw.

6 Check that free play is present in the throttle cable at all handlebar positions; if not slacken the adjuster and/or re-route the control cable as necessary.

7 With the engine idling at normal operating temperature check the speed recorded by the tachometer (rev-counter). If the speed is outside the specified range turn the idle adjuster screw to correct it; the screw is threaded into an extension of the cable pulley behind number 1 throttle body (75 models) or number 2 throttle body (100 models).

8 When the setting is correct, adjust the throttle cable so that there is 0.5 – 1.0 mm (0.02 – 0.04 in) free play between the cable outer and the abutment at its lower end when the twistgrip is firmly closed; use the adjuster at the twistgrip end to achieve the correct setting, then refit the rubber cover to secure it.

9 Finally, slowly open the twistgrip and check that a distinct click can be heard just off the idle position, ie just as all cable free play has been taken up and the throttle butterflies are beginning to open. If no click is heard, either the throttle position switch is incorrectly set (see Section 17) or the idle adjuster screw is tightened too far; in either case check the settings carefully before riding the machine.

Throttle butterfly synchronisation

10 While this task can be carried out using a set of four dial-type vacuum gauges, unless these are of very good quality, with proper glycerine damping, they will not be sufficiently accurate. BMW specify the use of a mercury filled manometer (part number 13 0 700, with adaptors 13 0 702 and 13 0 703) which is much more accurate but more difficult to use.

11 Given these facts, and that synchronisation is likely to be so infrequently required, owners are strongly advised to take their machines to an authorised BMW dealer for this task to be carried out by an expert using the correct equipment. For those owners who have the skill and equipment to carry out such work themselves, proceed as described below.

12 First ensure that the air filter element is clean and/or renewed and that it is securely fastened, also that there are no leaks in the induction system. Check the setting of the choke and throttle cables and that the idle speed is correct (see above). Check that the ignition system (particularly the spark plugs) is in good condition, that the valve clearances are correct and that the exhaust system is sound, with no leaks or damage. If the engine has covered a very high mileage carry out a compression test (see Chapter 1) to ensure that it is in good condition. Note that the engine must be fully warmed up to normal operating temperature (minimum coolant temperature of 85°C/185°F) before the synchronisation is checked. On K100 RS, K100 RT and K100 LT models, remove the fairing left-hand knee pad and lower side panel to reach the throttle assembly.

13 **Note:** This check merely corrects small differences, using the bypass screws, in intake vacuum caused by production tolerances and the different rates of wear of various components. It does **not** provide sufficient adjustment for synchronisation of the butterflies themselves, which should **never** be disturbed. These are set at the factory using special air flow-measuring equipment; if the butterfly settings are ever disturbed the complete assembly must be renewed.

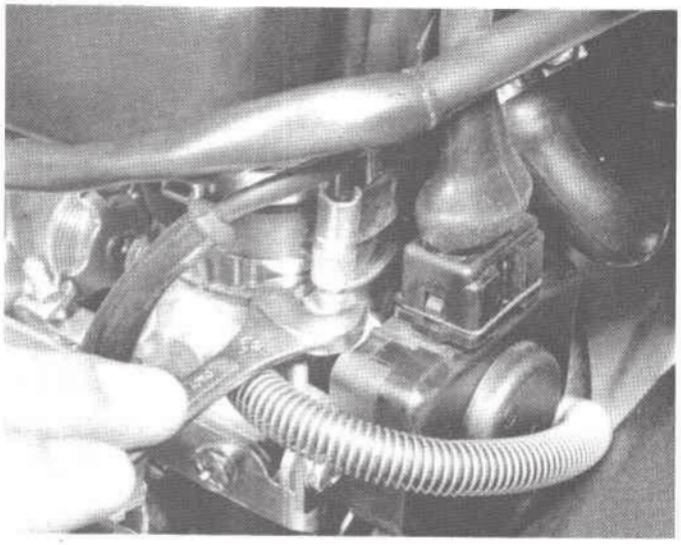
14 If using equipment other than BMW's own, note that a T-piece adaptor will be required to enable the pressure regulator vacuum hose to remain connected while the test is conducted. The vacuum switch fitted to early 100 models (if still installed) can be disconnected during the test since it becomes effective only above idle speed. The vacuum take-off points are covered by small rubber caps. It was found that the hoses of a high-quality vacuum gauge set could be connected to these take-off points, provided that they were secured by small plastic clips. The pressure regulator was connected using the T-piece from a car windscreen washer system and a short length of tubing.

15 With the engine fully warmed up and the gauges or balancing device securely connected with no air leaks, start the engine and allow it to idle. Where damping adjustment is provided, set it so that the reading flutter is just eliminated but so that it can respond instantly to any small changes in pressure. If aftermarket gauges are being used, it is useful to swap them between different throttle assemblies to ensure that all are producing exactly the same reading; if there is any variation this must be accounted for during adjustment. If any one cylinder is significantly lower than the others, there may be an air leak in the induction system.

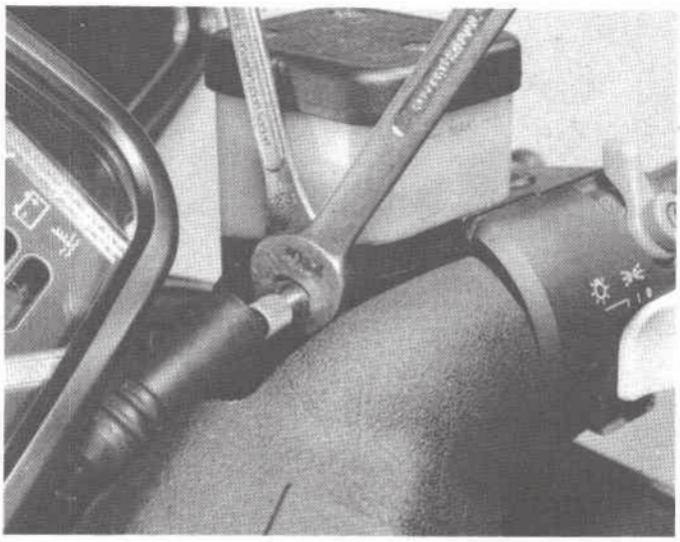
16 All gauges (or mercury columns) must show **exactly** the same reading with the engine at idle speed. If adjustment is necessary, it is made by rotating the bypass screw set in the appropriate throttle body. **Do not** disturb the screws and locknuts linking the various throttle butterflies. When all cylinders are giving exactly the same reading, stop the engine and disconnect the equipment.

Idle mixture adjustment

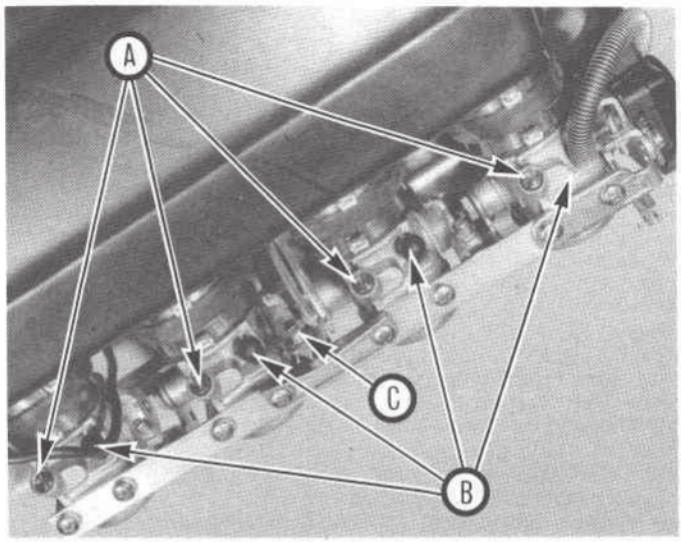
17 The fuel/air mixture ratio can only by adjusted at the airflow meter bypass screw, with an exhaust gas analyser being used to measure the level of carbon monoxide (CO) in the exhaust gases. Owners who do not have access to such equipment or the skill to use it should take their machines to an authorised BMW dealer for the work to be carried out. Those owners who have the equipment and wish to carry out the check themselves should proceed as described in Section 19 of this Chapter.



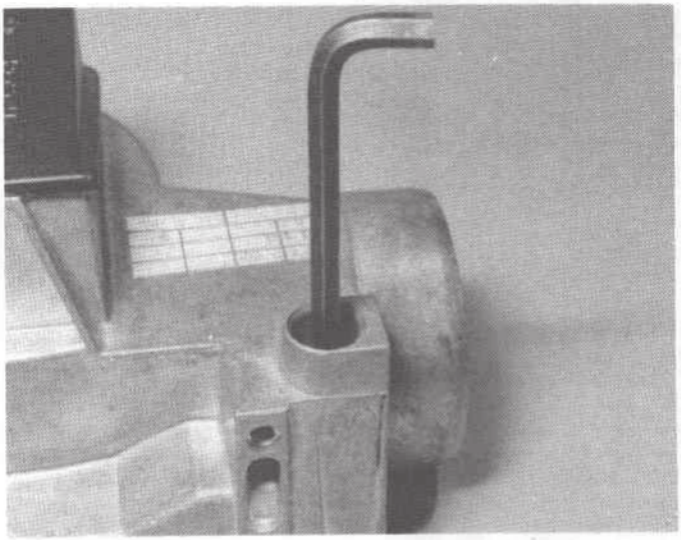
18.3 Fast idle speed setting is adjusted at control cable



18.8 Adjusting throttle cable free play



18.16 Throttle butterfly air bypass screws (A); vacuum gauge take-off points (B); idle speed adjusting screw (C) – do not disturb any other screws



18.17 Idle speed mixture can only be adjusted at airflow meter bypass screw

19 Mixture adjustment and checks using an exhaust gas analyser

General

1 The tasks described in this Section all require the use of an exhaust gas analyser (CO meter). Specialised equipment of this sort is normally available only to the better dealers and we would have to advise owners to take their machines to such dealers for servicing or similar work to be carried out. However, exhaust gas analysers have been in widespread use in the car world for some time now and will become more and more commonly available as emission control legislation is tightened. Accordingly, full information is given below for those owners who can gain access to an analyser and who feel that they have the skill and knowledge to use it successfully.

2 There are various types of analysers available; in all cases the manufacturer's instructions should be studied and followed with care. In general, all analysers are fitted with a water trap to remove condensation and filters to protect the unit's delicate internals; these must be cleaned out and the filter elements renewed (where applicable) before each testing session.

3 Switch on the analyser and leave it to run for a few minutes until the indicated CO reading has stabilised at the background level; it may be possible to recalibrate the analyser so that it reads zero at this level, if not, it will be necessary to subtract the background level from the test levels to obtain true readings.

4 If the test results are to be accurate, the engine must be in good mechanical order (check the compression and valve clearances), the exhaust system must be in good condition and free from leaks, the induction system must be free from leaks and the ignition system must be in good condition (eg ignition timing correct and spark plugs renewed or at least clean and correctly gapped). The throttle butterfly synchronisation must have been checked, also the adjusters of the throttle and choke control cables, and the idle speed.

5 Take the machine on a journey of at least 10 minutes duration so that the engine is fully warmed up to normal operating temperature, then check that the choke lever is pressed fully into the 'O' (off, or closed) position.

6 Insert the analyser's probe into the silencer outlet to a depth of approximately 30 cm (1 ft) so that fresh air cannot enter and upset the meter reading, then start the engine and allow it to idle. Secure the probe so that it cannot fall out.

7 Wait a few minutes for the meter reading to stabilise. Note that on US models in particular the reading may indicate quite a high level on starting the engine, due to the action of the Evaporative Emission Control System. The reading can be considered accurate when it has remained steady for one or two minutes.

8 With the analyser producing a steady, true reading of the CO level, proceed as described in the relevant sub-section below; do not forget to make allowance for the background level when taking readings. Note that several seconds may pass before any alteration to the induction system produces a corresponding change in the meter reading; always wait for a few minutes after making any alteration to ensure that the correct reading is obtained. Different meters will respond at varying speeds and levels of sensitivity; some skill and patience will be required to achieve an accurate result.

Idle speed mixture adjustment

9 Connect the test equipment as described above. If the reading obtained is outside the range of 2 ± 0.5% CO, remove the radiator cover panels or fairing right-hand lower side panels (as necessary) and prise out the plug from the top of the front right-hand corner of the air filter housing.

10 Insert a 5 mm Allen-key into the airflow meter bypass screw and rotate it until the setting is correct (see general notes above). Note that the screw should be turned in very small increments at a time; the setting is very sensitive.

11 On completion of adjustment, refit the plug with its index mark pointing to the rear. Check the idle speed and throttle synchronisation before refitting the fairing components or radiator cover panels.

Checking the air filter element

12 The condition of the air filter element can be checked by using the exhaust gas analyser. Connect the equipment and take a reading with the engine running at (no more than) two-thirds of its rated speed, ie approximately 5500 – 5700 rpm, maintain the test speed only for as long as is necessary to obtain a true reading. Stop the engine, remove the air filter element and repeat the test.

13 If the second reading was significantly lower than the first, the element is too choked to be of further use and must be renewed, regardless of its apparent condition.

14 Check that the element is securely refitted when the test is complete.

Checking for induction system air leaks

15 If the idle speed is unstable, or if the engine stalls when the throttles are shut suddenly, first check the ignition timing, the idle mixture setting and the valve clearances. If the fault persists, it may be due to a leak in the induction system.

16 BMW give details of a method of checking for air leaks which involves dropping very small quantities of fuel on to each joint in the system and noting the effect on the CO meter reading. If the reading increases slightly (or the idle speed increases) there is a leak at that

point, which must be sealed by tightening the clamp screw or renewing the component, as necessary.
17 Obviously this is an extremely dangerous procedure which requires great care in its execution to avoid any risk of fire. Be especially careful to keep drops of fuel away from electrical components and to wash off all surplus fuel as soon as the test is complete. Owners are advised not to attempt this work themselves but to take the machine to an authorised BMW dealer for the work to be carried out.

20 Compensating for high altitude – US models

1 Machines which are operated for any length of time at altitudes of more than 4000 feet (1200 metres) above sea level must be modified to ensure that the mixture remains correct. This normally involves fitting smaller main jets on carburettor-equipped machines, but on the models covered in this manual an electrical connection is made to the injection control unit.
2 A socket from an extension of the engine wiring loom is clipped to the frame tube behind the left-hand side panel. To adapt the machine for higher altitudes remove the side panel, withdraw the socket cover plug and plug in the correcting adaptor.
3 The adaptor, and the warning label which must be attached to the machine to satisfy EPA requirements are available from authorised BMW dealers. Ensure that the adaptor is removed and the cover plug refitted to the socket when the machine is operated at lower altitudes.

21 Recommended fuel: general

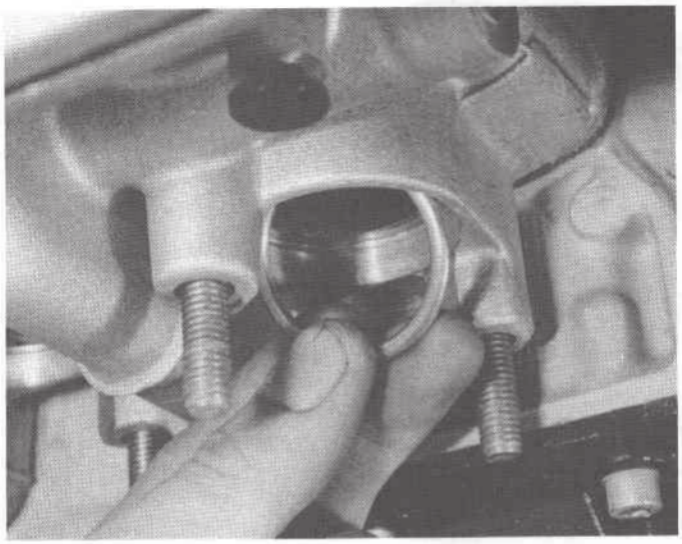
Note: *The information contained in this Section and in the Specifications Section of this Chapter is correct at the time of writing. For updated information, or for more specific details, refer either to the rider's handbook supplied with the machine or to a local BMW dealer or other BMW importer.*

1 At one time choosing the fuel for a machine was a simple task, the main criterion being that of price. However, with the introduction for environmental and health reasons of unleaded fuel and the progressive lowering of permissible levels of lead in leaded fuels, the situation is more complicated. Modern engines are also much more sensitive to the octane rating of the fuel used as they become more and more finely tuned to meet the conflicting demands of the greater performance and economy demanded by the consumer and the reduced pollution levels demanded by legislation. This Section expands on the basic information given in the Specifications Section of this Chapter.
2 First note that all recommendations are the minimum required. Depending on the quality of fuel locally available, on the operating conditions, on its owner's riding style or on its engine's particular characteristics or condition, any motorcycle may perform poorly on the specified grade of fuel and may require a higher grade to achieve normal performance.
3 Secondly, note that BMW advise against the use of any additives such as upper cylinder lubricants, octane boosters etc. Owners of machines used in the US should note that pure gasoline only is recommended – fuels containing a percentage of alcohol must **not** be used since alcohol will cause corrosion in aluminium, brass, rubber and plastic components and can cause severe engine damage. It may also cause bad starting and performance problems such as misfires or erratic idling.
4 Unleaded fuels should be used only as recommended. It is generally believed that the continuous use of unleaded fuels can cause accelerated wear of conventional valve seats, particularly on the exhaust; BMW have therefore fitted toughened exhaust valve seats to all 75 models and to all later 100 models (see below). However, modified engines (100 models only) can be identified only by reference to the frame number (where details are available) or by stripping the cylinder head to check the seats, so great care is required. Note that on suitably-modified engines it is preferable to use unleaded fuel rather than a low-leaded fuel.
5 At any time, if problems such as pinking (knocking) are experienced which could be attributed to poor quality fuel, attempt to solve the problem by changing the fuel before looking for a fault in the machine. First of all check carefully that the octane rating of the fuel used complies with BMW's minimum recommendations (see Specifications) then try higher grades and different types of fuel (eg leaded instead of unleaded) as well as different brands. Sometimes a cure can be effected by changing to a different filling station. If the fault persists, seek the advice of a good BMW dealer. Above all do not resort to unwarranted modifications to the machine; while, for example, it may be considered acceptable practice on many modern machines to retard the ignition timing by a small amount to compensate for reduced octane levels, this **must not** be attempted on the machines described in this Manual due to the difficulty of carrying out the task accurately without the special equipment necessary, and due to the fact that the effect of any such modifications on the machine's ignition and fuel injection systems cannot be checked.
6 **Leaded fuel** must be used on early 100 models and may be used on all other models. From early in 1985 (from frame numbers UK K100 0 007 291, UK K100 RS 0 081 107, UK K100 RT 0 024 999 onwards, equivalent US information not available) all engines were fitted with toughened exhaust valve seats. These valve seats, which can be identified by their having a groove 1 mm wide and 0.2 mm deep machined around the inside diameter of the exhaust port side of each seat, are now the only type which will be supplied as replacement parts (or in replacement cylinder heads and engine assemblies) and so may also be found on earlier models. Note: BMW state that unleaded (premium grade) fuel **may** be used, if desired, on these early UK machines, but **only** provided that every third tankful is leaded fuel to protect the valve seats; owners of early US models should seek the advice of a local BMW dealer or the BMW importer for confirmation of this.
7 **Unleaded fuel** may be used on all 100 models after the frame numbers given above (US owners must check with their BMW dealer or importer for the necessary information) or on earlier models which are known to have been fitted with the toughened exhaust valve seats, and on all 75 models.
8 **Premium-grade fuel** must be used on all early 100 models (see details in paragraph 6), on all UK 75 models and on early US 75 models. It may be used also on later 100 and US 75 models.
9 **Regular-grade fuel** may be used on all later 100 models and later US 75 models. While precise information is not available, and must be checked as described at the beginning of this Section, the changeover dates presumably coincide with the introduction of the modified valve seats on 100 models (see details in paragraph 6) and with the reduction in compression ratio carried out in mid-1986 on US 75 models.

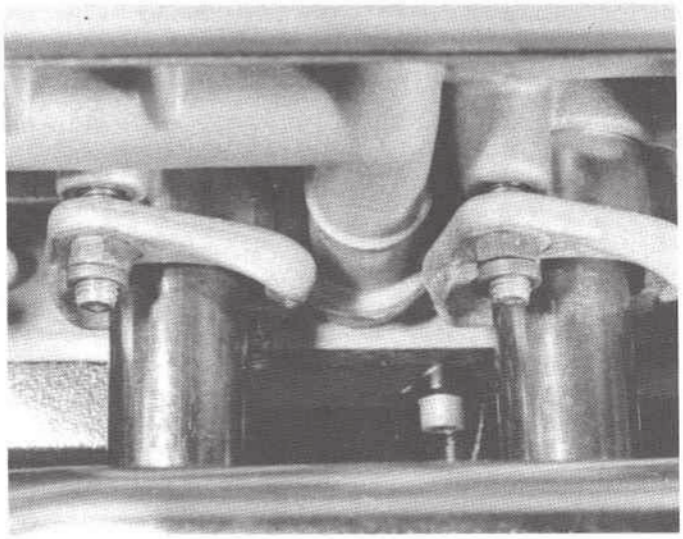
22 Exhaust system: removal and refitting

1 Working evenly on each exhaust pipe in turn, remove the exhaust pipe/cylinder head retaining nuts, then support the front end of the system while the nuts or bolts retaining the silencer to the footrest plate are removed. Withdraw the system and prise out the old gaskets from the exhaust ports; these should be renewed whenever they are disturbed.
2 On refitting, fit the new gaskets to the exhaust ports and stick them in place with grease. Carefully clean the threads of all mounting studs, nuts and bolts and apply a high-temperature copper-based anti-seize compound such as Copaslip or Never Seeze to the threads to prevent corrosion. Check that all components are cleaned and in place, particularly the exhaust pipe retainer plates.
3 Fit the system loosely to its rear mountings, then manoeuvre the exhaust pipes into their ports, position the retaining plates and secure them with the nuts. Tighten the nuts evenly and progressively to the specified torque wrench setting, then tighten the rear mountings securely.
4 The system can be divided into its component parts by slackening the clamp screws or bolts. Note that any component found to be stuck with corrosion should be cleaned carefully and treated with a coat of anti-seize compound on reassembly. The clamps have locating lugs which must be engaged correctly in their recesses on refitting so that the clamps do not foul each other or chafe against any other component.

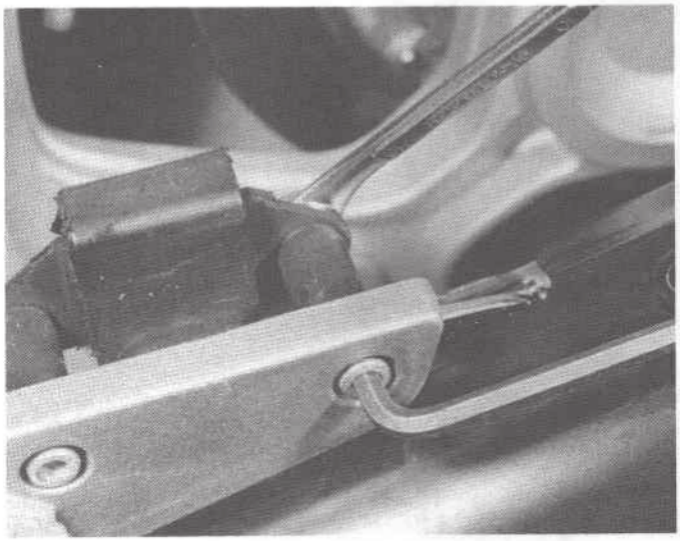
5 Check carefully all mounting components and renew any that appear damaged or worn. Note that the silencer mountings were modified on 100 models for 1986 on, the simpler mounting used on the 75 models being introduced.
6 Being made of stainless steel the exhaust system should last a considerable length of time. Clean it regularly and inspect it for any signs of damage and seek expert advice if signs of corrosion or deterioration do appear. An authorised BMW dealer may be able to supply suitable cleaning materials and polishes, or recommend suitable products.
7 The silencer cover panel is retained by five screws and washers which are fitted into separate nuts set in brackets on the silencer, with a cap nut securing a rubber mounting at the front on 100 models. The nut holder on 100 models, into which the rubber mounting is screwed, can break away as a result of temperature-imposed stresses. If this happens, the silencer must be removed and taken to an expert with facilities for welding stainless steel.
8 A new rubber mounting has been introduced to prevent this from happening. Note that the mounting outer end hexagon should be held with an open-ended spanner, to prevent it from shearing, whenever the cap nut is tightened or slackened, and that the cover panel should not touch the silencer at any point other than its mountings.



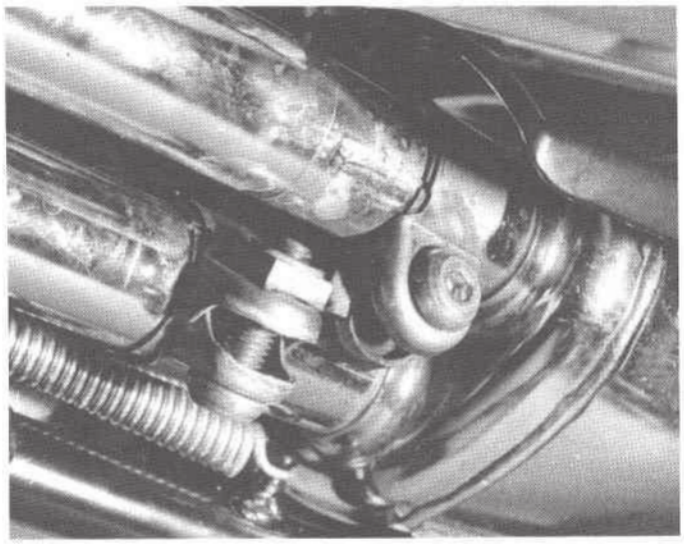
22.2 Always renew all exhaust gaskets whenever they are disturbed



22.3a Assemble system on to its mountings – secure front mountings first ...



22.3b ... followed by rear mountings



22.4 Check clamps are correctly positioned and securely fastened

23 Oil pump: removal, examination and refitting

1 The oil pump is the rear part of a combined oil/water pump assembly which is removed as follows:
2 Drain the engine oil as described in Routine Maintenance, then drain the coolant. See Chapter 4. Disconnect the oil pressure switch lead from the switch and remove the radiator bottom hose.
3 Remove the pump cover retaining screws and withdraw the cover, then remove the pump body retaining screws and withdraw the pump body; a few gentle taps with a soft-faced mallet should break the joint seal. Note the O-ring sealing the coolant passage between the pump and the crankcase lower section, also the O-ring around the pump drive shaft rear end; both should be renewed whenever they are disturbed.
4 Withdraw the pump drive shaft; if the pump shaft is to be removed, or either of the pump seals are to be renewed, refer to Chapter 4.
5 Closely examine all gear teeth mating surfaces and the body casting; if any component is seen to be worn or damaged in any way it must be renewed. Since there are no service limits specified, pump wear cannot be checked by direct measurement; the only possible test of the lubrication system is a test of the operating pressure which will require a pressure gauge and the necessary adaptors.

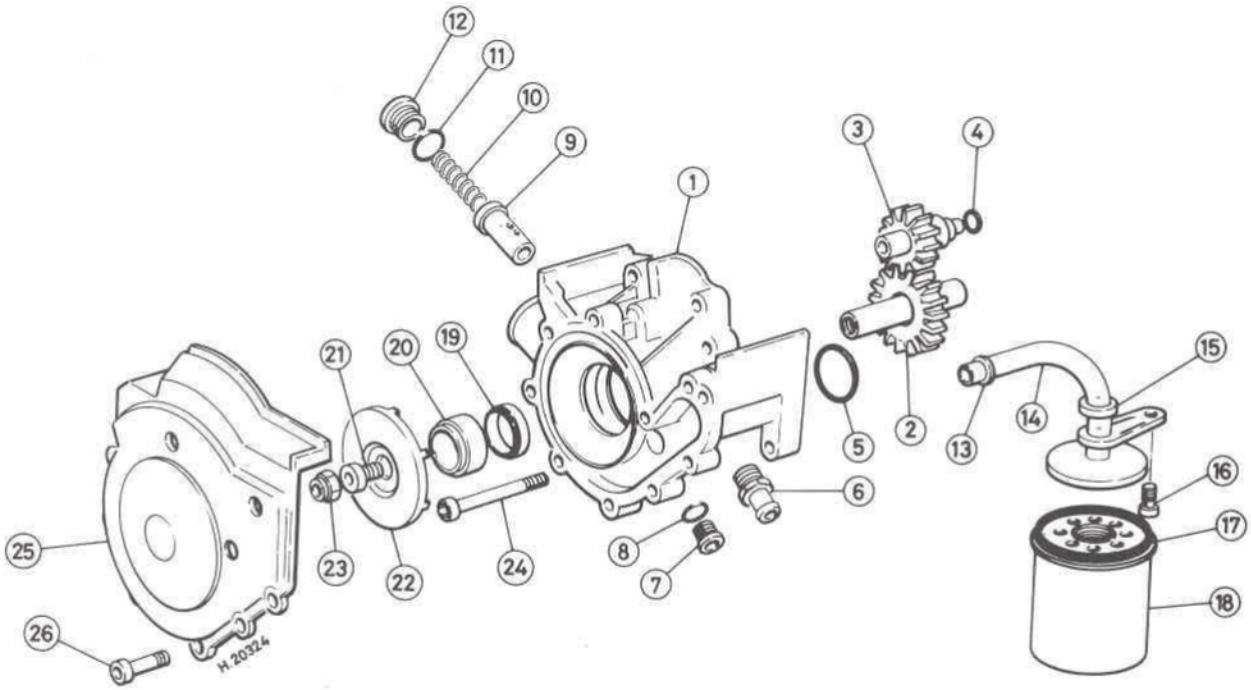
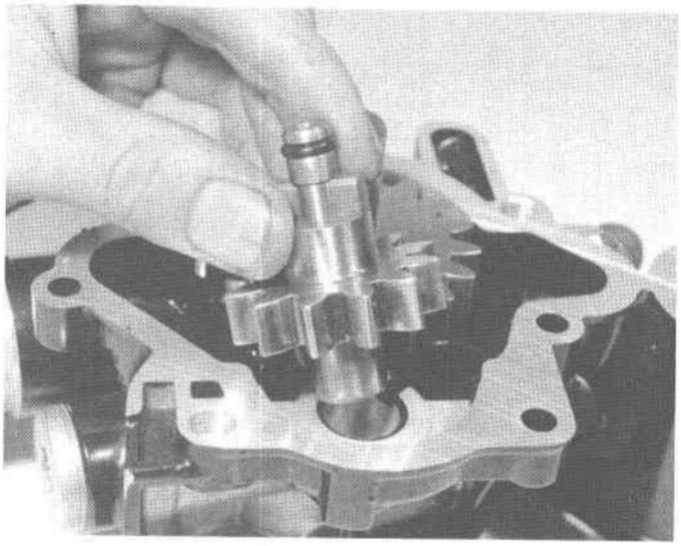


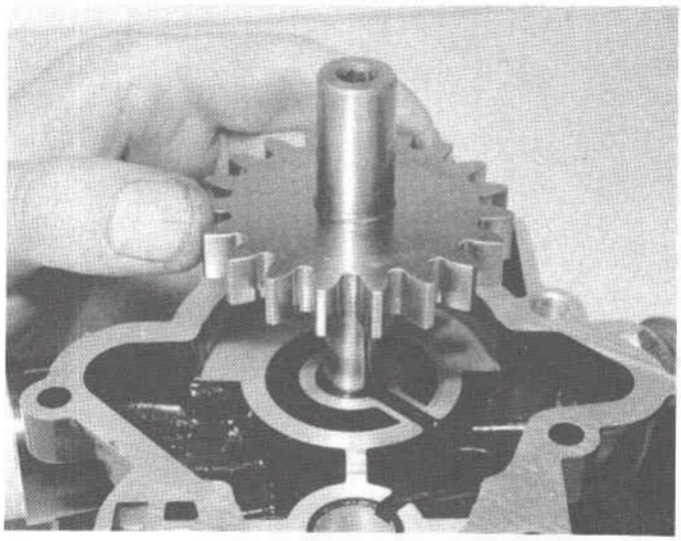
Fig. 5.4 Oil/water pump

1 *Body*
2 *Oil pump driven gear*
3 *Oil pump drive gear*
4 *O-ring*
5 *O-ring*
6 *Oil pressure switch*
7 *Coolant drain plug*
8 *Sealing washer*
9 *Pressure relief valve plunger*
10 *Spring*
11 *Sealing washer*
12 *Plug*
13 *O-ring*
14 *Oil pump pick-up*
15 *Grommet*
16 *Bolt*
17 *Sealing ring*
18 *Oil filter*
19 *Oil seal*
20 *Mechanical seal*
21 *Bolt – late models*
22 *Impeller*
23 *Nut – early models*
24 *Bolt*
25 *Cover*
26 *Screw*

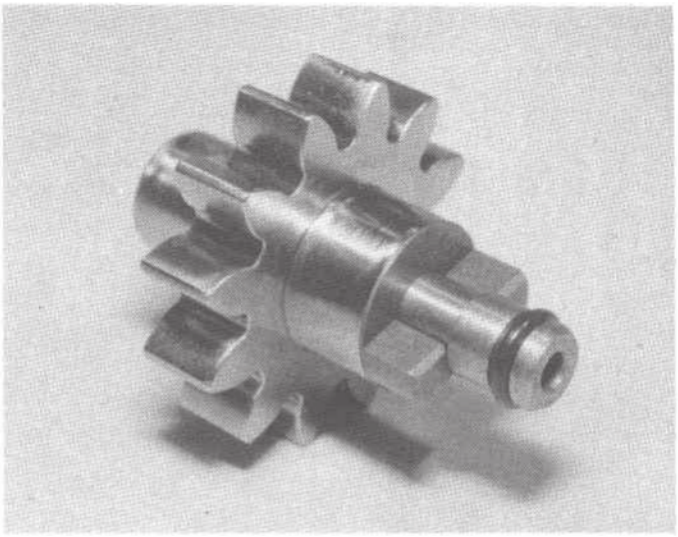
6 On reassembly, thoroughly clean all components in the pump body, including the pressure relief valve and pressure switch. Blow clear all oilways with compressed air and refit the various components.
7 Fit a new O-ring around the coolant passage and to the pump drive shaft rear end. Apply a thin smear of Three Bond 1207 B sealant to the pump/crankcase mating surfaces and refit the pump assembly, ensuring that the drive shaft engages correctly in the output shaft.
8 Rotate the crankshaft to centralise the pump gears while tightening the pump body mounting screws to the specified torque setting (where given). Connect the oil pressure switch lead to the switch terminal and carefully refit the switch cover. Apply a thin smear of Three Bond 1207 B sealant to the mating surfaces and refit the pump front cover, tightening its retaining screws to the specified torque wrench setting, where given.
9 Refill the cooling system (Chapter 4). Replenish the engine with oil as described in Routine Maintenance, then refit all other disturbed components.



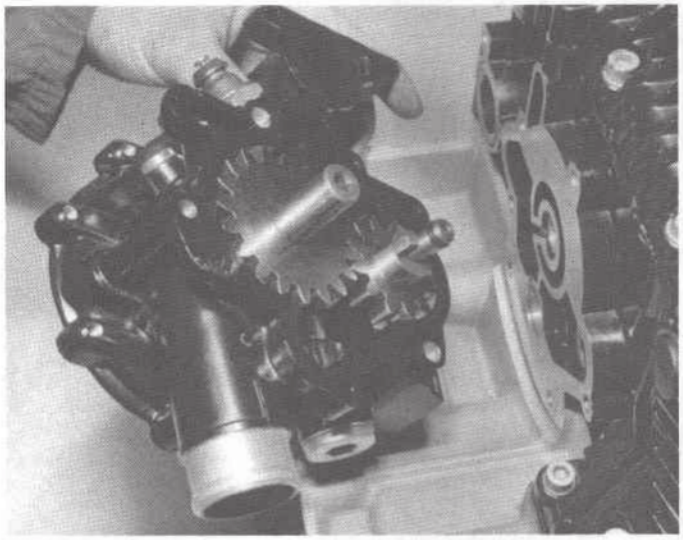
23.4a Withdraw pump drive shaft



23.4b Water pump must be dismantled to permit removal of pump driven shaft



23.5 Clean all pump components thoroughly and check for wear



23.7 Do not forget to renew O-rings on refitting oil/water pump assembly

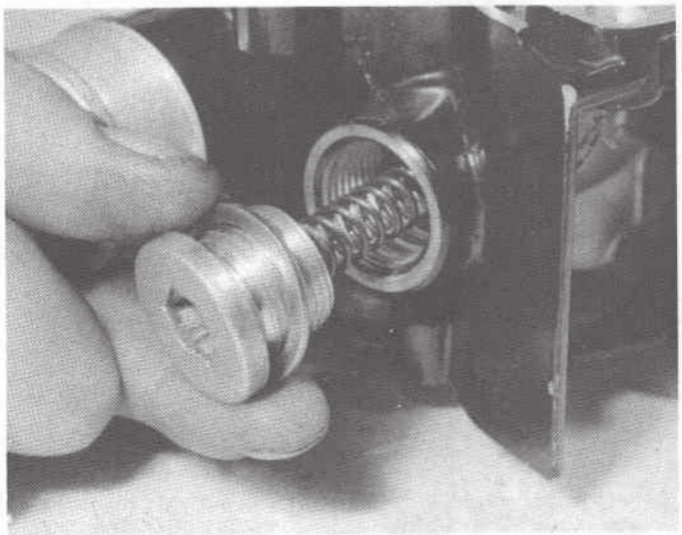
24 Oil pressure relief valve: general

1 The oil pressure relief valve consists of a spring-loaded plunger which is fitted in a bore in the oil pump body.

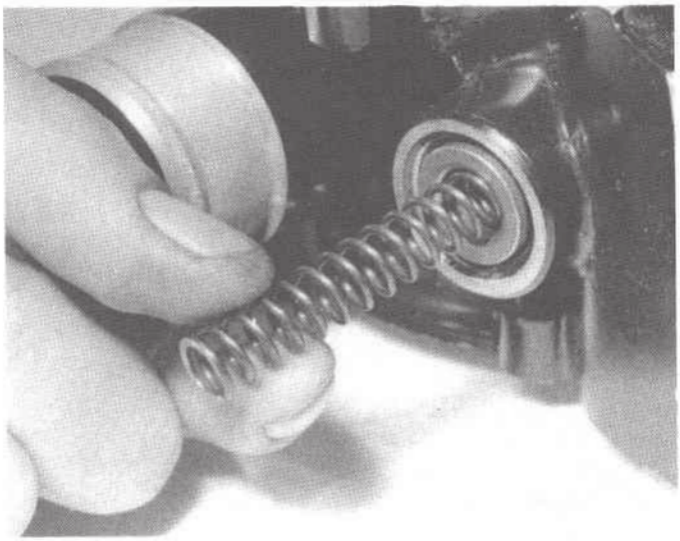
2 Depending on the tools available, it may be possible to remove the valve components with the oil pump installed, in which case it will be neccessary only to drain the engine oil (see Routine Maintenance) and to drain the coolant and withdraw the radiator bottom hose (see Chapter 4) before removing the valve. If not, remove the oil pump from the machine. See Section 23.

3 Unscrew the valve plug and withdraw the spring and plunger. Check both for signs of wear or damage and renew them, if necessary; note that the spring should be renewed if there is the slightest doubt about its performance. Polish away any burrs or raised edges from the plunger and check that it is free to slide smoothly, but without play, in the pump body.

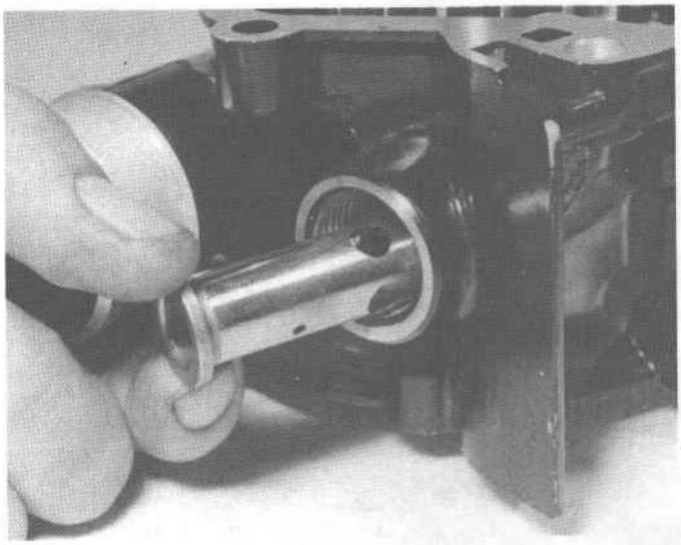
4 On refitting, renew its sealing washer and tighten the valve plug to the specified torque wrench setting.



24.3a Unscrew pressure relief valve plug from pump body – note sealing washer



24.3b Withdraw pressure relief valve spring ...



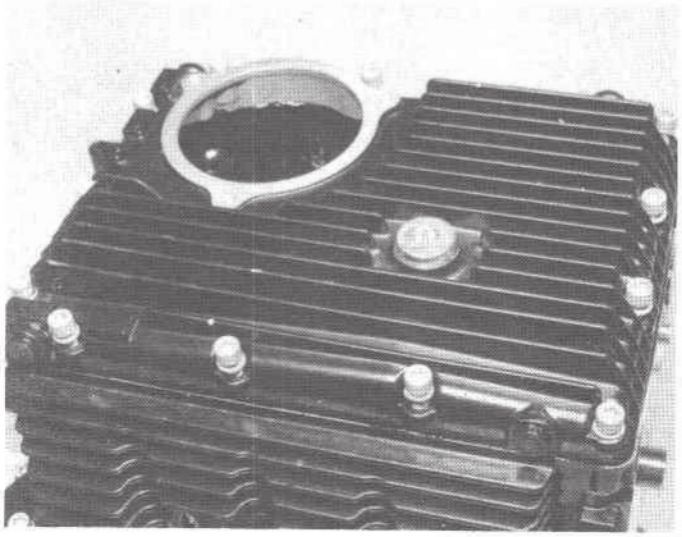
24.3c ... and plunger – check carefully for dirt or wear

25 Oil pump pick-up filter gauze: cleaning

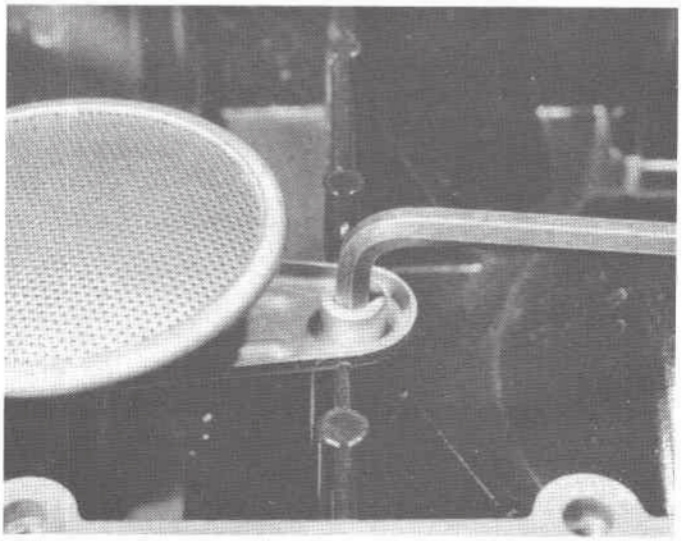
1 The filter gauze should be cleaned whenever the sump (oil pan) is removed or the engine and/or oil pump are overhauled.
2 Referring to Routine Maintenance, drain the engine oil and remove the oil filter.
3 Unscrew the retaining bolts around the periphery of the sump (oil pan), tap it with a soft faced mallet to break the seal, and withdraw it. Carefully remove all traces of old sealant from both mating surfaces and thoroughly clean the sump (inside and outside). Use a clean, lint-free rag, to wipe down the inside of the crankcase.
4 Remove the retaining Allen screw and manoeuvre the pick-up assembly out of the crankcase. Note the sealing O-ring set in a groove in the pipe aperture in the crankcase wall, around the pick-up pipe's upper (oil pump) end; this must be displaced, using a suitable pointed instrument, and renewed whenever it is disturbed. Wash the pick-up thoroughly in a high flash-point solvent and use a soft-bristled brush to scrub away any particles of foreign matter.
5 When the pick-up is complete, clean and dry, fit a new O-ring to the groove in the pipe aperture in the crankcase wall and apply a smear of grease to the pipe end. Carefully refit the pick-up, taking care not to displace the sealing O-ring and ensuring that the rubber grommet is seated correctly in its bracket. Tighten the pick-up retaining screw securely, using the specified torque wrench setting, where given.
6 Degrease the mating surfaces and apply a thin smear of Loctite 574 (early models) or Three Bond 1207 B sealant. Refit the sump (oil pan) and tighten its retaining screws securely to the specified torque wrench setting, working progressively and evenly in a diagonal sequence from the centre outwards.
7 Refit the engine oil drain plug and oil filter, then refill the crankcase with oil as described in Routine Maintenance.

26 Oil filter: renewal

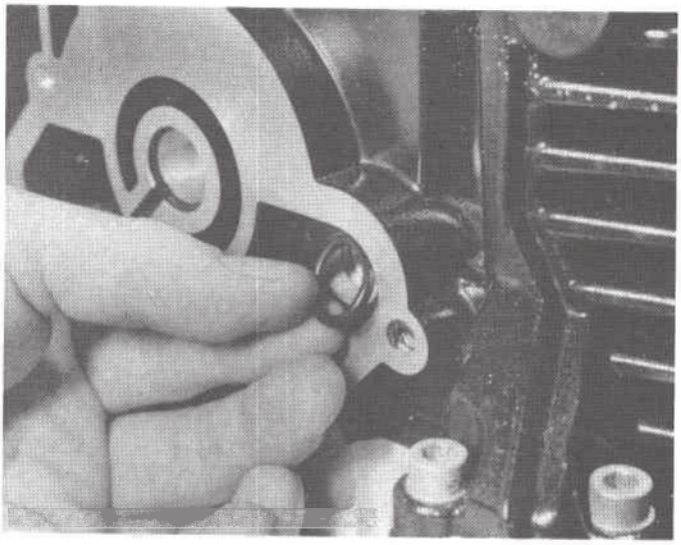
The engine oil filter element should be renewed at the intervals specified, working as described in Routine Maintenance.



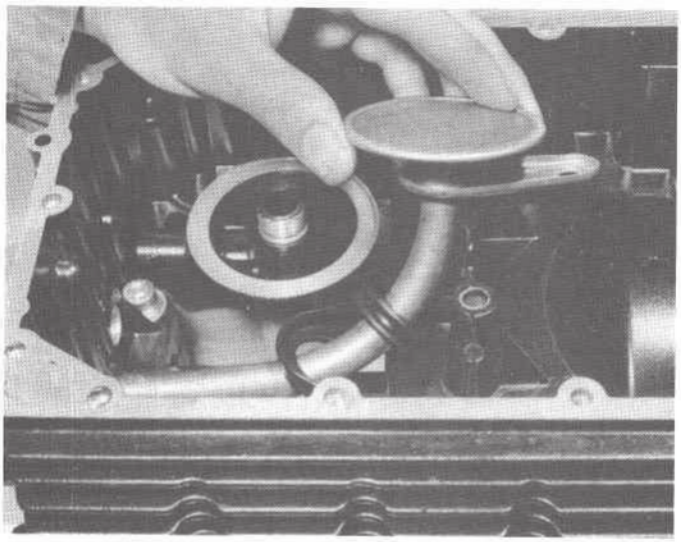
25.3 Withdraw sump (oil pan) to reach pump pick-up filter gauze



25.4 Pick-up assembly is retained by a single Allen screw



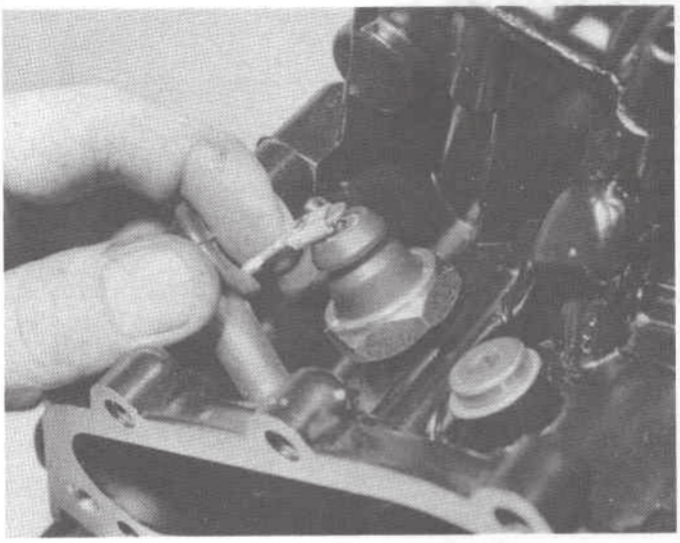
25.5a Note sealing O-ring set in crankcase wall ...



25.5b ... and rubber grommet – ensure this is fitted correctly in mounting bracket

27 Oil pressure warning lamp: general

1 The oil pressure warning lamp, which comes on when the ignition is switched on, should extinguish at idling speed. It is operated by a switch on the oil pump body.
2 If the lamp flashes, or remains on, check the oil level in the sump and ensure the filter is not clogged. If these are in order, check the electrical system for faults. See Chapter 10. If the lamp comes on when slowing down from high speed, again check the oil level and the filter. If these are OK, the main bearings or big-end bearings may be worn, or the oil pressure relief valve or oil pump may be faulty. Have the oil pressure checked with a guage. If the pressure is low, overhaul the engine.
3 To remove the switch, peel back the rubber cover and slacken or remove, as necessary, the terminal screw. The oil should be drained before the switch is removed, so that the switch threads can be cleaned properly. Unscrew the switch.
4 On refitting, clean the threads of the switch and the oil pump body, apply a thin coat of sealant, and refit the switch. Tighten it carefully to the specified torque wrench setting; do not overtighten it or the switch may be broken and the pump body cracked. Tighten the terminal screw securely, apply a coat of WD40 or similar (see Chapter 10) and refit the rubber cover, ensuring that it seats fully.



27.4 Oil pressure switch is screwed into pump body – ensure it is completely waterproofed

Chapter 6 Ignition system

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Specifications

Ignition system		
Type	Bosch VZ-51L or VZ-52L	
Static ignition timing:	**Crankshaft angle**	**Piston position**
US 75 models	4° BTDC	0.10 mm (0.0039 in) BTDC
100 models, UK 75 models	6° BTDC	0.24 mm (0.0095 in) BTDC
Advance starts at	1300 rpm	
Advance range:		
US 75 models	26°	
100 models, UK 75 models	24°	
Maximum advance at	8650 rpm	
Retard starts at:		
75 models	8777 rpm	
100 models	8650 rpm	
Fuel injection shuts off at:		
75 models	8905 rpm	
100 models	8770 rpm	
Starter motor lockout effective above	711 rpm	
Cylinder identification	Numbered consecutively front to rear, Number 1 cylinder at front (cam chain) end	
Firing order:		
75 models	3-1-2	
100 models	1-3-4-2	
Direction of rotation	Anticlockwise, looking at ignition trigger from front of machine	

Ignition HT coil	**75 models**	**100 models**
Primary winding resistance	0.8 ohm	N/Av
Secondary winding resistance	10 K ohm	N/Av
Suppressor (HT lead connector)	1 K ohm or 0 ohm (marked)	N/Av

Spark plug	
Make	Bosch
Type	X5DC
Gap:	
Standard	0.6 – 0.7 mm (0.024 – 0.028 in)
Service limit	0.8 mm (0.032 in)
Cap resistance	5 K ohm

	75 models		**100 models**	
Torque wrench settings				
Component	**Nm**	**lbf ft**	**Nm**	**lbf ft**
Spark plugs	20 ± 2	15 ± 1.5	20	15
Ignition trigger backplate screws	3.5 ± 0.5	2.5 ± 0.5	3.6	2.5
Ignition trigger cover screws	6 ± 1	4.5 ± 0.5	N/Av	N/Av
Ignition HT coil mounting bolts	6 ± 0.5	4.5 ± 0.5	N/Av	N/Av

1 General description

The ignition system is a microprocessor-controlled digital system powered by the battery. The heart of the system is the ignition control unit which receives signals from the trigger assembly mounted on the crankshaft front end and switches off the power supply to the HT coils thus inducing a spark across the spark plug electrodes.

The trigger assembly contains two Hall effect transmitters; on 100 models these are equally spaced, one triggering the spark for cylinders 1 and 4 while the other acts for cylinders 2 and 3. On 75 models the transmitters are positioned at 120° and 240° to serve cylinders 1 and 3 respectively; from this the control unit works out the correct firing position for number 2 cylinder. On both models a 'wasted' spark system is used in which the spark plugs 'fire at every crankshaft revolution.

The impulses transmitted by the trigger assembly are used by the control unit to build up the spark at the HT coils and to advance or retard it according to a preprogrammed curve depending on engine speed and on early 100 models only, intake manifold depression. It also triggers the control pulses for the injectors and prevents engine damage through excessive speed by first retarding the ignition timing at a set speed and then cutting off the injectors when a maximum set engine speed is reached. A lockout circuit prevents the starter motor from being operated if the engine is still turning over.

On early 100 models a vacuum switch fitted to the intake manifold was used to bring in a second advance curve for part-load operation. However this was found to have so little effect in practice that it was omitted from all models from late 1985 on.

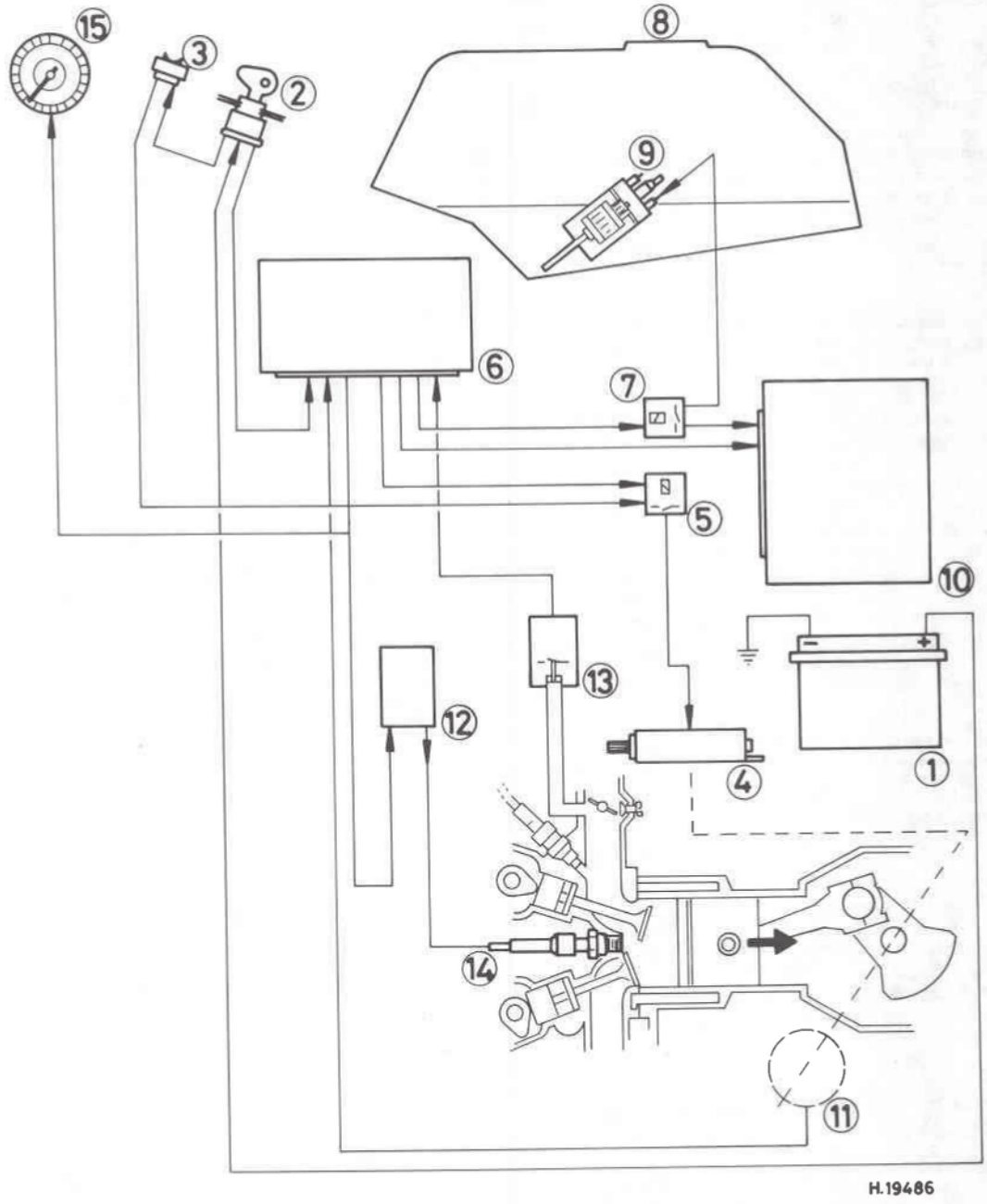


Fig. 6.1 Ignition system components

1 *Battery*
2 *Ignition switch*
3 *Starter button*
4 *Starter motor*
5 *Starter relay*
6 *Ignition control unit*
7 *Injector relay*
8 *Fuel tank*
9 *Fuel pump*
10 *Fuel injection control unit*
11 *Ignition trigger assembly*
12 *Ignition HT coil*
13 *Vacuum switch – early 100 models*
14 *Spark plug*
15 *Tachometer*

2 Precautions to be observed when checking the ignition system

Warning: *The very high output of the type of ignition system fitted means that it can be very dangerous or even fatal to touch live components or terminals of any part of the system while it is in operation. Therefore take great care to avoid personal contact with any part of the system while the engine is running, or even when the engine is stopped but the ignition is switched on.*

1 When working on any part of the ignition system, always cut off the power supply either by switching off the ignition key or by disconnecting the battery (negative terminal first). If test procedures require the system to be in operation, take great care to prevent personal contact with any part of the system.

2 Do not attempt to run the engine with the battery disconnected or with its connections made to the wrong terminals; this will destroy the ignition trigger assembly and may damage the alternator and other electrical components.

3 **Never** disconnect or attempt to disconnect the ignition HT leads at the coils or spark plugs while the engine is running; apart from the personal risk described above the coils and control unit would almost certainly be damaged.

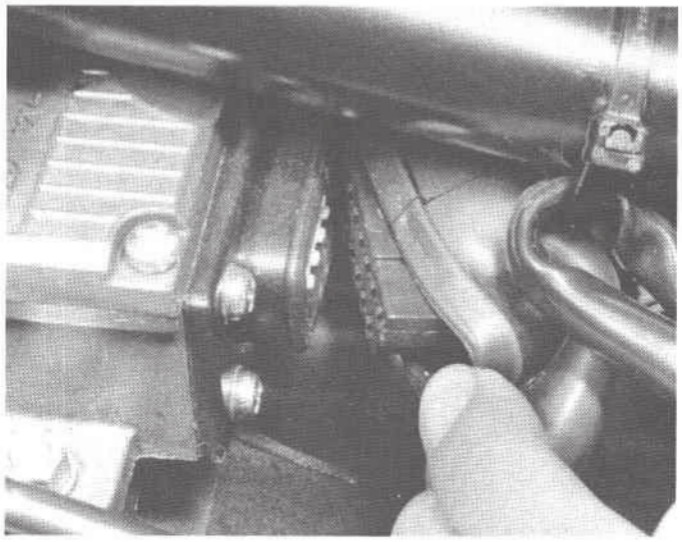
4 **Never** attempt to test either the trigger assembly or the control unit using equipment which has its own source (eg multimeters, ohmmeters, meggers, or battery and bulb test circuits); the applied voltage may damage one or more of their sensitive circuits.
5 If the resistance of any other part of the system is to be tested, ensure that the power supply is cut off (see above) and that the wires leading to the trigger assembly or control unit are disconnected. This is to prevent the risk not only of personal injury but also of damage either to the tester or to any of the system's components.
6 **Note:** Owners of machines used in the US, particularly in California, should note the possible legal implications of attempting to service any part of the ignition system before undertaking such work. Refer to Chapter 5, Section 2.

3 Ignition control unit: removal and refitting

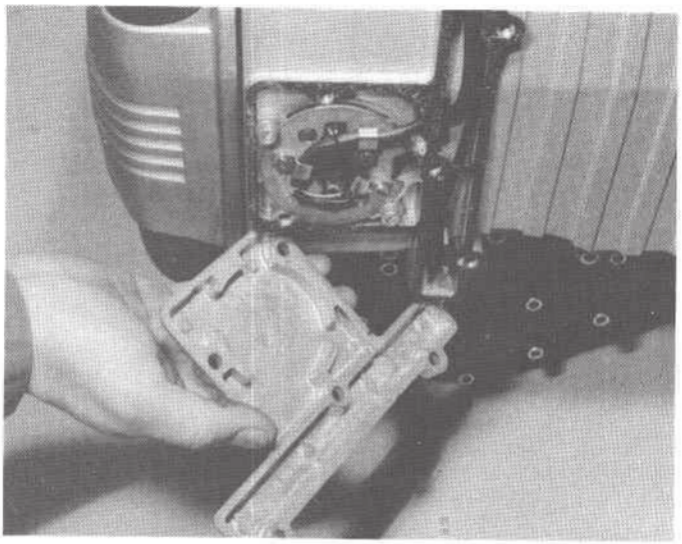
1 Remove the fuel tank. See Chapter 5.
2 Observing the precautions noted in Section 2 of this Chapter, peel back the waterproof cap from the rear of the control unit and unplug its connector.
3 Remove the mounting nuts and washers and manoeuvre the unit clear of the frame tubes, noting the locating tab which projects into a rubber grommet at the front of the unit.
4 Refitting is the reverse of the above; take great care to ensure that the connection is securely fastened and that the waterproof cover is refitted.
5 Note that all 100 models from early 1985 onwards were fitted with a modified unit which has a strengthened, ribbed cover, and improved sealing arrangements to exclude moisture.

4 Ignition trigger assembly; removal and refitting

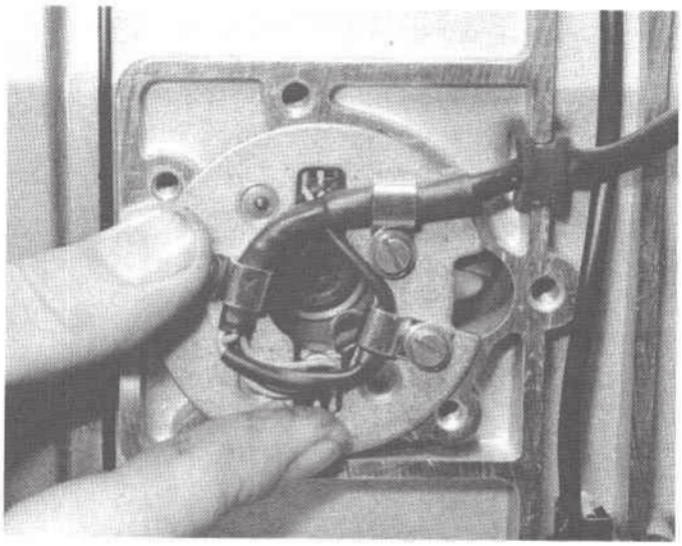
1 Remove the fuel tank. See Chapter 5. Where fitted, remove the engine spoiler or belly fairing. Disconnect the trigger assembly wires at the single connector on the frame top tubes, adjacent to the radiator filler.
2 Remove the trigger cover screws from the front of the engine front cover and withdraw the cover and its gasket.
3 Carefully punch or scribe a reference mark from the trigger backplate across to the engine front cover so that the backplate can be refitted in its original position. Remove the two retaining Allen screws and withdraw the backplate; release the electrical lead from the grommet set in the front cover and from any clamps or ties provided which secure it to the frame.
4 Remove the three screws which secure the ignition rotor and timing plate to the rotor flange and withdraw them, noting the locating pin.
5 On reassembly install the timing plate and the ignition rotor noting that they can fit only one way when aligned with the mounting screw holes and locating dowel pin. Refit the three retaining screws and tighten them securely.
6 Refit the backplate, align the marks made on dismantling, then refit and tighten the retaining Allen screws. If no marks are available, a basic setting which should allow the engine to run reasonably well can be made by aligning the edges of the cutout in the backplate exactly with the edges of the cutout in the housing. **It is essential** that the timing is checked properly as soon as possible after the ignition trigger is disturbed.
7 Route the trigger lead up through the sealing grommet and up to the connector securing it to the frame out of harm's way.
8 Refit the ignition trigger cover and gasket, tightening its screws to the specified torque wrench setting (where given).
9 If there is any doubt about the ignition timing setting, take the machine to an authorised BMW dealer as soon as possible to have the timing checked.



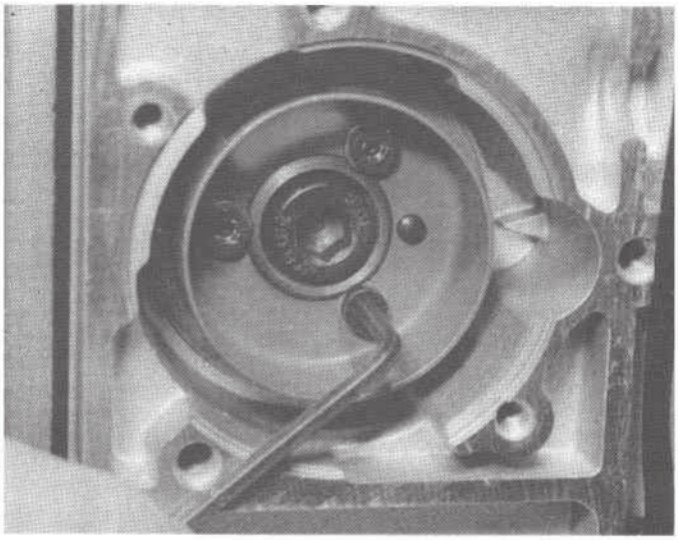
3.2 Ignition control unit is mounted just behind the steering head



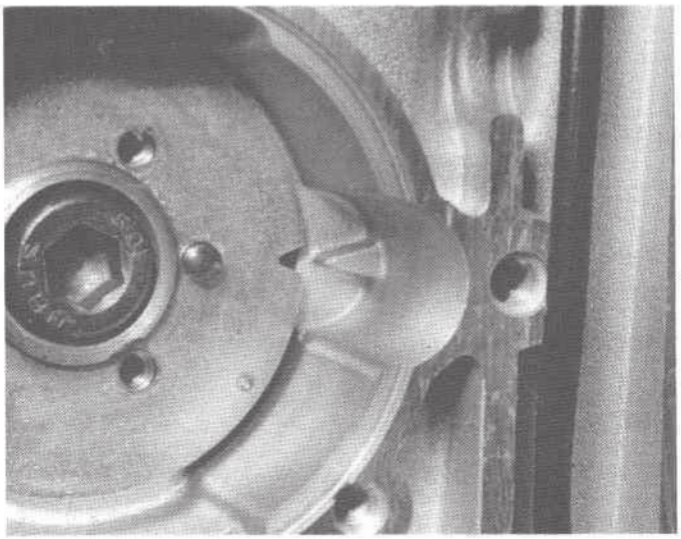
4.2 Ignition trigger assemby is mounted on engine front cover



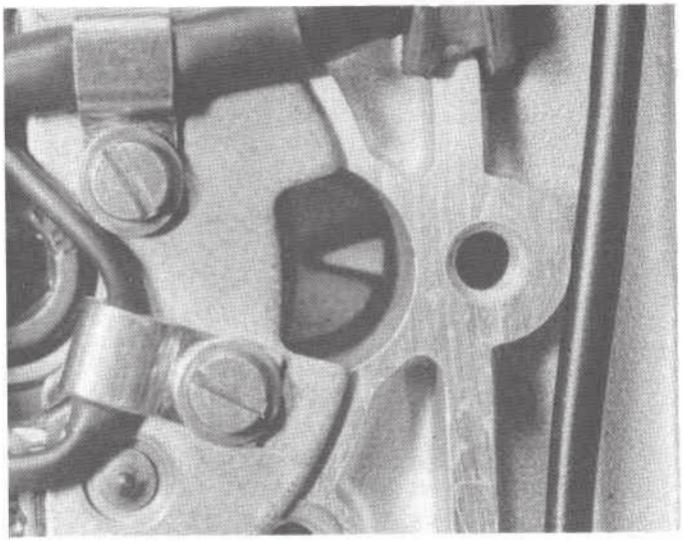
4.3 Scribe or punch reference mark before removing backplate so that it can be refitted in same position



4.4 Ignition rotor is secured to crankshaft flange by three screws



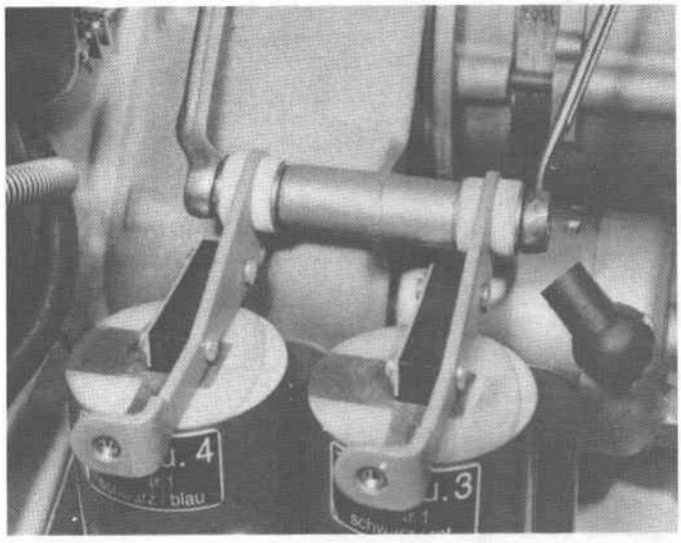
4.5 Timing plate notch aligns with cover pointer at TDC



4.6 Ignition timing basic setting can be achieved by aligning cutouts as shown – have timing checked properly as soon as possible

5 Ignition HT coils: removal, refitting and testing

1 Remove the ignition HT coil cover (where fitted) and make a note of the connections before disconnecting the HT leads and the coil wires.
2 On 75 models remove the coil bracket top mounting bolt and swing out the assembly until the bottom mounting bolt can be removed. Withdraw the complete assembly; the individual coils can be unbolted if necessary.
3 On refitting, ensure that there is clean metal-to-metal contact between the coils' centre poles and their mounting bracket, also that the mounting bolts are securely fastened. If there is any doubt about the wire connections, note that the HT lead length will show which coil is connected to which spark plug and that the coil for cylinder number 1 (front) has the black/blue wire, number 2 has the black/red and number 3 (rear) has the black/green wire.
4 On 100 models remove the coil mounting bolts and nuts and withdraw the coils. Check that all connections are clean and all mountings securely fastened on reassembly.
5 If there is any doubt about the wire connections note that the front HT coil serves cylinders 1 and 4, 1 being on the outside (left-hand side); the black/blue wire is connected to its terminal 1, the green/yellow wire to its terminal 15 and the brown wire to its (centre) terminal 31. The rear HT coil serves cylinders 2 and 3, 2 being on the outside (left-hand side); apart from the black/red wire being connected to its terminal 1, all other connections are similar to the front coil.
6 The coils can be tested fully only on a spark-gap tester, which means that they must be taken to an authorised BMW dealer or a similar auto-electrical expert who has the necessary equipment if they are thought to be faulty. First of all, however, a suitable meter should be used to check that full battery voltage is available when the ignition is switched on. Connect the meter between the coil terminal 15 and a good earth point to make the test. If no power is found, check back through the system (as far as is possible) to trace the fault.
7 A quick check which will give a reasonable idea of a coil's condition is to measure the resistance of its windings, but this can be applied to 75 models only due to the lack of equivalent data for 100 models. Disconnect the coils completely and connect the meter between terminals 15 and 1 to obtain a reading for the primary winding. To test the secondary winding connect the meter between terminal 15 and the HT lead terminal. In both cases the resistances recorded should be close to those specified; if not the coil is suspect but should be checked very carefully by an expert using the correct equipment before any action is taken.



5.4 Ignition HT coils are rubber-mounted on bellhousing

6 Ignition HT leads: general

1 The HT leads are easily removed by withdrawing the HT coil cover (where fitted) and the spark plug cover. Make a note of the routing of each lead before disconnecting and withdrawing it.
2 On refitting, note that each lead in numbered to identify which cylinder's spark plug it serves. On 75 models the length of the leads will reveal which HT lead is to be connected to which coil; if in doubt note that the HT coil for cylinder number 1 (front) has the black/blue wire, number 2 has the black/red and number 3 (rear) has the black/green wire.
3 On 100 models the front HT coil serves cylinders 1 and 4, 1 being on the outside (left-hand side) terminal, and the rear HT coil serves cylinders 2 and 3, 2 being on the outside (left-hand side).
4 In some cases suppressors are fitted to the HT leads; the resistances of these are usually marked on them as on the spark plug caps. If a fault arises, the HT lead can be quickly and easily detached so that its resistance can be measured. If the resistance reading obtained is significantly different from the value specified the component concerned should be renewed.
5 Always ensure that the leads are correctly routed to prolong as much as possible their service life and if any are to be renewed at any time it is advisable to use only genuine BMW replacement parts so that the correct resistance values are maintained.

7 Spark plugs: general

1 Refer to Routine Maintenance for information on spark plug removal and refitting.
2 Note that if the spark plugs are thought to be faulty they can be tested only by the substitution of new components.

8 Vacuum switch: general – early 100 models only

1 This unit is to be found on 100 models only that were manufactured before mid-1985; owners should note however, that the switches may well have been removed from, or blanked off on, models built before that date.
2 The switch is a small unit retained by two screws to the right-hand side of the throttle body mounting bracket; a vacuum line joins it to number 1 cylinder vacuum take-off point.
3 The switch's function was to improve economy and part-load running by bringing a second pre-programmed advance curve into operation. However this was found to have so little effect that it was omitted from all later models.
4 If a fault arises which necessitates inspection of the switch, disconnect it and remove it from the throttle body. Insulate its connection and tape the wire back to the loom, then remove the vacuum line and fit a small cap, as on the middle two cylinders, to the vacuum take off point.

9 Ignition and engine kill switches: general

The switches fitted in the ignition system can be tested, after they have been disconnected, by using a meter or other test equipment as described in Chapter 10.

10 Ignition timing: adjusting

1 Setting the ignition timing requires the use not only of a dial gauge with the necessary long adaptors but also a device which will indicate precisely when the trigger assembly sends a pulse to the control unit. BMW recommend a service tool 12 3 650 which is used with a test lead 12 3 651; with this equipment an LED lights when the trigger assembly reaches the firing point. Since it is expensive and not likely to be required very often, this equipmnent places the task beyond the scope of most owners.
2 Accordingly, owners are advised to take their machine to an authorised BMW dealer for the work to be carried out. For those who have the equipment, proceed as follows.
3 **Note:** Before starting work refer to Section 2 of this Chapter and **take all the necessary precautions** to prevent any risk of damage or of personal injury.
4 On 75 models the ignition timing is set on number 3 (ie the rearmost) cylinder; on 100 models it is set on number 1 (ie the front) cylinder. Remove the spark plugs (see Routine Maintenance), install the dial gauge on the appropriate cylinder, and zero it at Top Dead Centre (TDC).
5 Remove the fuel tank. See Chapter 5. Disconnect the trigger assembly wires at the connector on the frame top tubes and connect the test lead and ignition tester. Remove the trigger assembly front cover.
6 Turn the crankshaft backwards (ie clockwise, looking at the ignition trigger) to a point just before the specified firing point then slowly rotate it forwards again until the piston is **exactly** at the specified distance before TDC, whereupon the ignition tester diode should light. If not, slacken the trigger backplate mounting Allen screws and rotate the plate anticlockwise to retard the timing or clockwise to advance it. When the diode lights at the correct moment, tighten the backplate screws.
7 Repeat the procedure to check that the setting is correct, then disconnect the test equipment and refit all disturbed components.

11 Ignition system: fault-finding

1 Although electronic ignition systems are by now familiar equipment to most motorcyclists, the lack of test data on the system fitted to these machines, and its interconnection with the fuel injection system, means that there is very little the ordinary owner can do to test or repair it if a fault should arise.
2 As with the fuel injection system, the emphasis must be more on preventing faults from arising in the first place than on actual remedial repair work. The simplest approach can be summed up as follows:

(a) If the system is working properly, leave it alone.
(b) Prevention (in the form of preventive maintenance) is better than cure.
(c) In the event of a fault, take the machine to an expert.

3 The first of these is obvious, but worth stressing. **Do not** attempt to 'tune', modify or 'improve' the system in any way. The only maintenance necessary is set out below and in the Routine Maintenance section of this manual; at all other times the system should not be disturbed.
4 The second is by no means as contradictory as it might first appear; the electronic components themselves are generally very reliable and any faults are usually caused by disruption of the current flow between the various components or by external factors such as excessive heat, vibration or attack by foreign matter or corrosive chemicals. Therefore anything that can be done to ensure that all components receive a stable supply of the correct amount of electrical current, that they are kept clean and properly secured to protect them from excessive heat and/or vibration, and that they are kept free of dirt, corrosion and substances such as water, coolant, brake fluid, battery acid or engine oil which might cause damage, must help to minimise the risk of ignition failure.
5 These preventive measures can be summed up as follows:

(a) Ensure that the battery electrolyte levels are correct and that the terminal connections are clean and securely fastened at all times. If the machine is not used for any length of time, ensure that the battery is given refresher charges to keep it in good condition.
(b) Working through the relevant wiring diagram to ensure that all components (including individual connectors) are treated, carefully clean back to bare metal all connections and terminals (finishing off with proprietary contact cleaner to remove any grease or oil) then pack them with silicone grease to exclude water and dirt and to prevent corrosion. On reassembly ensure that, where applicable, the waterproof cover is correctly refitted over each connector plug and that the retaining clip is secured. The ignition and kill switches should be packed with silicone grease or regularly lubricated with WD40 or similar to protect their terminals.

(c) Ensure that all frame earths and earth connections are completely clean and securely fastened. Where wires are connected to the frame earth point, or at the bellhousing/frame mounting joint, ensure that the frame paint is scraped away to provide a clean metal-to-metal joint and that silicone grease or similar is applied to prevent corrosion.
(d) Ensure that all components are correctly positioned and securely fastened at all times, also that all are as clean and dry as possible.
(e) All wiring must be correctly routed so that it runs in smooth loops but avoids all possible contact with sharp edges, control cables or other moving components and components which became hot in operation. The wiring must be secured out of harm's way, using plastic cable clips or insulating tape. Remember that wires which are too tight or sharply kinked may fail due to the effects of vibration, but wires which are too slack may foul other components. The HT leads must be routed with particular care to prolong as much as possible their service life, and the spark plug cover should be fitted at all times to protect the plugs, caps and leads from dirt, water and other debris.
(f) Be careful never to knock, drop or otherwise mishandle any of the components; all are extremely sensitive and easily damaged.
(g) If any component is found to be damaged or faulty at any time, repair or renew it immediately, before the damage has a chance to affect any other component. Note that if the HT coils, suppressors, HT leads or spark plug caps are renewed at any time, only genuine BMW parts must be used to ensure that the replacements are compatible with each other and with the control unit. If non-standard components have to be fitted in emergency, ensure that their resistance values are the same as the genuine items; if incompatible items are fitted the different resistance values may well damage the HT coils or the ignition control unit. Only the specified type and grade of spark plug should be fitted; seek the advice of an authorised BMW dealer or similar expert before making any changes from standard specification. Ensure also that the plugs are regularly serviced and/or removed as described in Routine Maintenance; wrongly-gapped or worn-out plugs may overload the control unit.

6 If a fault does arise, first read Section 2 concerning the precautions to be taken to prevent personal injury or damage to the machine when carrying out test procedures. To isolate the fault, check through the system in a logical sequence; while different faults may require varying methods, the following sequence of tests should permit the tracing of most faults (as far as the ordinary owner is likely to be able to follow them):
7 Check that the battery is in good condition and fully charged – while it is possible, as a quick check, merely to ensure that all the other systems are working normally, it should be remembered that the battery may well be only just able to turn the engine over on the starter motor without having the reserves necessary to power the ignition and fuel injection systems. Therefore in certain circumstances it may be preferable to use a meter to check the battery rather than more rough and ready methods.
8 Check that the ignition and engine kill switches are properly switched on and that both are functioning correctly, also that the load-shedding relay is correctly cutting off the other circuits.
9 If the starter motor will not turn over, check that the fault is not in one of the ignition system-related safety interlock components (refer to the relevant wiring diagram for details).
10 If the starter motor is functioning correctly but the engine will not start, remove the spark plugs, connect each to its cap and lay it on the cylinder head or cylinder head cover. Be careful to place the electrodes as far away as possible from the spark plug apertures and to cover each aperture with a wad of rag or similar to prevent the risk of fire from sparks igniting any fuel/air mixture that may be ejected. Also ensure that the metal body of each spark plug is firmly in contact with the metal of the cylinder head or cover so that the risk of damage to the ignition system is avoided, which might result if one or more of the spark plugs is not correctly earthed during the performance of this test. When the engine is turned over on the starter motor (taking great care to prevent the risk of personal injury, as warned in Section 2), a strong blue spark should appear at regular intervals across the electrodes of each plug.
11 If no spark appears, or if the spark appears thin or yellow, further investigation will be required. First of all, substitute brand new spark plugs of the correct type and grade, then repeat the test to check whether any improvement is obtained. If the fault occurs on one cylinder only, swap the complete HT lead assembly (right angled suppressor/connector, lead, spark plug cap and spark plug) with that of another cylinder to check whether this cures the fault. Note however (on 100 models only) that if cylinders 1 and 4, or 2 and 3, are faulty at the same time the problem is most likely to be in the appropriate HT coil or its connections; this can be checked easily by swapping over the coil connections and repeating the test.
12 All of the HT lead components can be tested as described in Section 6 of this Chapter, but for the purposes of a quick check the various components can be tested by disconnecting them and swapping between cylinders until the faulty item is isolated; it is extremely unlikely that the same fault would cause failure in all three or four of any of these components.
13 If the fault is thought not to be in the HT lead assemblies, check the coils themselves. If all their connections and mountings are secure and there is no visible sign of damage, the power supply can be checked, as described in Section 5; a 12 volt bulb can be substituted if a meter is not available. The only full test for the HT coils that can be carried out by the ordinary owner is described in the same Section, but requires the use of a meter.
14 If the power supply to the coils is not correct, check the ignition and engine kill switches for faults, also the battery and earth connections (see the relevant wiring diagram for details).
15 If the coils are receiving the correct power supply and if there is no apparent fault in the coils themselves or in the HT lead components, the fault must lie in the ignition trigger assembly or in the control unit, or in the wires between them. It is worth checking that the trigger assembly is securely fastened and in the correct position, also that the connections are secure and the wires in good condition. It is permissible for the private owner to use an ordinary multimeter to check the wiring for faults, **provided** that all ignition system or fuel injection system components have been first disconnected. Refer to Section 2.
16 If none of the checks outlined above reveal the cause of the fault, the machine should be taken to an authorised BMW dealer who has the tester/diagnostic unit developed for BMW by Bosch. This equipment is connected to the machine by a set of adaptor leads and should be capable of checking the function of the entire ignition and fuel injection systems; in skilled hands it should be able to trace faults very quickly and easily.
17 Unfortunately there is no real alternative to the use of this equipment; while this manual contains all the relevant test data, nothing additional is available which will allow the checking of the system's components using ordinary equipment. Since all other available data is related specifically to the Bosch diagnostic unit, it is of no use to anyone who does not have access to one of these units. The only other possibility is to test by substitution; since the ignition system has only two major components it is feasible for an ordinary owner to swap first the trigger assembly, and then, if necessary, the control unit, in an attempt to isolate a fault. This is a very inconclusive and unsatisfactory test procedure which of course presupposes that sound components of exactly the correct type are available, either from a friendly BMW dealer or from a friend's machine.
18 Taking all the above into account, many owners may well feel that the simplest course of action is to take the machine to an authorised BMW dealer if a fault of any sort is encountered in the ignition system. Compared with the time-consuming nature of the various tests and the dangers both to the machine and its owner inherent in some of them, the idea must be attractive of having a skilled operator quickly and safely run through a test sequence on the diagnostic unit to check the entire system and locate any faults, even if this does mean having to pay the labour charge necessary.

Chapter 7 Frame and forks

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Specifications

Front forks

Travel:	
K75 S, any model with 'S' suspension	135 mm (5.32 in)
All other models	185 mm (7.28 in)
Stanchion OD	41.325 – 41.350 mm (1.6270 – 1.6280 in)
Lower leg ID	41.400 – 41.439 mm (1.6299 – 1.6315 in)
Stanchion/lower leg clearance	0.050 – 0.114 mm (0.0020 – 0.0045 in)
Stanchion maximum warpage	0.100 mm (0.0039 in)
Stanchion installed height (test length) – from top of stanchion to top machined surface of bottom yoke	180 mm (7.0866 in)
Fork spring free length:	
Top spring – K75 S, any model with 'S' suspension	N/Av
Main spring – K75 S any model with 'S' suspension	N/Av
Main spring – all other models	395 – 401 mm (15.5512 – 15.7874 in)
Main spring wire diameter	4.67 – 4.73 mm (0.1839 – 0.1862 in)
Fork oil capacity – per leg:	
K75 S, any model with 'S' suspension	280 ± 10 cc (9.86 ± 0.35 Imp fl oz, 9.47 ± 0.34 US fl oz)
K100, all other 75 models	330 ± 10 cc (11.62 ± 0.35 Imp fl oz, 11.16 ± 0.34 US fl oz)
K100 RS, K100 RT, K100 LT	360 ± 10 cc (12.67 ± 0.35 Imp fl oz, 12.17 ± 0.34 US fl oz)

Recommended fork oil: Manufacturer:	Type
Aral	1010 shock absorber oil
Aral	P3441 shock absorber oil
Bel-Ray	SAE 5 Fork Oil (with 'Seal Swell')
BP	Aero Hydraulic
BP-Olex	HLP 2849
Castrol	Fork Oil Extra Light
Castrol	DB Hydraulic Fluid
Castrol	1/-318 Shock Absorber Oil
Castrol	LHM – only for temperatures below 0°C (32°F)
Castrol	AWH 15
Esso	Univis 13 Telefork Oil
Golden Spectro	Suspension Fluid Very Light
Mobil	Aero HFA shock absorber oil
Mobil	DTE 11 shock absorber oil
Premium Fork Lubricant	Spectro SAE10 – for competition use only
Shell	Aero Fluid 4
Shell	4001 shock absorber oil
Wack Chemie	SAE 5 (red) high-performance telescopic fork oil

Torque wrench settings

Component	75 models		100 models	
	Nm	lbf ft	Nm	lbf ft
Steering stem top bolt – early 75 models, all 100 models	74 ± 5	54.5 ± 4	80	59
Steering stem locking sleeve – late 75 models	45 ± 3	33 ± 2	N/App	N/App
Locking sleeve locknut – late 75 models	45 ± 3	33 ± 2	N/App	N/App
Steering head bearing adjusting knurled circular nut – all models	Tightened until free play is just removed from bearings			
Handlebar clamp bolts	22 ± 2	16 ± 1.5	N/Av	N/Av
Handlebar mirror retaining nuts	16 ± 3	12 ± 2	N/Av	N/Av
Fork oil filler plug	15 ± 2	11 ± 1.5	8	6
Top yoke pinch bolts	21 ± 2	15.5 ± 1.5	24	18
Fluidbloc retaining screws or bolts	9 ± 1	6.5 ± 0.5	N/App	N/App
Bottom yoke pinch bolt	43 ± 3	32 ± 2	47	34.5
Fork brace/lower leg mounting bolts	21 ± 2	15.5 ± 1.5	21 ± 2	15.5 ± 1.5
Damper rod Allen screw	20 ± 2	15 ± 1.5	N/Av	N/Av
Fork oil drain plug	9 ± 1	6.5 ± 0.5	9	6.5
Stand mounting bracket/gearbox bolts	41 ± 5	30 ± 4	N/Av	N/Av
Centre and side stand pivots	41 ± 5	30 ± 4	N/Av	N/Av
Footrest plate/gearbox bolts	15 ± 2	11 ± 1.5	N/Av	N/Av
Pillion footrest/footrest plate retaining nuts	29 ± 3	21.5 ± 2	N/Av	N/Av
Rear brake pedal pivot	25 ± 3	18.5 ± 2	N/Av	N/Av
Fairing mounting bracket/steering head screws or bolts – K75 S	9 ± 1	6.5 ± 0.5	N/App	N/App

1 General description

The front forks are of the telescopic type with internal coil springs and hydraulic damping and are built for BMW by Fichtel and Sachs. The original design received a minor modification late in 1984 and a major revision of the damping components in 1986, when the 75 models were introduced. All 75 models and a special edition K100 RS were fitted with an integral fork brace. When the K75 S model was introduced it was fitted with shorter travel forks which were fitted with two springs in each leg and heavily revised damping components. This type of fork, now offered on other models as 'S' type suspension, carries the same damping components as all other current models in its left-hand fork leg but some are omitted from its right-hand leg. The extra spring, coupled with the preload spacers at the bottom of each leg, gives a much stiffer ride than is normal for BMW; these forks must be used only in conjunction with the stiffened K75 S rear suspension unit.

The steering head bearings are of the taper roller type for all models but the top bearing was modified on 75 models early in 1986 to incorporate a more accurate method of adjustment. Also introduced at this time on 75 models was the 'Fluidbloc' steering damper which consists of a stiff rubber bush lubricated with silicone grease and fixed around the steering stem by grub screws passed through the steering head lug; it can be fitted to any earlier 75 model.

The frame is a spine type, constructed of welded steel tubing and incorporating the engine/transmission unit as a stressed member.

2 Front forks: removal

1 It is advisable to prevent any risk of damage to its paintwork by removing the fuel tank. See Chapter 5.

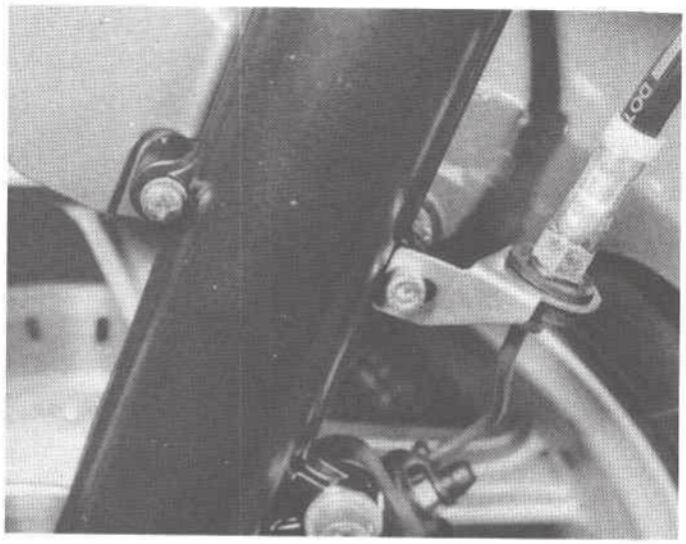
2 On machines fitted with fairings, remove any internal panels (eg the knee pads on K100 RS, K100 RT and K100 LT models) that prevent access to the fork yokes, and on K100 RS, K100 RT and K100 LT models, remove the fork gaiter retaining screws (where fitted). On models fitted with the handlebar fairing (K75 C-type) slacken the clamp screws holding the fairing bracket to the fork stanchions.

3 Remove the front wheel. See Chapter 9. Disconnect the second brake caliper from the fork lower leg, place a soft wooden or plastic spacer between the pads of each caliper and tie both calipers loosely to the frame so that both are out of harm's way and their hoses are not kinked or stretched.

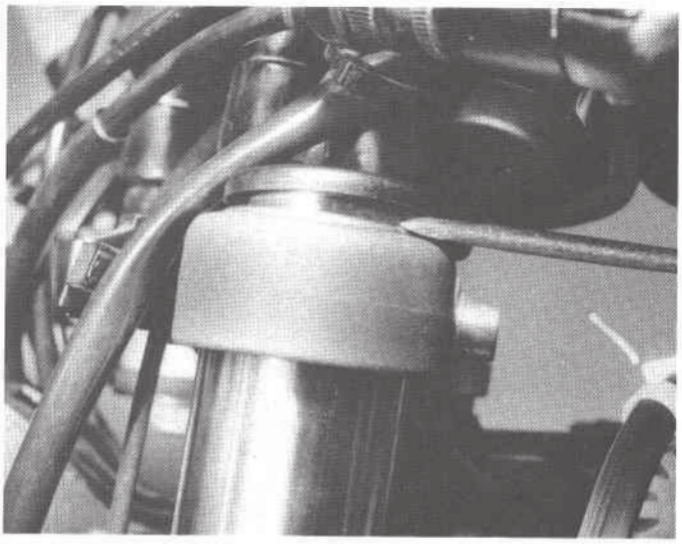
4 Remove its mounting bolts and withdraw the front mudguard and, where fitted, the fork brace.

5 Prise the black plastic cap off the top of each fork leg and slacken fully both fork yoke pinch bolts to release each leg.

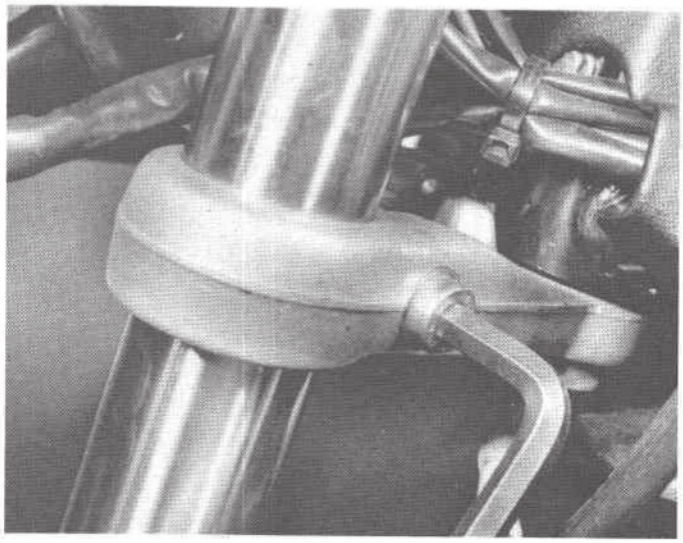
6 Unless the yokes have been distorted through excessive overtightening, the fork legs can be pulled easily downwards and out of the yokes. If resistance is encountered, apply a liberal quantity of penetrating fluid to the fork stanchions where they pass through the yokes, allow time for it to work and then try to rotate the stanchion to break it free of the yoke's grip, before pulling it downwards.



2.3 Remove front wheel, both brake calipers and hoses, and front mudguard



2.5a Prise plastic cap off each leg ...



2.5b ... then slacken pinch bolts to release fork stanchions

3 Front forks: dismantling

1 Always dismantle fork legs separately to avoid the risk of interchanging parts and causing increased wear. Store all components in separate, clearly-marked containers and work on one leg at a time to ensure this.

2 Holding the top plug with an open-ended spanner, remove the filler plug then unscrew the drain plug and hold the leg over a suitable container to drain the oil. Pump the leg vigorously to expel as much oil as possible.

3 Using the wheel spindle placed in one of its lugs to prevent rotation, unscrew the damper rod Allen screw from the base of the fork lower leg.

4 Clamp the fork lower leg by the caliper mounting or wheel spindle lugs in a vice equipped with soft jaws to avoid marking the soft alloy, then use a suitable rod to press in the top plug until the retaining circlip is exposed. Push the circlip down into the leg on one side only so that it can be gripped with a pair of pliers and withdrawn. Allow the spring pressure to push the top plug out of the stanchion; in some cases the sealing O-ring may be such a tight fit that the top plug must be extracted using a pair of pliers to grip a bolt screwed into the filler plug thread.

5 Make a very careful note of the order components are removed, and which way round each is fitted. Note that any references to K75 S suspension components automatically apply to any model fitted with S type suspension.

6 On all models except the K75 S, remove first the white nylon spacer then the fork spring, noting which way round the spring was fitted, also the spring seat at each end.

7 On K75 S models remove the spacer(s), followed by the top spring, then the main spring; note carefully which way round each component was fitted.

8 On all models, remove the damper rod Allen screw and pull the fork stanchion assembly out of the lower leg. Owners should note that the rebuilding procedure is quite difficult if the damper components are removed from the stanchion; it is recommended that these components are left undisturbed unless their removal is absolutely necessary.

9 Remove the circlip from the stanchion lower end and note the number and thickness of shims fitted above it. Pull the damper assembly carefully out of the stanchion; as the damper piston emerges note which way round the piston ring is fitted. The valve housing can be removed from the lower end of the damper rod and the piston ring can be removed from its groove.

10 If the damper components are to be dismantled, thoroughly clean the rod assembly, removing all traces of oil and dirt and finishing off with a rinse in hot soapy water to remove any flammable solvents. On K75 S models measure the exact overall length of each damper rod from the piston top surface to the rod lower end and record the results. The damper piston is screwed on to the rod upper end and secured at a precise distance by Loctite 638 or 273 thread-locking compound; to release this it must be heated in a gentle flame until the Loctite starts to burn (approximately 250°C/482°F), whereupon the piston can be gripped with a pair of pliers or similar and unscrewed. The damper components can then be removed after taking careful note of exactly which way round each is fitted.

11 To remove the fork oil seals, withdraw the dust excluder from the top of each fork lower leg and carefully lever out the seal. Use only a tool with well-rounded edges to avoid scratching the seal housing and place a piece of wood across the top of the leg to act as a pivot and prevent damage to the leg itself. If a seal is very difficult to remove, pour boiling water over its upper end, taking care to prevent the risk of personal injury.

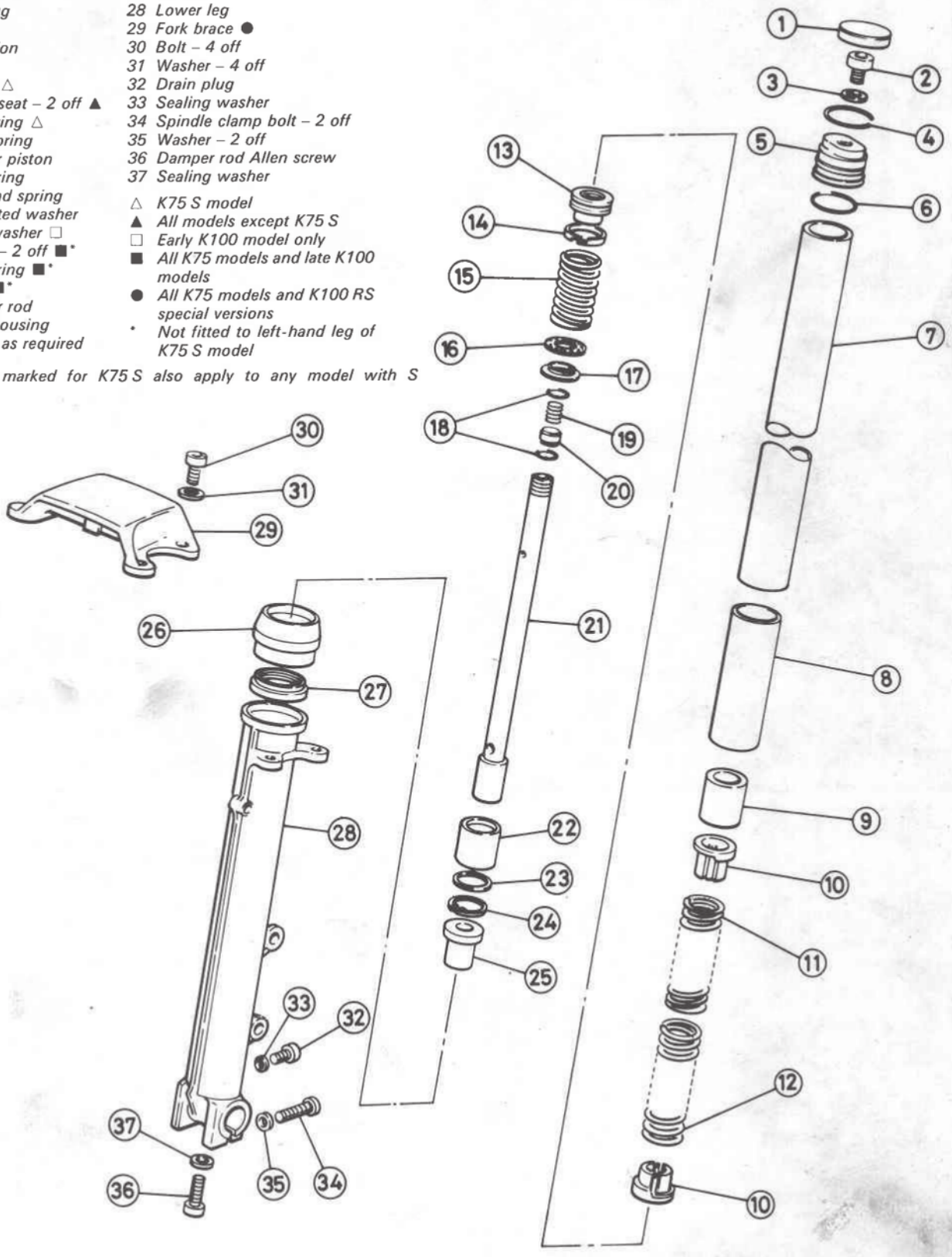
12 On K75 S models once the seals are removed the spacers can be tipped out of the fork lower legs; note which way round each is fitted.

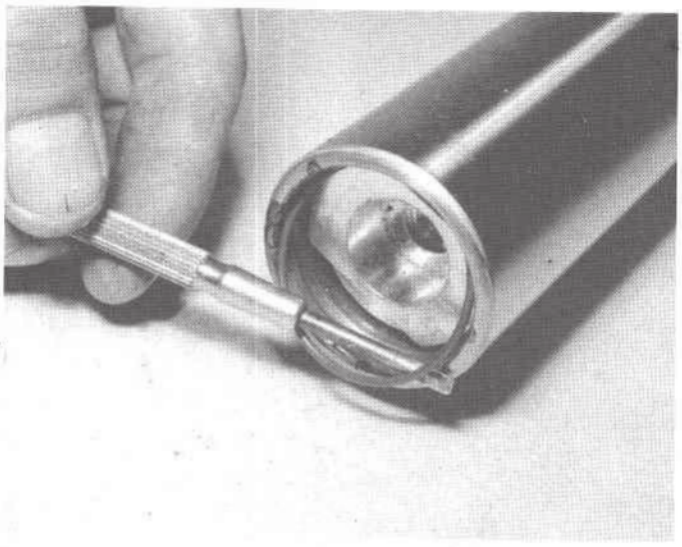
Fig. 7.1 Front forks

1 *Plastic cap*
2 *Filler plug*
3 *Sealing washer*
4 *Circlip*
5 *Top plug*
6 *O-ring*
7 *Stanchion*
8 *Spacer*
9 *Spacer* △
10 *Spring seat – 2 off* ▲
11 *Top spring* △
12 *Main spring*
13 *Damper piston*
14 *Piston ring*
15 *Rebound spring*
16 *Perforated washer*
17 *Valve washer* □
18 *O-ring – 2 off* ■*
19 *Coil spring* ■*
20 *Valve* ■*
21 *Damper rod*
22 *Valve housing*
23 *Shim – as required*
24 *Circlip*
25 *Spacer* △
26 *Dust excluder*
27 *Oil seal*
28 *Lower leg*
29 *Fork brace* ●
30 *Bolt – 4 off*
31 *Washer – 4 off*
32 *Drain plug*
33 *Sealing washer*
34 *Spindle clamp bolt – 2 off*
35 *Washer – 2 off*
36 *Damper rod Allen screw*
37 *Sealing washer*

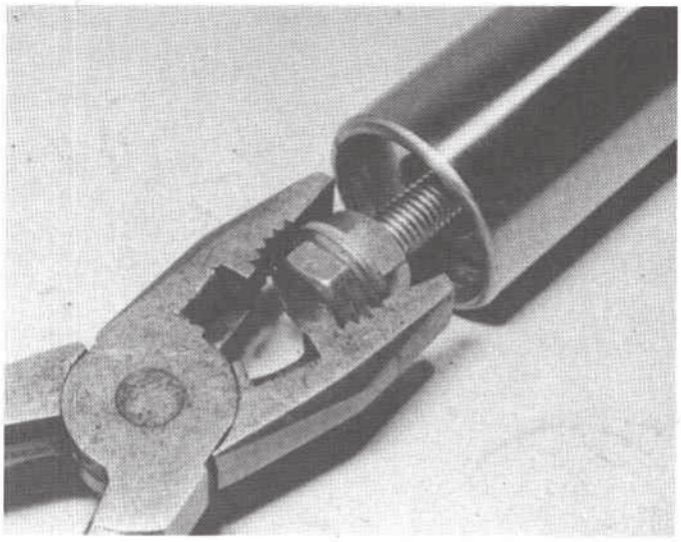
△ *K75 S model*
▲ *All models except K75 S*
□ *Early K100 model only*
■ *All K75 models and late K100 models*
● *All K75 models and K100 RS special versions*
* *Not fitted to left-hand leg of K75 S model*

Note: items marked for K75 S also apply to any model with S suspension

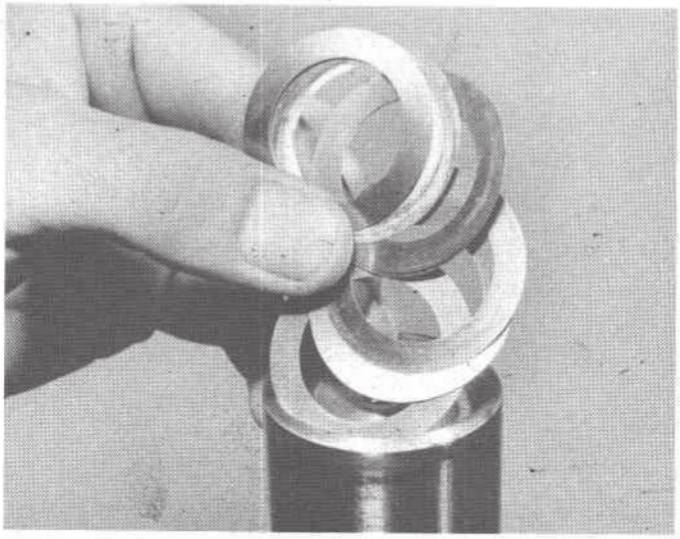




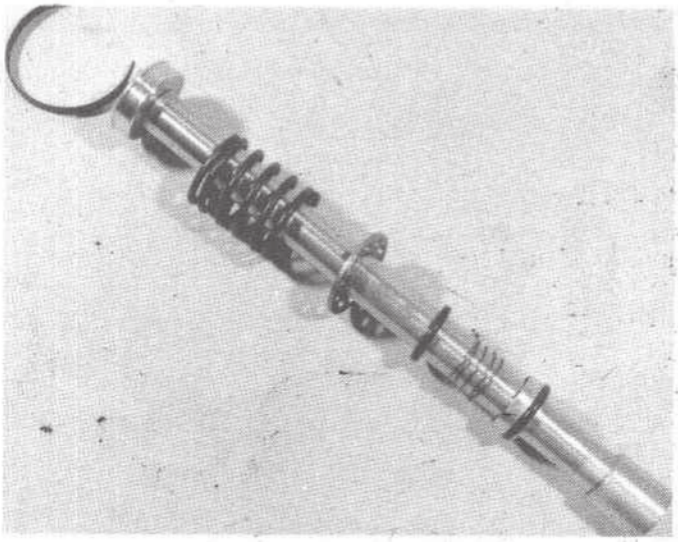
3.4a Push top plug into stanchion until circlip can be withdrawn ...



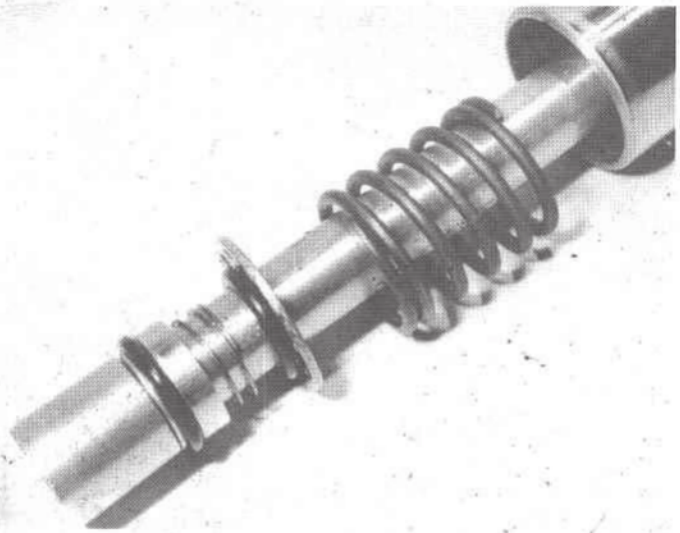
3.4b ... top plug should be pushed out by spring pressure but may require pulling, as shown, if O-ring is a tight fit



3.9 If damper rod is removed from stanchion, note number and thickness of shims



3.10a Do not dismantle damper rod unless necessary – piston must be heated to release locking compound ...



3.10b ... Note carefully which way round components are fitted before removing them

4 Front forks: examination and renovation

1 If the forks have been damaged in an accident, it is essential to inspect both fork yokes, the stanchions and the lower legs, for distortion and hairline cracks. Distorted components must be renewed, do not attempt to straighten them.

2 Stanchions may be checked for straightness by rolling them along a flat surface.

3 Check the fork bottom yoke by clamping the steering stem horizontally in a vice with soft jaws. Fit the stanchions to the yoke, with the upper ends projecting the specified test length beyond the top machined face of the yoke.

4 Take a sight across two straightedges laid across the extreme ends of the stanchions. Check for parallelism by measuring between the stanchions at each end, at right angles. Fit the top yoke and check that the steering stem and both stanchions fit into it without any apparent strain.

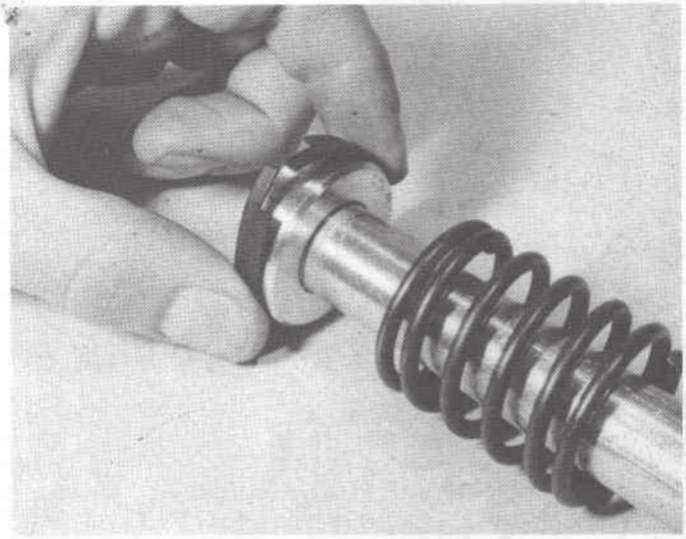
5 The fork lower legs are not bushed; the stanchions bear directly in the alloy casting. If the lower legs are worn or scored they must be renewed. Permissible clearance is given in the Specifications Section of this Chapter.

6 The oil seals should be renewed whenever they are disturbed, as should all sealing O-rings and washers. Check carefully the condition

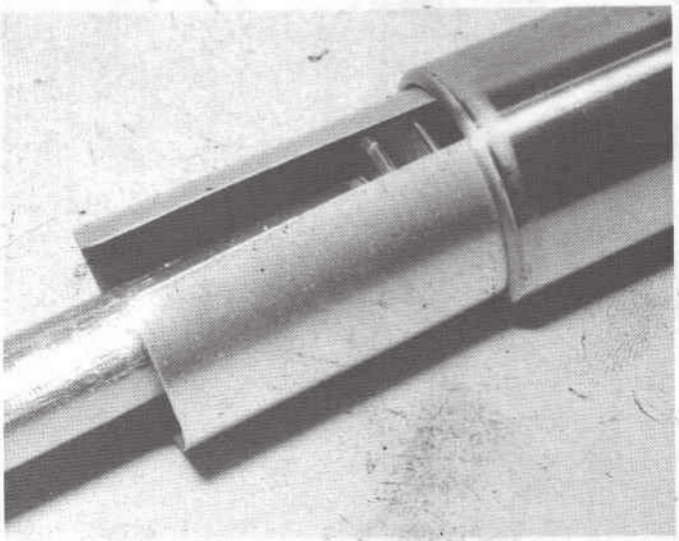
of each damper rod piston ring and renew it if there is any doubt about its condition. Where fitted, check the dust excluder and fork gaiters for signs of wear or damage and renew them if necessary.
7 Measure the spring free lengths; if either has settled to less than the specified length, where available, both springs must be renewed.
8 Thoroughly clean all components and dry them ready for reassembly.

5 Front forks: reassembly

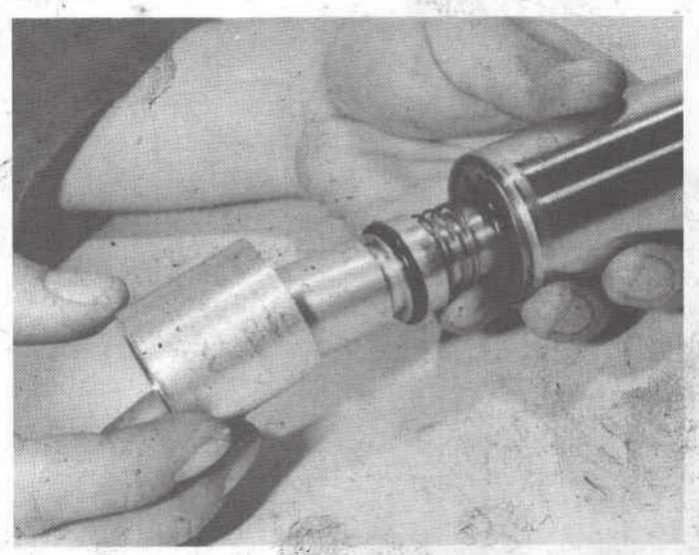
1 On K75 S models refit the spacers to the fork lower legs, ensuring that they are the correct way up.
2 On all models refit the fork seals. Check that each housing is free from burrs or raised edges, then smear grease over the seal's outside edge and tap it squarely into its housing until it is **just** flush with the top of the fork lower leg. **Do not** attempt to drive it in any further as this will merely distort the seal and promote leaks. Use a hammer and a tubular drift such as a socket spanner which bears only on the seal's hard outer edge to tap the seal into place.
3 If the damper rod assembly was disturbed, it must be rebuilt following the accompanying photographs and illustrations to ensure that all components are correctly refitted. Note particularly that the valve fitted at the bottom of the rod on later models has an O-ring around it which should be on the lower side of the valve.
4 When the damper assembly is complete, the piston must be refitted to retain the components; make a final check that all are refitted and degrease the piston and rod threads. Apply a single drop of Loctite 638 or 273 thread-locking compound and screw the piston on to the rod until the rod's overall length (from the top of the piston to the bottom of the rod's lower end) is 258 ± 0.5 mm (10.16 ± 0.02 in). Note that a specified figure is not available for K75 S models; these must be rebuilt to the length noted on dismantling. When the piston is correctly set, either dry the Loctite with a hot-air blower or leave it to cure for 24 hours at room temperature.
5 Fit the damper piston ring to the piston groove so that its notched end is downwards then wrap a sheet of thin (the metal in the photograph is 0.35 mm/0.014 in thick) metal or stiff plastic around the piston and ring to hold the ring securely in its groove and to act as a guide to lead it into the stanchion bore. Withdraw the guide and push the damper rod into the stanchion.
6 Fit the valve housing over the rod lower end and insert it into the bottom of the stanchion. The housing is retained by a circlip but the clearance between them must be eliminated by careful shimming to prevent an annoying rattle. Shims are available in thicknesses of 0.1 and 0.3 mm (0.004 and 0.012 in) for early 100 models but can only be used in conjunction with a modified circlip which was subsequently fitted to all other models. For later models shims are available in thicknesses of 1.6, 1.7, 1.8, 1.9 and 2.0 mm (0.063, 0.067, 0.071, 0.074 and 0.079 in).
7 Smear the stanchion assembly with oil and insert it into the fork lower leg, using the spring(s) to stop the damper rod from disappearing inside the stanchion. Refit the damper rod Allen screw and its sealing washer. Either pass a slim wooden dowel, with a coarse taper ground on one end, down inside the stanchion to bear against the damper piston or refit the spring(s) and spacer(s) and use these to apply sufficient pressure to stop the damper rod from rotating. Tighten the damper rod Allen screw to the specified torque wrench setting, where given. Refit the drain plug and tighten it to its specified torque setting. Smear the sealing lips with grease (BMW specify Gleitmo 805) and refit the dust excluder.
8 If required, the fork oil can be added at this stage rather than risk wasting any in trying to pour it through the rather small filler hole. Refit the fork spring(s) ensuring that the spring seats (where fitted) are correctly installed and that the springs are refitted the correct way up. Refit the spacer(s) and install the fork top plug with a new O-ring.
9 Push the plug into the stanchion, fit the retaining circlip to its groove and allow the spring pressure to push the plug back up against the circlip.
10 Fill the fork leg with exactly the specified amount of the correct type of oil, as described in Routine Maintenance, then check that the fork leg is fully extended before refitting the filler plug; the forks are designed with the cushioning effect of the trapped air in mind. Hold the top plug with an open-ended spanner and tighten the filler plug to the specified torque setting.



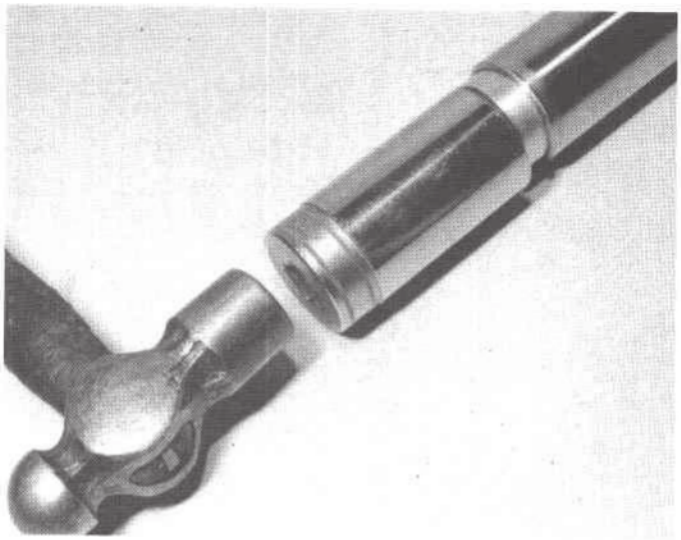
5.5a Wrap piston ring around piston groove ...



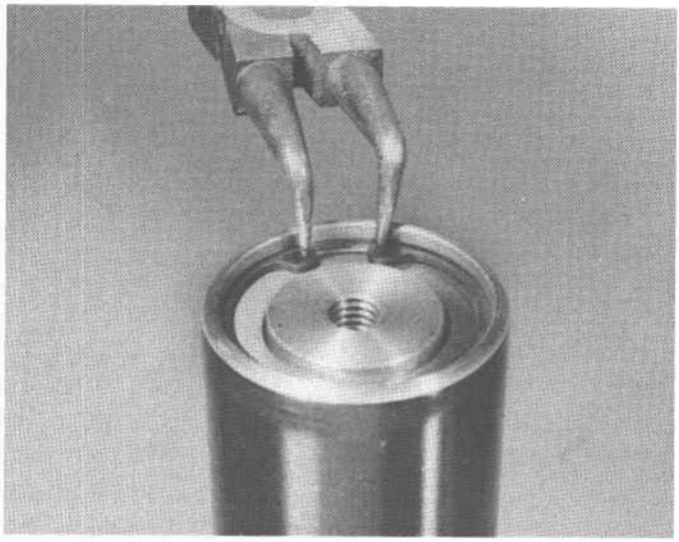
5.5b ... and use fabricated guide to ensure assembly is inserted into stanchion without damage



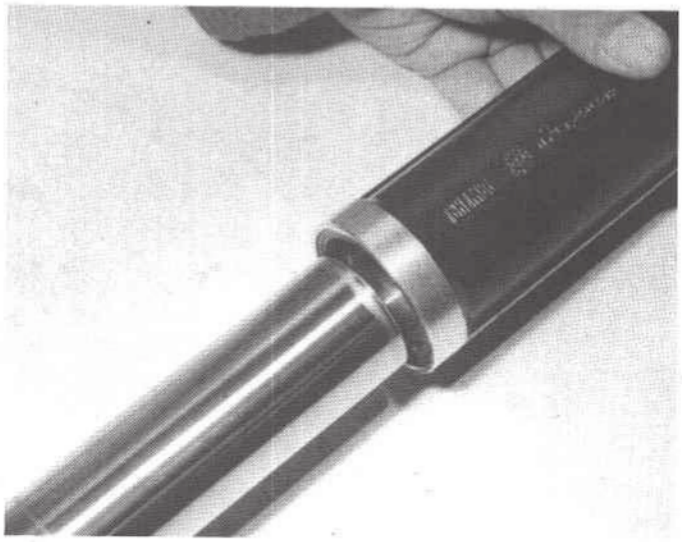
5.6a Fit valve housing over damper rod lower end ...



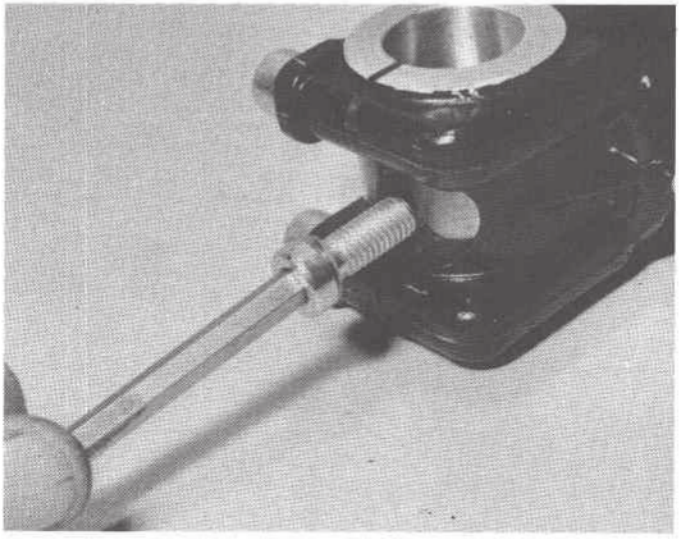
5.6b ... valve housing may have to be tapped gently into stanchion



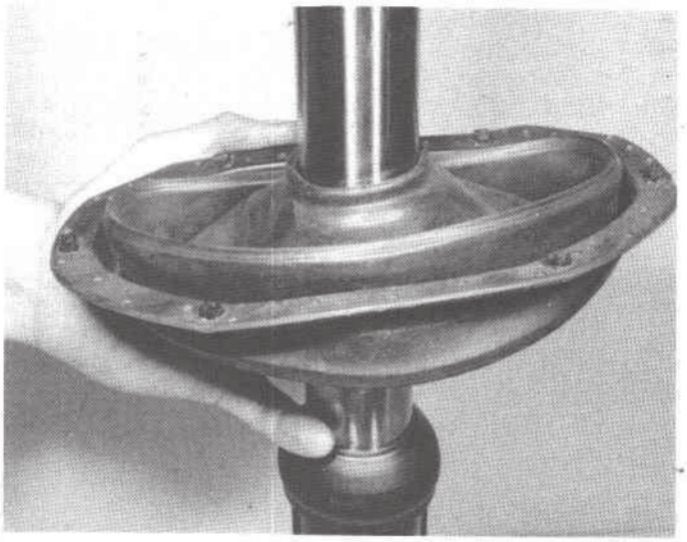
5.6c Clearance between valve housing and circlip must be eliminated using shims



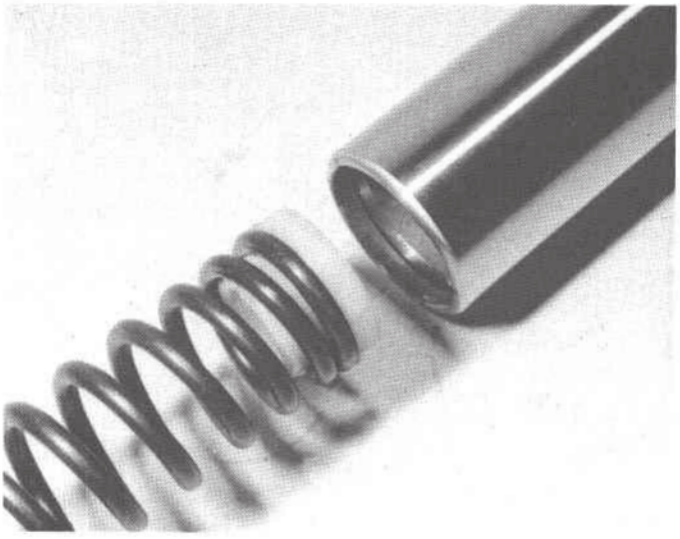
5.7a Lubricate all components before refitting stanchion assembly to lower leg



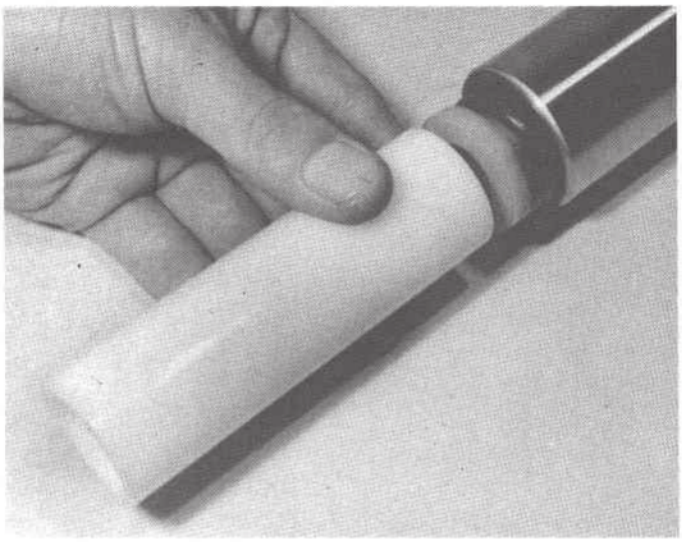
5.7b Prevent damper rod from rotating while Allen screw is fastened



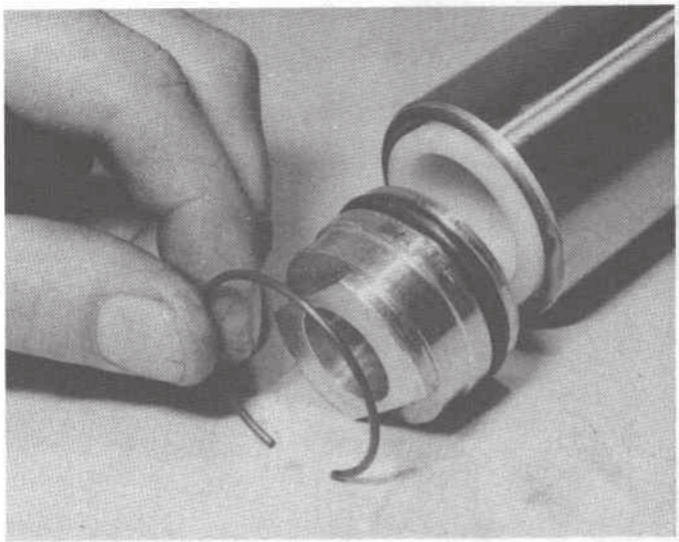
5.7c Refit dust seal to top of lower leg – do not forget gaiter (where fitted)



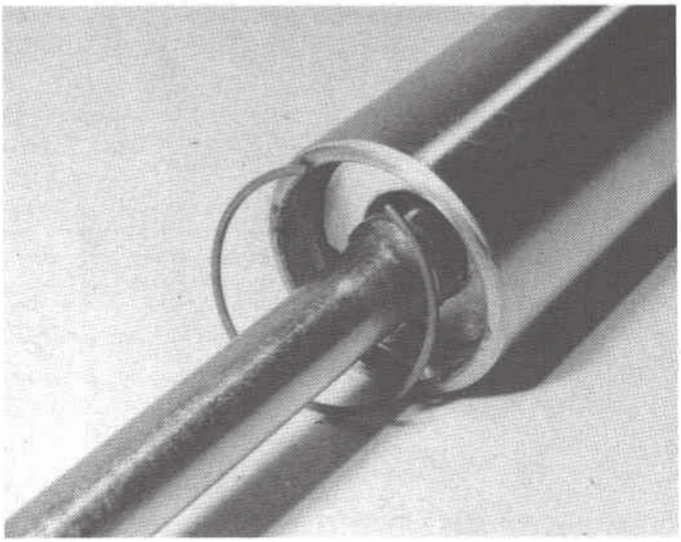
5.8a Ensure springs are refitted original way up – do not omit spring seats, if fitted



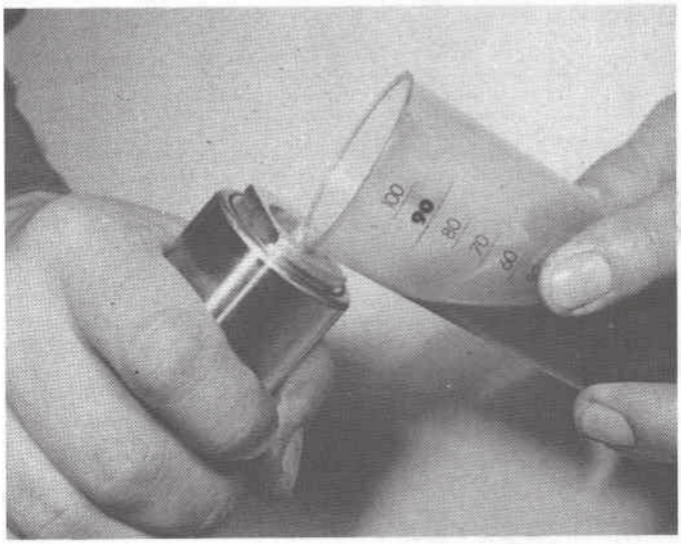
5.8b Refit fork spring spacer ...



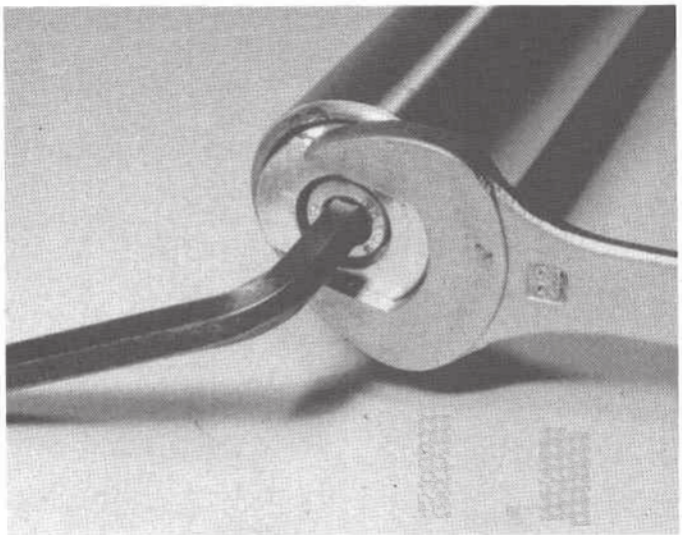
5.8c ... followed by top plug – note new sealing O-ring



5.9 Push top plug into stanchion until circlip can be refitted



5.10a Add exactly the specified amount and type of oil to each fork leg



5.10b Hold top plug as shown while tightening filler plug – fork leg should be fully extended

6 Front forks: refitting

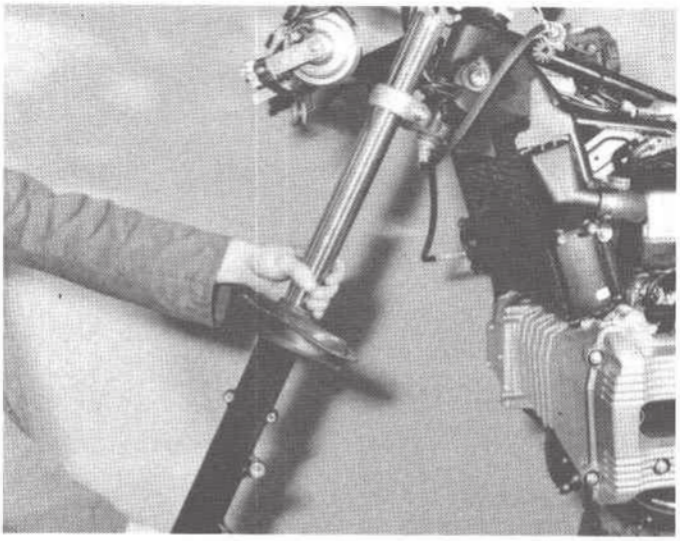
1 Use fine abrasive paper to polish away any burrs, raised edges or deposits of corrosion from the fork stanchions and from the yokes through which they must fit. Smear a light coat of grease over the stanchion upper end and slide the legs into place.

2 Lightly tighten the pinch bolts so that the legs are just held in the yokes, then check that the tops of the stanchions are flush with the top of the top yoke. Slide the wheel spindle through the spindle lugs to ensure that the fork legs are correctly aligned, then tighten first the top yoke pinch bolts to their specified torque setting, followed by the bottom yoke pinch bolts which must also be tightened to their specified setting. Refit the black plastic cap to the top of each leg.

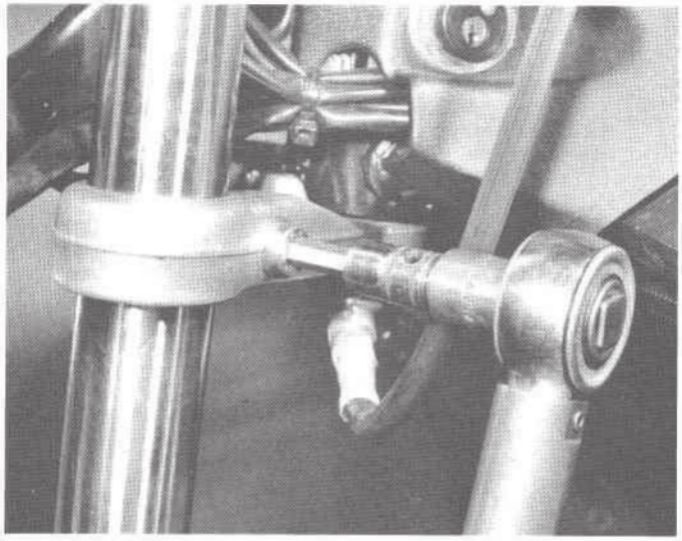
3 Refit the fork brace (if fitted) and the front mudguard, followed by the front wheel and the brake calipers.

4 When the front mudguard and wheel have been refitted, push the machine off its stand, apply the front brake and pump the forks up and down to align the legs and their mountings. Working from the top downwards tighten all fasteners to their specified torque settings, where available.

5 Check that all controls are correctly adjusted, that all components are securely fastened and that the suspension works smoothly before using the machine.



6.1 Smear grease over stanchions to aid fitting – do not forget gaiters, if fitted



6.2 Tighten pinch bolts to specified torque settings – do not overtighten

7 Front forks: aligning the damping components

1 Due to their long travel and relatively complex construction, these forks can be noisy in operation or, especially after they have been disturbed, they can become stiff in operation. While the standard procedure described in Sections 5 and 6 of this Chapter is sufficient in most cases, to remedy this, on occasion a stiff or noisy fork can be cured only by the more elaborate procedure described below. Note that the procedure starts with the premise that the stanchions are in place on the machine, with the damper rods fitted, and that the lower legs are attached loosely by the damper rod Allen screws; the mudguard, front wheel and fork brace (if fitted) must be removed.

2 Push each lower leg sharply upwards until it is heard to make contact, then rotate it two or three times around the stanchion to centre the damper rods before tightening the damper rod Allen screw to the specified torque setting (where given); use the spring or a wooden dowel to prevent the damper rod from rotating. Check that the lower leg still slides smoothly and easily and rotates without stiffness; if necessary slacken the Allen screw and repeat the procedure until results are satisfactory.

3 If a fork brace is fitted, install it but tighten the bolts only lightly then refit the wheel spindle and clamp it on one side only. Push both lower legs upwards simultaneously until contact is heard again then tighten the fork brace mounting bolts evenly and in a diagonal sequence to the specified torque setting; tighten also the second pair of spindle clamp bolts to the specified torque setting.

4 Pump the lower leg assembly up and down several times to check for any signs of stiffness or distortion, then check that the wheel spindle can be easily removed and refitted. If any stiffness or difficulty is found, check the fork components for distortion.

5 Refit the oil drain plugs, the front mudguard, the front wheel and the brake components then fill each leg with the specified quantity and type of fork oil and refit the fork springs and spacers.

6 Raise the front wheel from the ground and support the machine with a wooden box or similar under the crankcase so that the forks are fully extended. Refit the top plugs and oil filler plugs, then lower the machine to the ground and check the fork action.

7 Note that some stiffness will be inevitable in a freshly-rebuilt fork and a running-in period of 600 miles (1000 km) will probably prove necessary before the fork operates with absolute smoothness.

8 Steering head bearings: removal

1 Owners of machines with fairings are strongly advised to remove the fairing components to prevent any risk of damage.

2 Remove the fuel tank. See Chapter 5.

3 Remove the front fork legs. See Section 2 of this Chapter.

4 Carefully prise out the ignition switch surround and disengage the switch from the handlebar panel with a small screwdriver, then remove the panel mounting screws and withdraw the panel.

5 On K75, K75 C, K75 T and K100 models remove the headlamp surround/handlebar fairing, then remove its two fixing bolts and withdraw the headlamp unit, disconnecting the electrical leads to release it. Disconnect the horn wires, slacken the horn mounting bolts and remove the single screw securing the connector plug cover to the underside of the instrument panel. Withdraw the cover and unplug the connectors, then unscrew four Allen screws or hexagon-headed bolts securing the housing rear cover to the fork yokes. Withdraw the rear cover complete with the instrument panel, manoeuvring the panel clear of the bottom mounting bracket.

6 Disconnect the brake hose at the unions on the steering stem upper end and either plug the hose or wrap it tightly in a plastic bag or similar so that brake fluid cannot leak out. Unscrew the plastic nut (early 75 models and all 100 models) or release the retainer (later 75 models) at the top of the steering stem and pull the brake pipe down through the steering head, taking care not to splash brake fluid.

7 Remove the handlebar clamp bolts and bring the handlebars to the rear, clear of the steering head area, ensuring that all cables and wiring are out of the way. The fork yokes should now be completely clear and ready for removal.

8 On all 100 models and early 75 models unscrew the steering stem top bolt, tap the top yoke upwards off the steering stem using only a soft-faced mallet, unscrew the circular adjusting nut and pull the bottom yoke downwards out of the steering head; it may be necessary to use a soft-faced mallet to tap the steering stem down through the bearings. Withdraw the top bearing.

9 If working on an early K75 C model that has been subsequently fitted with a 'Fluidbloc' damper (identified by the two bolt heads protruding from the steering head lug) wipe all traces of grease away from the steering stem and wrap a thin layer of insulating tape around the threads to prevent them damaging the damper rubber as they pass through it.

10 On later 75 models unscrew the locking sleeve locknut and tap the fork top yoke upwards off the steering stem, then slacken the locking sleeve and unscrew the bearing adjuster nut while pulling the bottom yoke downwards out of the steering stem. The top bearing must be driven off the adjuster nut using a hammer and a pin punch passed through the holes in the nut top cover.

11 The bearing outer races can only be extracted using a slide-hammer or similar puller which has an internally-expanding adaptor of the necessary size.

12 To remove the bottom bearing thoroughly clean the whole steering stem and mark its installed position in the bottom yoke next to the slot

for the steering lock. Heat the assembly to 120 – 130°C (248 – 266°F) and drive or press the steering stem downwards through the bottom yoke until the bearing is released.

13 Before the yoke cools down, use a 30 mm (1.2 in) drift to tap the stem back into its previously marked position; the circlip should locate against the yoke underside.

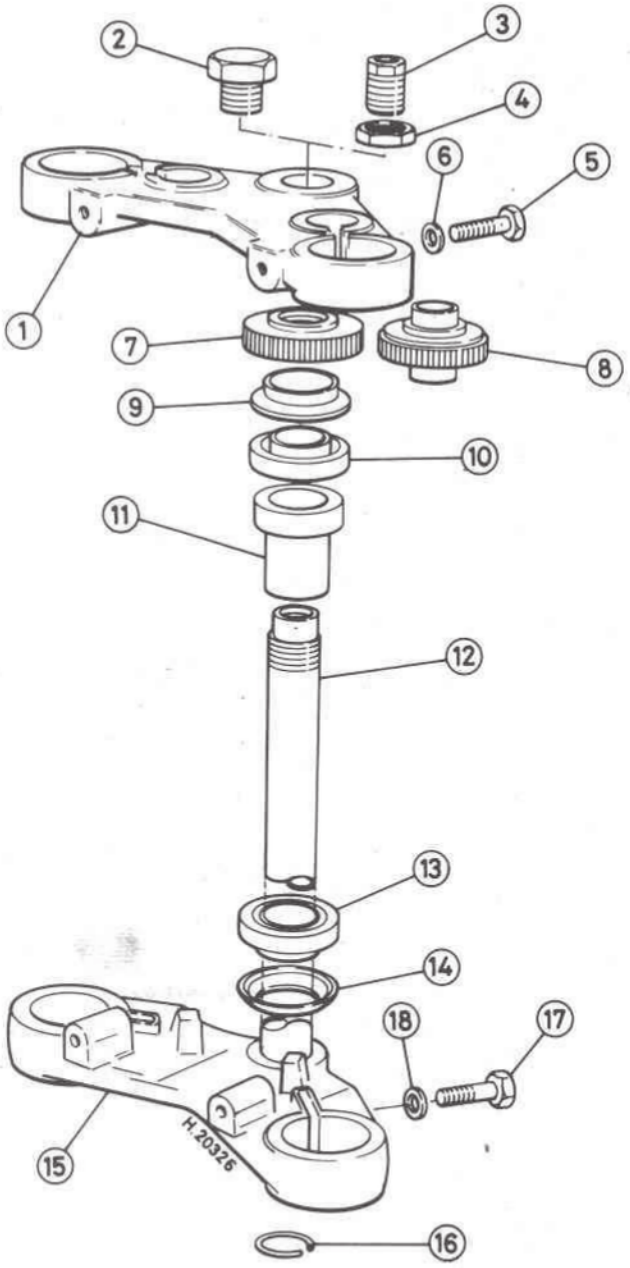
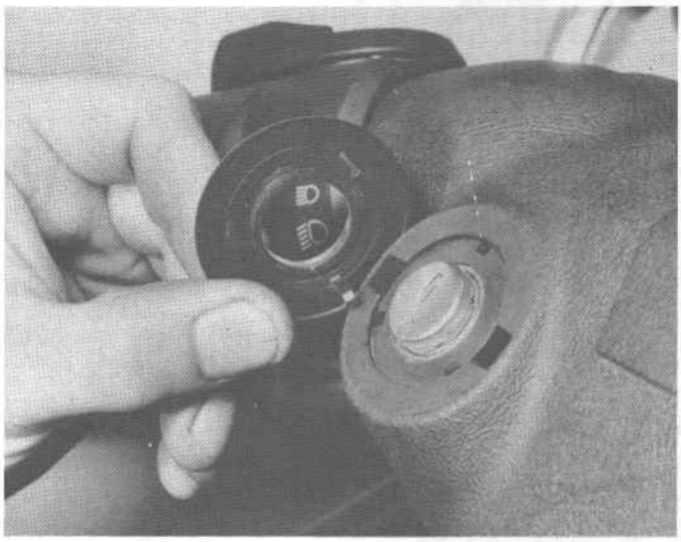


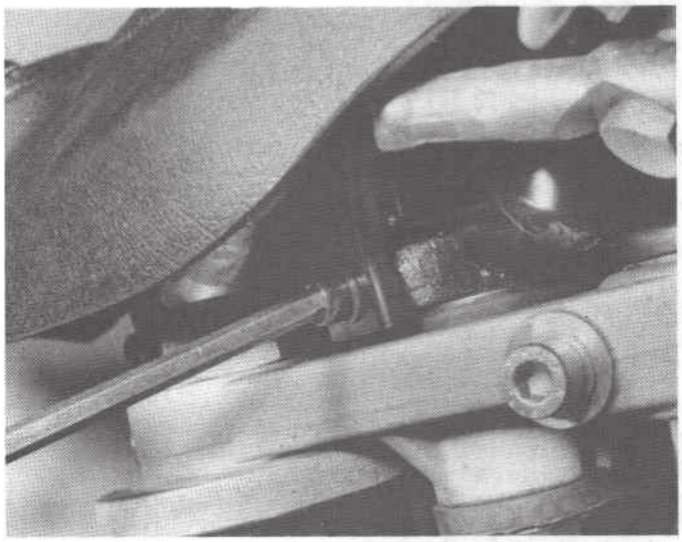
Fig. 7.2 Steering head assembly

1 *Top yoke*
2 *Steering stem top bolt* △
3 *Locking sleeve* ▲
4 *Locknut* ▲
5 *Bolt – 2 off*
6 *Washer – 2 off*
7 *Bearing adjuster nut* △
8 *Bearing adjuster nut* ▲
9 *Dust seal – where fitted* ▲
10 *Taper roller bearing*
11 *Fluidbloc steering damper* ▲
12 *Steering stem*
13 *Taper roller bearing*
14 *Dust seal – where fitted*
15 *Bottom yoke*
16 *Circlip*
17 *Bolt – 2 off*
18 *Washer – 2 off*

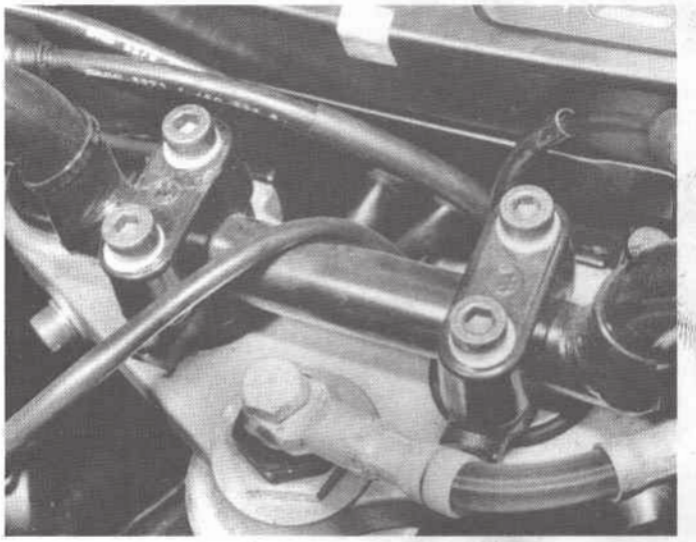
△ *All models except late K75*
▲ *Late K75 models only*



8.4a Prise off switch surround to release ignition switch from handlebar cover ...



8.4b ... then remove panel mounting screws and withdraw panel



8.6 Brake hose must be disconnected before fork top yoke can be removed

9 Steering head bearings: examination and renovation

1 Clean and examine the outer bearing tracks whilst in the steering head. Since the forks rotate through only a small angle, the commonest damage to the bearings is brinelling. This is indenting of the roller tracks by the rollers, generally due to maladjustment. It can be felt, when turning the forks, by the steering seeming to 'index' in one position.
2 Check the rollers and their cages for signs of wear or damage and renew the complete bearing if in doubt about its condition.
3 Always renew any dust seals or other sealing components to prevent the entry of dirt.

10 Steering head bearings: refitting

1 To refit the bearing outer races assemble a drawbolt consisting of a pair of thick steel washers which are large enough to fit over the end of the steering head lug, a bolt long enough to pass through the head lug, both washers and one outer race, and a large nut.
2 Ensuring that it is square to its housing in the steering head lug draw the bottom bearing outer race into the head lug until it seats fully. Do not forget to fit the Fluidbloc (where fitted) before repeating the procedure to refit the top bearing outer race.
3 Both inner races must be heated to 80°C (176°F) to refit them. To fit the lower bearing inner race a tubular drift must be found that will fit over the steering stem and yet bear only against the bearing inner race itself, not touching the rollers or cages. Refit the dust seal (where fitted) heat the bearing and drop it over the steering stem (ensuring that it is the correct way up) then tap it firmly down on to the bottom yoke; there must be no clearance between the bearing and the yoke.
4 The top bearing is fitted in a similar manner to the adjuster nut; again there must be no clearance between the bearing and the nut top cover.
5 Thoroughly grease all bearings after they have cooled, but be careful to keep grease away from the 'Fluidbloc' (where fitted). Where a Fluidbloc has been fitted to an early K75 C model, wrap a thin layer of tape around its threads before refitting the steering stem.
6 On early 75 models and all 100 models check that the bottom bearing is greased and refit the bottom yoke to the steering head. Remove the tape (if applicable). Heat the top bearing to 80°C (176°F) and drop it over the stem upper end. Tap it into place and refit the circular adjuster nut. Allow the bearing to cool, pack it with grease, if necessary, and tighten the nut hard to preload the bearings then slacken it fully and re-tighten it until all free play is **just** eliminated.
7 On later 75 models check that the bearings are greased and carefully refit the bottom yoke to the steering head. Refit the circular adjuster nut with the top bearing and locking sleeve. Again tighten the adjuster nut hard to preload the bearings, then slacken it fully and retighten it until all free play is just eliminated.
8 On all models refit the top yoke, followed by the top bolt (early 75 models and all 100 models) or locknut (late 75 models); do not tighten them until adjustment is complete.
9 Refit the handlebars, ensuring that the punch mark is aligned on the inside of the left-hand clamp, between the joint faces of the two clamps.
10 Refit the brake pipe to the steering head, fasten the plastic nut or retainer to secure it and connect the master cylinder brake hose again, using new sealing washers. Refill the brake system with fresh fluid, check that the spacers are in place between the brake pads, and bleed the brake system until normal lever pressure is restored. If the handlebars are kept on full left lock, the master cylinder will be the highest point in the system which will aid this procedure. Be very careful to check that the brakes are working correctly before taking the machine out on the road.
11 Refit the front forks, mudguard and fork brace. See Sections 6 and 7 of this Chapter. Refit the front wheel as described in Chapter 9.
12 Adjust the steering head bearings as described in Routine Maintenance, then refit all disturbed fairing or headlamp housing components, the handlebar panel and ignition switch and the fuel tank.
13 Check that the front brakes, the suspension, the steering and all controls work properly and are adjusted correctly before taking the machine out on the road. All fasteners should be securely tightened to their respective torque wrench settings, if available.

11 Fluidbloc steering damper: general – 75 models

1 This component is fitted as standard to all K75 C models from the end of 1985 onwards and to all K75 S models; it can also be fitted to any earlier K75 C model.
2 It consists of a firm rubber bush set in the steering head lug and retained by two tapered screws or bolts which are of exactly the required length to penetrate the soft surface of the damper without tearing it and so cannot be swapped between models.
3 The carefully shaped pattern on the damper's inside diameter, coupled with the use of silicone grease, gives sufficient friction to damp any fork movement greater than 1 degree side to side.
4 The unit requires no maintenance since the grease specified is a long-life lubricant. If the steering head bearings are to be adjusted at any time remove the tapered screws or bolts so that the damper no longer exerts any damping effect which would otherwise give a false setting, and always take great care to protect the damper from other types of grease and from any damage when overhauling the steering head bearings.
5 It will be necessary to remove the steering head bearings to remove or refit a Fluidbloc damper. If installing a new damper mark a line on its larger diameter at a point 7 mm (0.28 in) below its top edge. Fill the recesses with the specified Silicone Grease 300 Heavy and press the damper into the steering head until the mark appears in the tapped holes; refit and tighten to the specified torque setting the tapered retaining screws or bolts.

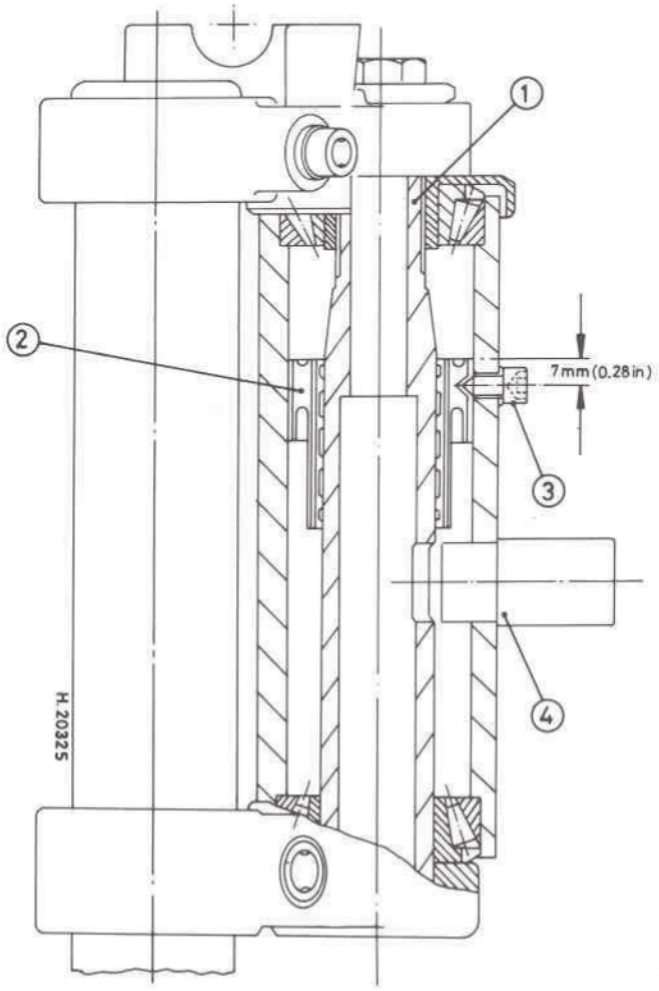


Fig. 7.3 Fluidbloc steering damper installation

1 Steering stem
2 Fluidbloc
3 Tapered screw or bolt
4 Steering lock

12 Frame: examination and renovation

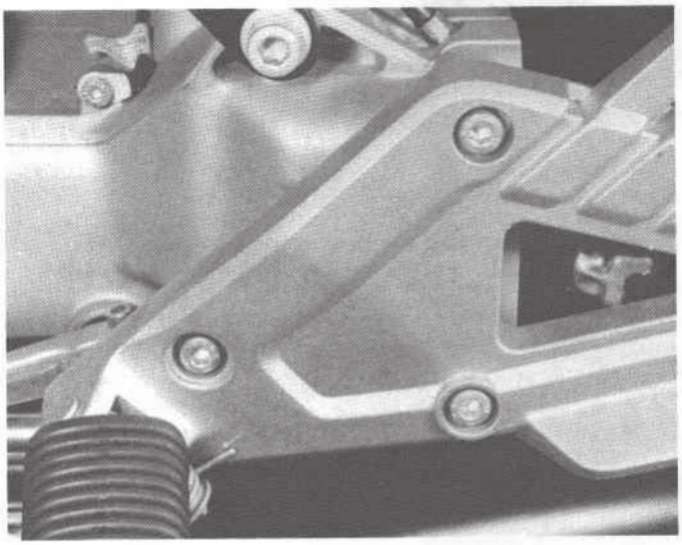
1 The frame is unlikely to require attention unless accident damage has occurred. In some cases, renewal of the frame is the only satisfactory remedy if the frame is badly out of alignment. Only a few frame specialists have the jigs and mandrels necessary for resetting the frame to the required standard of accuracy, and even then there is no easy means of assessing to what extent the frame may have been over-stressed. Note that BMW specifically advise against straightening or repairing components such as frames, fork stanchions and wheels because of the real danger of a fatigue fracture appearing subsequently.
2 After the machine has covered a considerable mileage, it is advisable to examine the frame closely for signs of cracking or splitting at the welded joints. Rust corrosion can also cause weakness at these joints. Minor damage can be repaired by welding or brazing, depending on the extent and nature of the damage.
3 Remember that a frame which is out of alignment will cause handling problems and may even promote 'speed wobbles'. If misalignment is suspected, as a result of an accident, it will be necessary to strip the machine completely so that the frame can be checked, and if necessary, renewed.
4 BMW specifically advise against fitting a sidecar or a trailer to any of the machines described in this Manual. Note that they also advise against fitting RS- or RT-type fairings to K100 models (with rigid engine front mountings) because of the risk of vibration damage. Check with an authorised BMW dealer for details.

13 Footrests: general

1 The footrests are pivoted, the rider's is being spring-loaded on large alloy plates bolted to the gearbox housing. On the early 100 models the plates were rubber mounted but since they were found to promote vibration they were replaced for the 1986 models by the 75 (rigidly-mounted) type. A modified version which can be fitted to early models was introduced in the US during 1985.
2 The footrests require no attention save a quick check at intervals that they are securely fastened and that the pivots are unworn; apply a few drops of lubricant at regular intervals to each bearing surface. Check regularly that all components are undamaged. If any are found to be damaged, cracked or broken they must be renewed unless an expert alloy welder can be found.
3 The footrests can be removed and refitted as major assemblies; it is merely necessary to unscrew the three bolts securing each plate to the gearbox housing to release them, although the rear brake components must be disconnected or removed to release the right-hand plate. On refitting, tighten the bolts to their specified torque setting, where given.

14 Stands and controls: general

1 At regular intervals (see Routine Maintenance) the stands, brake pedal and gearchange lever or linkage should be checked and lubricated. Check that all mountings are securely fastened using the specified torque settings if given.
2 If necessary, dismantle the assembly so that all pivot points and bearing surfaces can be cleaned and greased. Return springs, where fitted, must be in good condition with no trace of fatigue and must be securely mounted.
3 If accident damage is to be repaired, check that the component is not cracked or broken. Such damage may be repaired by welding if the pieces are taken to an expert but since this will destroy the finish renewal is the most satisfactory course of action. If a component is bent it can be straightened after heating the affected area to a dull cherry red with a blowlamp or welding torch. Again the finish will be destroyed but painted surfaces can be repainted easily, while chromed surfaces can only be replated.



13.1 Footrests are mounted on alloy plates bolted to gearbox housing

15 Fairing: removal and refitting

K75 – headlamp surround

1 The headlamp surround is retained by two screws at the bottom rear, one on each side, by two screws into the instrument panel/ rear cover and by a screw on each side next to the headlamp shell mountings.
2 Remove the screws, withdraw the surround, and disconnect the turn signal lamp wires. Refitting is the reverse of the removal procedure. If the rear cover is to be removed, refer to Section 8.

K75 C, K75 T, K100 – headlamp surround

3 The headlamp surround is retained by four screws which pass forwards from the rear cover; one at the top and one at the bottom, next to each fork yoke.
4 Remove the four screws, lift the surround forwards and disconnect the turn signal wires to release it. Refitting is the reverse of the removal procedure.
5 Once the surround has been removed the top panel can be unclipped and the turn signal lamp assemblies removed; each is retained by a single screw or bolt from inside the surround. If the rear cover is to be removed, refer to Section 8.

K75 C – handlebar fairing

6 This unit is listed as an optional extra for the K100 model and may be found on some K75 T versions.
7 Working from the rear of the unit, use an Allen key or a screwdriver, as necessary, to remove the screw which is threaded into the rear of each turn signal lamp assembly, then remove the four screws (two on each side) which secure the fairing to the fork stanchion brackets. Lift the fairing forwards, disconnect the turn signal lamp wires and withdraw it.
8 If required, remove the two clamp screws securing each bracket to the fork stanchions and withdraw the brackets. If the rear cover is to be removed, refer to Section 8.
9 Refitting is the reverse of the removal procedure.
10 Note that the windscreen is attached to the fairing by six rivets which require the use of a special tool to fit.

K75 T – windscreen

11 This unit is listed as an optional extra and may be found on K75 C and K100 models.
12 The screen itself is mounted at four points. Remove the four cap nuts and their plain washers and carefully withdraw the screen, noting the rubber grommet fitted on each side of all four mounting points, also the two bushes at each of the bottom mountings.
13 On refitting, ensure that all mounting rubbers are correctly placed

on each side of the screen so that it is completely rubber-mounted. Refit the plain washers and nuts; tighten the nuts securely but do not overtighten them or the mountings will be distorted and the screen may crack.
14 The screen mountings are clamped to the fork stanchions, just under the top yoke, giving a small amount of adjustment for height.

K75 S – fairing
15 Remove its four mounting screws and withdraw the windscreen. Working from in front of the radiator cover, remove its four mounting screws (two on each side) and carefully withdraw the cover; the mesh panel is retained by seven small screws and can now be removed if required. Unscrew the single mounting screw from in front of the brake hose union.
16 Remove the single screw retaining each turn signal lamp assembly, withdraw the assemblies and disconnect their wiring to release them.
17 Working from underneath the bottom rear edge of each main side panel, remove the single screw securing each bottom cover to its respective side panel and withdraw the bottom cover to expose the side panel mounting bolt. Move to the top of each side panel and remove the single retaining screw from inside each turn signal lamp housing and the two screws passing down into each side panel from the top centre panel (peel back the windscreen gaskets, if necessary), then move downwards along the panel's upper edge and remove the screw securing each one to the fairing inner cover. Remove each side panel's mounting bolt and withdraw both side panels.
18 The top centre panel is now retained by a single bolt and a small screw on each side; remove the two bolts (noting the arrangement of the rubber mountings) and the two screws and withdraw the panel, then disconnect the headlamp, parking lamp and horn wires to release it. If required, the two retaining screws can be removed from the headlamp mounting to separate the centre panel.
19 Remove the single retaining screw, withdraw the connector block cover from underneath the instrument panel and unplug the two connector blocks. Remove the four retaining screws and withdraw the instrument panel, noting the mounting components, then disengage the wiring leads from the inner cover clips.
20 Noting how the wiring and control cables are routed on each side of its mountings, remove its two mounting screws and remove the small cover from the front of the top yoke. Withdraw the fairing inner cover from around the fork stanchions, slackening the mounting bracket fasteners, if necessary. If required, the mounting bracket can be removed, but note that of its four mounting bolts the two top ones are the tapered screws or bolts which secure the Fluidbloc; ensure that these are correctly refitted.
21 On refitting, do not tighten the mounting bracket screws or bolts until the fairing inner cover is in place, then tighten all four to the specified torque setting. Ensure that the wiring and control cables are correctly routed before refitting the small cover to the top yoke, and clip the electrical leads into place on the inner cover once the instruments have been refitted.
22 Assemble the centre panel and headlamp assembly and refit the two retaining screws. Fit the panel and headlamp as a single unit and connect their wires to the bulbs and horn; check that the centre panel/fairing mounting bracket mounting grommet is correctly refitted before pressing the shouldered bush through it from the inside outwards and refitting the bolt and washer.
23 If working alone, fit one side panel and tighten its four retaining screws and one mounting bolt lightly, then refit the second panel and ensure that the two mate correctly at all points of contact with each other or with the other panels before tightening all fasteners on both panels. Do not forget the single screw at the joint in front of the brake hose union. Refit the side panel bottom cover, the radiator cover, the turn signal lamp assemblies and the windscreen.

K75 S – engine spoiler/belly fairing
24 A similarly-mounted version of this component is listed as an optional extra for other 75 models.
25 Remove from under the bottom edge of the fairing radiator cover the single screw mounting screw, noting the metal and rubber washers. Remove the two screws from underneath the front of the belly fairing, noting the plastic shouldered sleeves pressed into the rubber mounting grommets. Carefully move the belly fairing forwards and downwards to disengage it from the tongue of the rear mounting. Refitting is the reverse of the removal procedure.
26 The belly fairing's front mounting consists of a large bracket bolted to the sump or crankcase casting, and its rear mounting is bolted to the centre stand mounting bracket; the rear mounting's height is adjusted using shims which must be refitted correctly if the mounting is disturbed or the line of the fairing against the engine will be spoiled. If any shims are omitted, the fairing may contact the engine castings, thus damaging the paintwork and causing an annoying rattle.
27 If the belly fairing is to be dismantled, remove the four mounting screws and withdraw the mesh panel, then remove the rear mounting socket and unscrew the screws which secure the two halves along their mating surface. On refitting, use strips of draught-proofing tape, if necessary, to prevent the mesh panel from rattling against the inside of the fairing.

K100 RS – fairing
28 Remove the single retaining screw at the bottom rear edge of each lower side panel and the two screws at the top edge of each knee pad, then withdraw the knee pads, noting the clip at the bend in the middle of each pad.
29 Remove the six screws which secure each fork leg gaiter to the underside of the fairing and push the gaiters up inside.
30 Working from in front of the radiator cover, remove the six screws (three on each side) which secure the cover to the lower side panels, then support the cover while the screws are removed which secure it to the main fairing section and to the central front panel; note particularly the screws on each side of the brake hose union, which can be easily missed. When all screws are released, carefully manoeuvre the radiator cover away from the machine, turning the forks to clear the brake hose unions; the mesh panel with its sealing strip and frame is retained by six screws and can be removed, if required.
31 To remove each of the lower side panels, unscrew the single bottom mounting bolt and the four small screws along the top edge; be careful to support each panel while removing the fasteners and to remove it carefully once all have been unscrewed.
32 Remove the mirrors. To gain adequate working space inside the fairing remove the covers and panels. The small covers fitted between the top of the knee pads and the horizontal centre panel can be lifted up gently and unclipped from the centre panel. The covers over the windscreen mountings are each retained by a countersunk screw at their middle and a cheese-head screw at the top; remove the two screws and unclip each cover from the front of the centre panel. The centre panel itself is retained by a screw at each front corner; removing the cover with the fairing installed is a difficult operation but if required it can be left loosely in place so that it can be moved when necessary.
33 Remove the metal inner panels which are each retained by one screw at the bottom rear, one screw next to the mirror mounting and one screw at the panel front mounting.
34 Slacken the horn mounting nuts and pivot the horns away from the guide channels, then remove from outside the fairing the guide channel retaining screw and withdraw each channel. Disconnect the headlamp and parking lamp wires.
35 The main fairing section should now be retained by two bolts (to frame-mounted brackets) at the lower side panel mating surface and by four nuts or bolts to the fairing mounting bracket at the front. Engage the aid of an assistant to help support the fairing as it is removed.
36 Unscrew the two rear mounting nuts and remove the bolts, noting the arrangement of the mounting rubber grommets and metal washers, then ensure that the assistant is supporting the fairing as the front mounting nuts or bolts are removed. Withdraw the fairing.
37 If required, the fairing mounting bracket can be removed by disconnecting and removing the horns (front bracket only) and unscrewing the four bolts retaining it to the frame. Ensure the bolts are securely fastened on refitting.
38 To remove the headlamp assembly or windscreen, remove first the adjustable spoiler, then remove the windscreen mounting screws and withdraw the screen. Remove the three headlamp assembly mounting screws and withdraw the assembly, noting the sealing grommet around its outer edge. The central front panel can be removed from the fairing underside by unscrewing the remaining mounting screws.
39 On reassembly, place the sealing grommet on the headlamp outer edge, refit it to the fairing and tighten securely the mounting screws. Refit the windscreen and ensure that its bottom edge seats correctly on the grommet before refitting only the bottom four mounting screws. Do not overtighten the screws, or those of the spoiler which should be fitted next; the screen or spoiler may be cracked. Ensure that the spoiler angled spacers are positioned so that it can be adjusted through its full

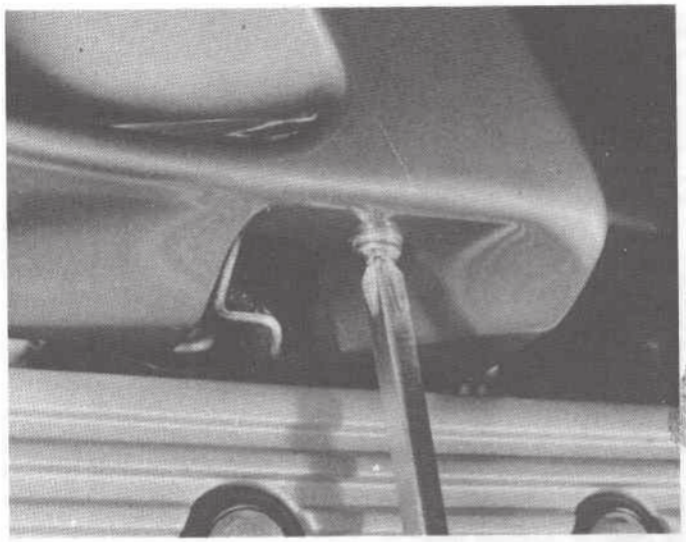
travel. Refit the central front panel if disturbed.
40 Push the gaiters to the top of the stanchions with their curved edges outwards, hold the horizontal centre panel roughly in place under the instruments and refit the fairing, ensuring that the recess in the central front panel engages around the rubber collar fitted to the brake hose union. Engage the fairing on its mountings and refit all mounting nuts or bolts, ensuring that the rubber grommets are correctly placed so that the fairing is isolated from the frame. Check the fit of the central front panel around the brake hose union, connect the headlamp and parking lamp leads to the bulbs and check that the horizontal centre panel is correctly fitted underneath the instruments, then tighten securely the fairing mounting nuts and/or bolts. Check that both fork gaiter mounting flanges are pushed inside the fairing and aligned with it.
41 The remainder of the reassembly procedure is the reverse of that followed on dismantling, noting the following points. Do not forget to position the horns so that their mouths are over the horn channels, then tighten their retaining nuts securely and refit the channel retaining screws. Fit the metal inner panels next, followed by the windscreen mounting covers, which share the windscreen top mounting screws (as well as the countersunk screws) and clip into the horizontal centre panel at their bottom edges. Refit the centre panel mounting screws, followed by the small cover fitted next to each mirror mounting. Refit the mirrors, not forgetting to connect the turn signal lamp wires.
42 Be very careful not to scratch or damage any component as the lower side panels are refitted and the radiator cover installed; it is best to refit these as a single operation and to tighten the retaining screws by just enough to hold each panel until all are correctly aligned. Be careful to align the air intake hose front end with the aperture in the radiator cover, or the machine's performance will be noticeably reduced and ensure that the radiator cover is engaged correctly on the brake hose union. Refit the gaiter mounting screws and the knee pads and make a final check that all components are correctly installed and secured.

K100 RT, K100 LT – fairing

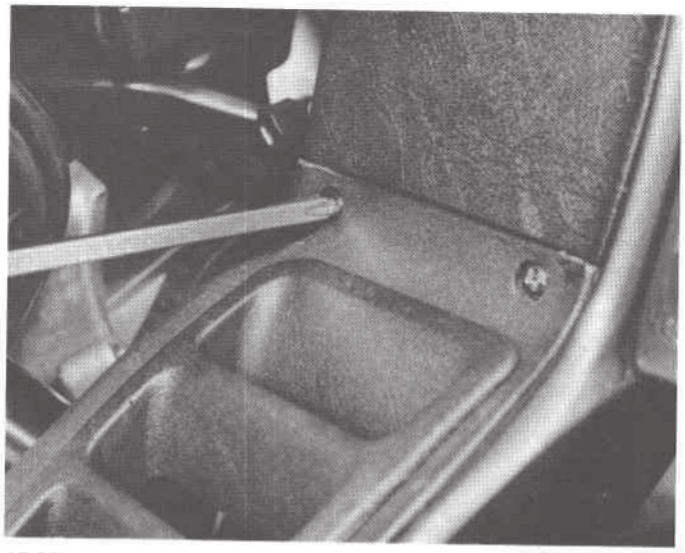
43 Remove the single retaining screw at the bottom rear edge of each knee pad and the two screws securing the storage compartment to its upper edge (it will be necessary to unlock and open the compartment to reach the screws). Withdraw the knee pads, noting the clip at the bend in the middle of each pad.
44 Remove the remaining four retaining screws and withdraw each storage compartment. Remove the fuel tank, as described in Chapter 5.
45 Remove the six screws which secure each fork leg gaiter to the underside of the fairing and push the gaiter up inside. Note that some models may have had air scoops substituted for the gaiters, in which case their removal is not necessary.
46 Checking carefully that all screws are removed, withdraw the radiator cover and the central front panel set in the underside of the main fairing section. Work around the outer edge of each panel to ensure that all screws are removed, then carefully withdraw each in turn, taking care not to scratch or damage the paintwork and turning the forks to clear the brake hose union. The mesh panel with its sealing strip and frame can be released from the radiator cover, if required, by removing the retaining screws.
47 With the knee pads, storage compartments and radiator cover removed, withdraw the lower side panels by removing the three screws securing each panel's top edge to the main fairing section (noting that this will also release the metal inner panels) then unscrewing the two mounting bolts. Note carefully the arrangement of the mounting rubber grommets and metal washers.
48 Slacken evenly the windscreen retaining screws working from the outside inwards, noting the cap nut retaining each upper mounting and the shouldered bushes pressed into the captive nuts at the four front retaining screws. Withdraw the windscreen and the inner fairing panels.
49 Disconnect the wires to the headlamp, parking lamp and turn signal lamps. The main fairing section should now be retained only by two bolts (to frame-mounted brackets) at the lower side panel mating surface and by four nuts or bolts to the fairing mounting bracket at the front. Engage the aid of an assistant to help support the fairing as it is removed.
50 Noting the arrangement of the mounting rubber grommets and metal washers, unscrew the two rear mounting nuts and remove the bolts, then remove the front mounting nuts or bolts and withdraw the fairing.
51 If required, the fairing mounting brackets can be removed by disconnecting and removing the horns (front bracket only) and unscrewing the retaining bolts. Ensure the bolts are securely fastened once the brackets have been re-aligned on refitting. The headlamp is retained by three screws and can be removed, if required; ensure the sealing grommet is correctly installed around its outer edge on refitting.
52 Refitting the fairing is the reverse of the removal procedure, noting the following points. If gaiters are fitted to the fork legs, push them to the top of each stanchion with the curved edges outwards. Engage the fairing on its mountings and refit the nuts or bolts and metal washers, ensuring that the rubber grommets are correctly placed so that the fairing is isolated from the frame. If the mounting brackets were disturbed, ensure that all components are correctly aligned before tightening the mounting nuts and/or bolts. Check that the horn mouths are aligned over the horn channels and connect the headlamp, parking lamp and turn signal lamp wires again.
53 Be careful not to scratch or damage any component as the lower panels are refitted; it is best to refit these as a single operation and to tighten the retaining screws by just enough to hold each panel until all are correctly aligned. Ensure that the central front panel and radiator cover are engaged correctly around the rubber collar fitted to the brake hose union and that the air intake hose front end is aligned with the aperture in the radiator cover. If the hose is distorted against the radiator cover, the machine's air supply could be severely restricted.
54 Where fitted, refit the fork gaiter mounting screws, then refit the storage compartments and knee pads. When refitting the windscreen, be careful to install the shouldered bushes in the four front mounting nuts and to tighten the screws securely, working from the front centre outwards and upwards. Do not overtighten the screws or the screen will crack. The spoiler on early models is retained by clear plastic fasteners which were later modified. Check with an authorised BMW dealer for details.
55 Make a final check that all disturbed components have been correctly installed and secured.
56 Note that different riders and passengers will experience different levels of noise from behind full fairings, particularly wind roar and buffeting. Windscreens of varying heights are available for K100 RT/LT fairings, and for some early models, modified spoilers. Check with an authorised BMW dealer for details.

K100 – fairing installation

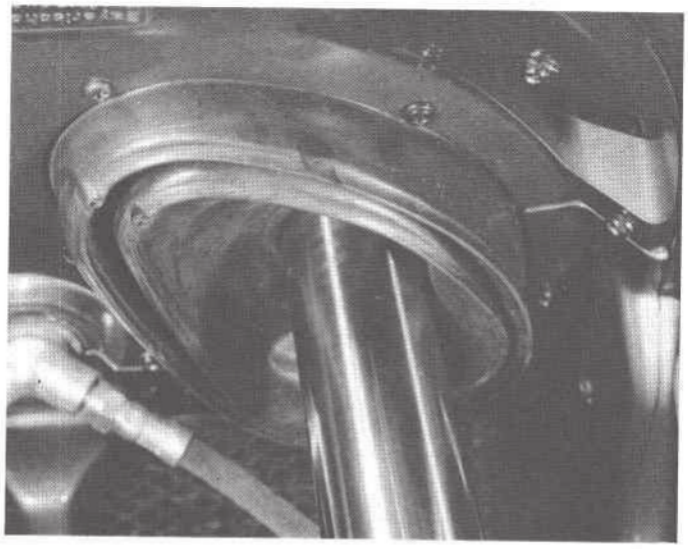
57 At the time of writing BMW advise against the fitting of RS or RT type fairings to standard K100 models because of the risk of vibration damage. Owners wishing to fit full fairings to these machines should check with an authorised BMW dealer for details of suitable after-market equipment.



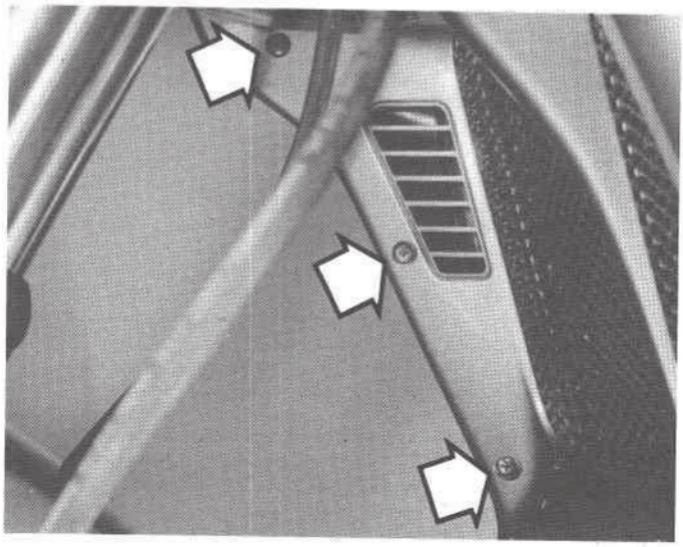
15.28a K100 RS fairing removal – knee pads are retained by single screw at bottom ...



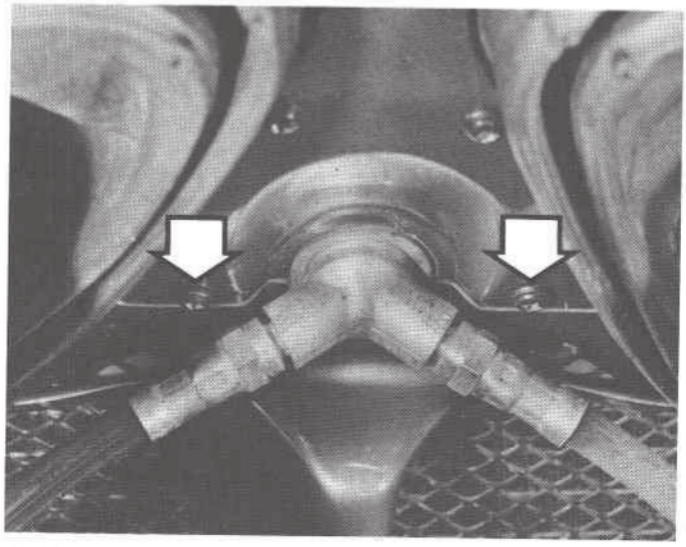
15.28b ... and by two screws at upper edge – note clip at middle bend



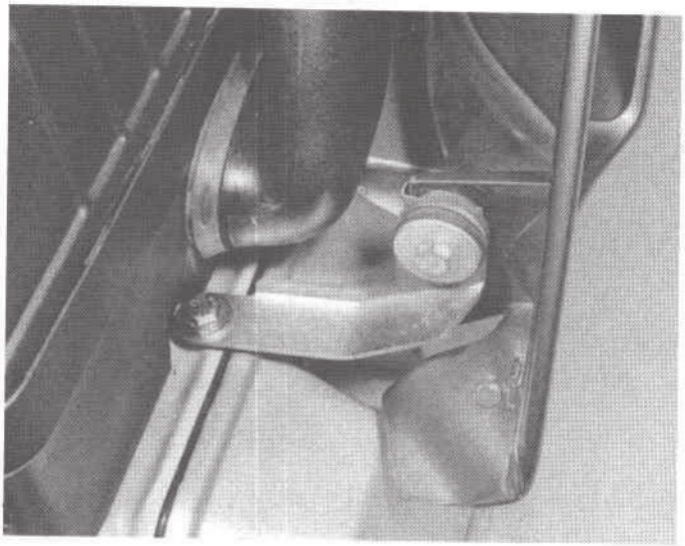
15.29 Remove screws securing each gaiter to fairing



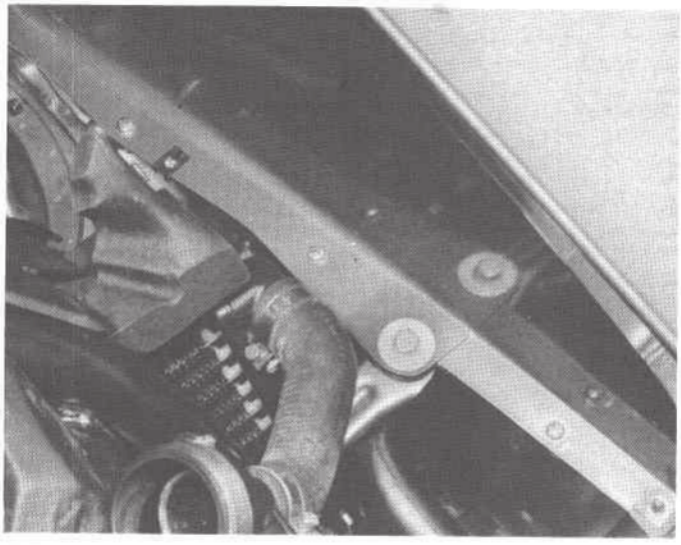
15.30a Radiator cover is retained by three screws (arrowed) to each lower side panel ...



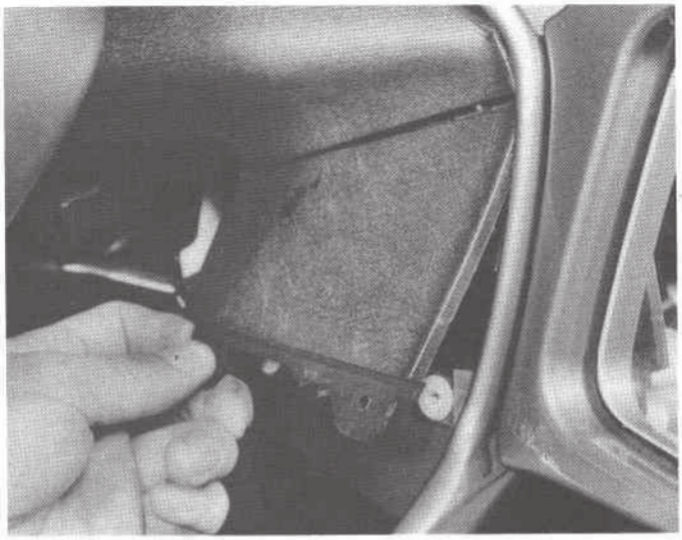
15.30b ... do not forget two screws next to brake hose union when removing radiator cover



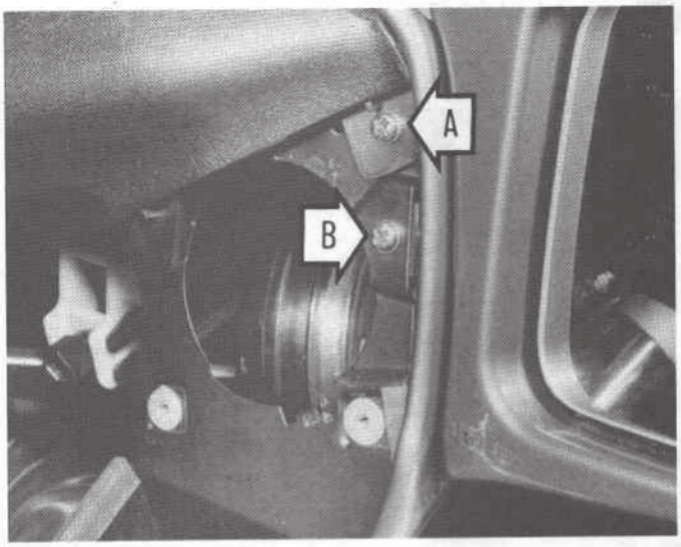
15.31a Lower side panels are each retained by single bottom mounting bolt ...



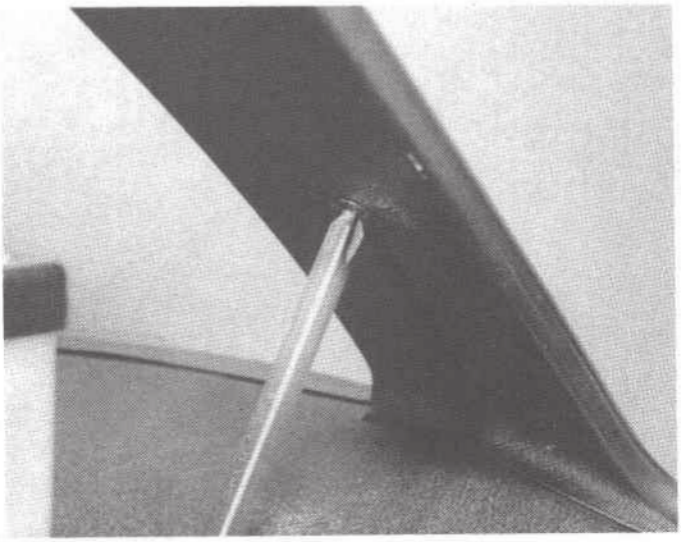
15.31b ... and by four screws along top edge



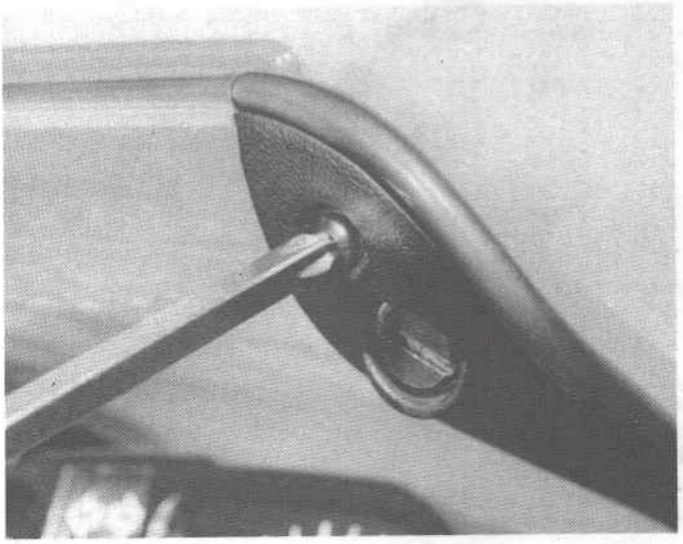
15.32a Unclip small panels from horizontal centre panel



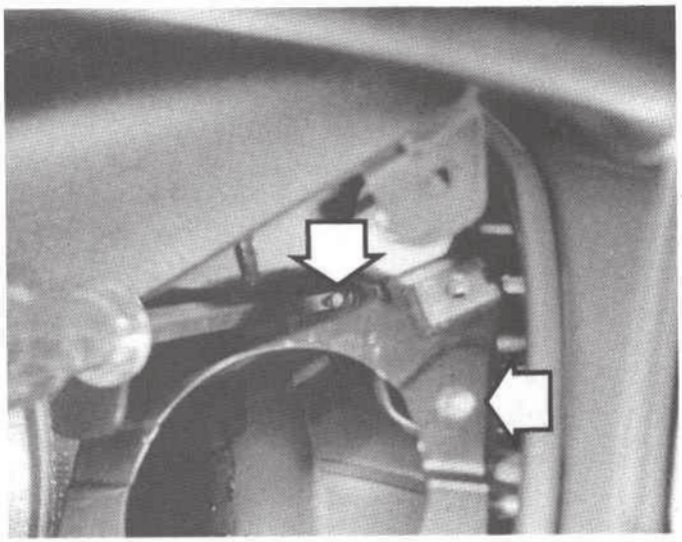
15.32b Screw A retains horizontal centre panel, screw B retains metal inner panel



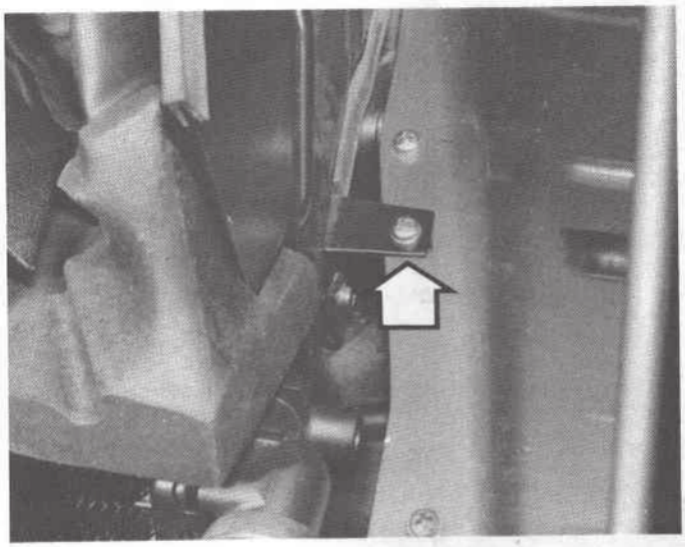
15.32c Windscreen mounting covers are each retained by countersunk screw at centre ...



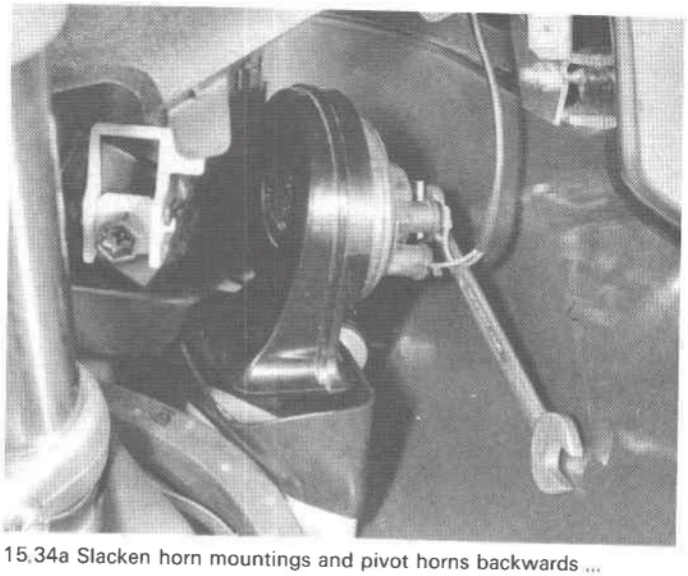
15.32d ... and by standard screw at upper end



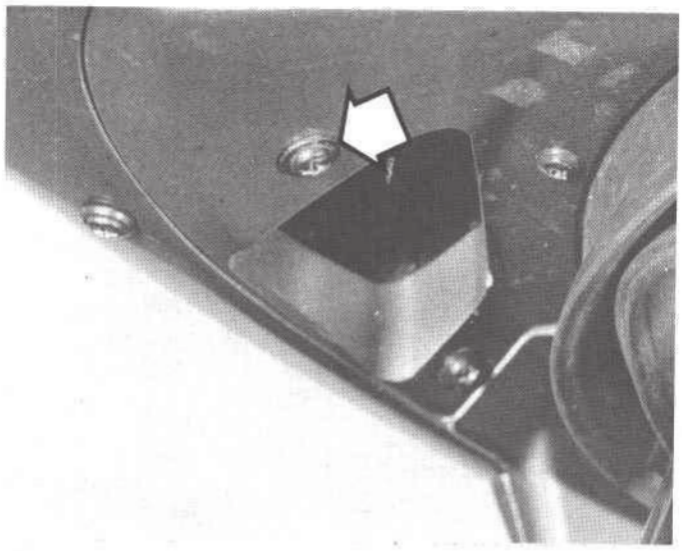
15.33a With screw next to mirror mounting removed, unscrew front mounting ...



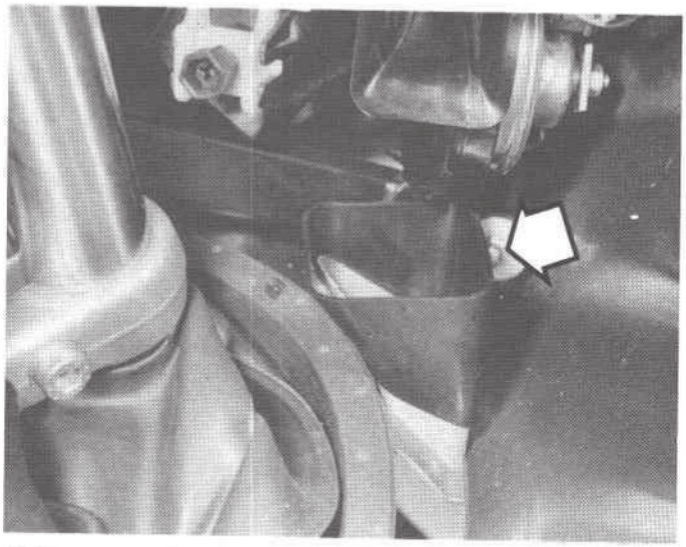
15.33b ... and bottom rear mounting screws (arrowed) to remove each metal inner panel



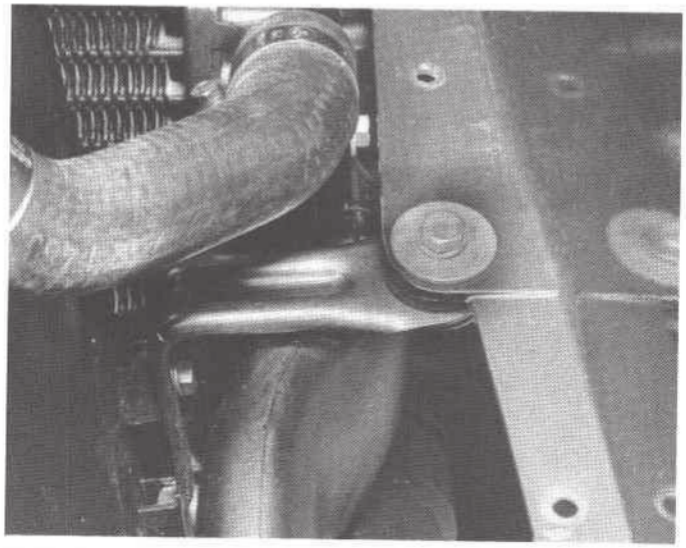
15.34a Slacken horn mountings and pivot horns backwards ...



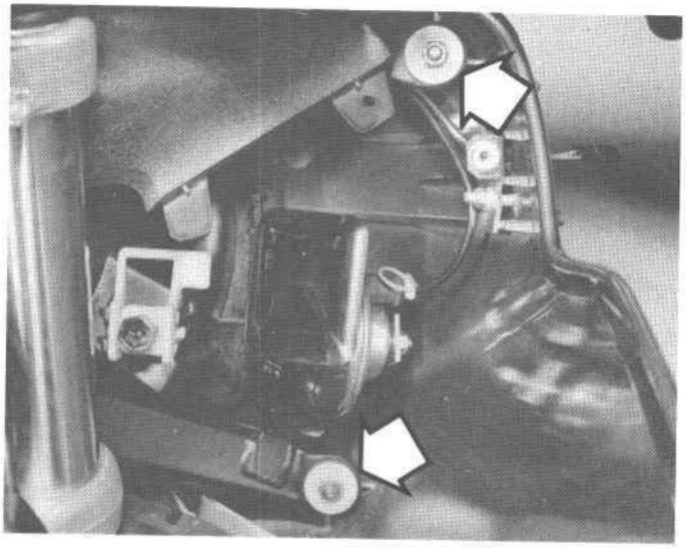
15.34b ... then remove guide channel retaining screw (arrowed) ...



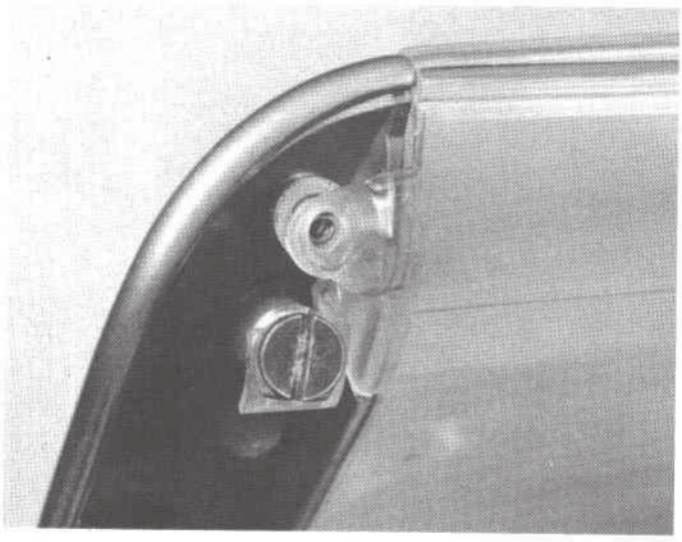
15.34c ... and withdraw horn guide channels to expose main fairing lower front mountings (arrowed)



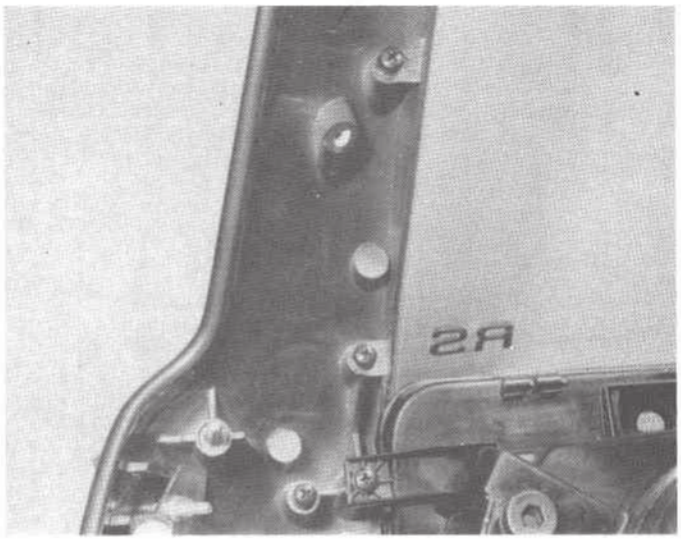
15.36a To remove main fairing remove rear mounting nuts and bolts ...



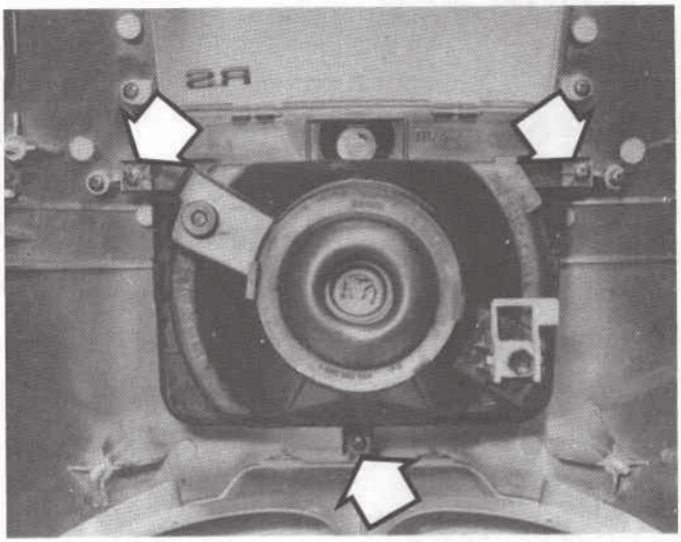
15.36b ... then front upper and lower nuts or bolts (arrowed)



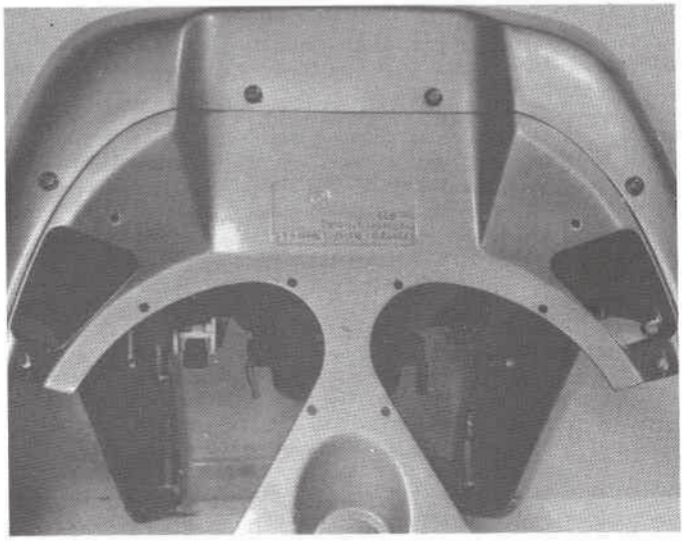
15.38a Dismantle spoiler assembly, noting angled spacers ...



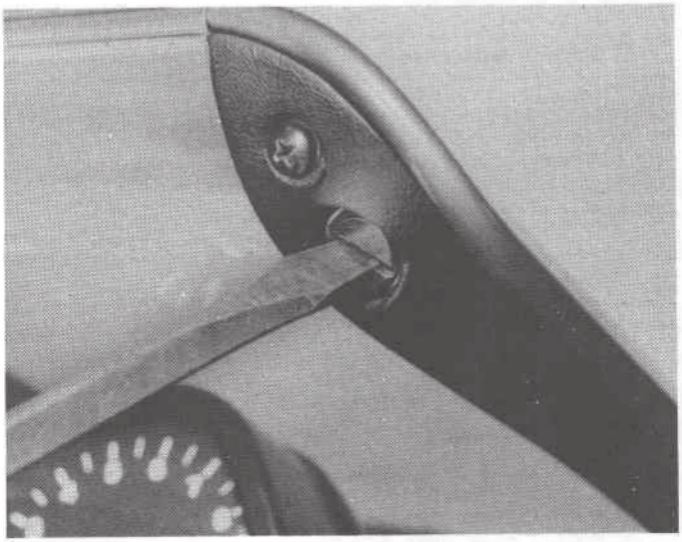
15.38b ... then unscrew all retaining screws to remove windscreen



15.38c Headlamp assembly is retained by three screws (arrowed)



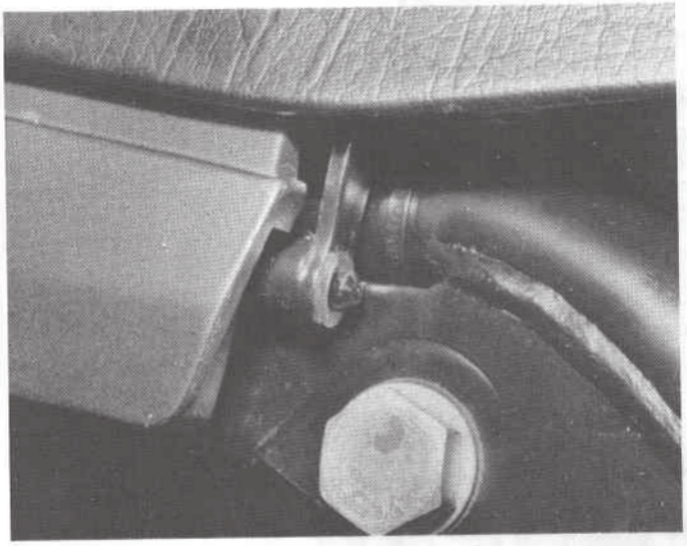
15.38d Fairing central front panel can be removed if required



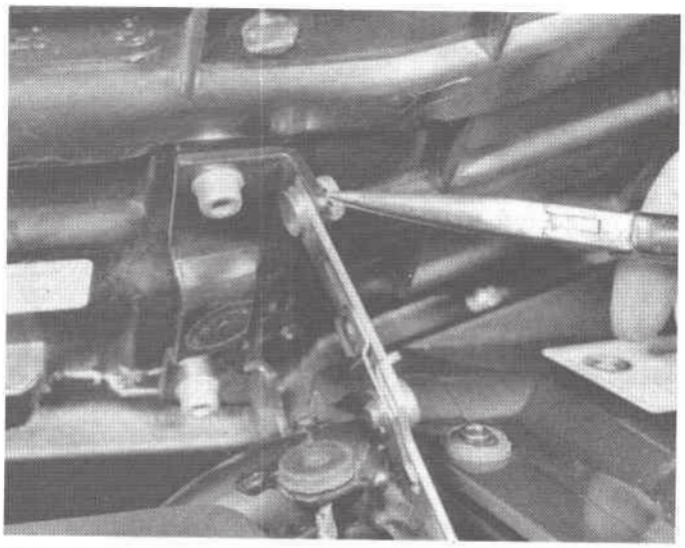
15.42 Do not forget to secure spoiler on reassembly – do not overtighten screws

16 Seat: removal and refitting

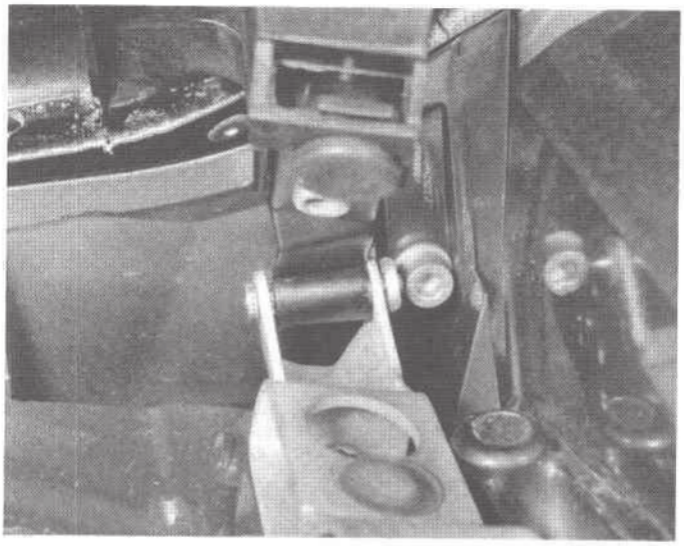
1 Remove the side panels, then unlock and raise the seat.
2 Remove the circlips from the front (early models only) and rear seat hinges and from the supporting arm pivot, withdraw the pivot pins and lift the seat away; on later models it must be moved forwards to disengage the hinge from the front mounting.
3 The mounting bracket and hinges may be removed, if necessary, by unscrewing the mounting nuts or bolts.
4 Note that if the seat mountings are disturbed, the length of the latch pin may require adjustment; this is made by slackening the locknut and screwing the pin in or out until the seat locks correctly when it is bearing fully on the frame.
5 Seat covers are available as separate items but the fitting of a seat cover is a task for the expert upholsterer only.



16.2a Remove circlips from seat hinges ...



16.2b ... and from supporting arm to release seat



16.3 Seat mounting bracket may be unbolted if required

17 Bodywork: removal and refitting

Front mudguard

1 On 100 models without a fork brace the mudguard is retained by four Allen bolts or screws. Remove the bolts or screws and carefully withdraw the mudguard, noting the metal brackets which retain the nuts.

2 On all 75 models, and 100 models fitted with a fork brace, the mudguard is in two pieces, joined by the brace. Fold down the cover at the rear of the brace, remove the longitudinal Allen screw, then unscrew the lateral Allen screws securing the mudguard section to the fork lower legs; note carefully the location of the spacers between the fork lower legs and the mudguard, also the rubber grommets which protect the brake hoses.

3 Taking care not to distort the brake pipes, withdraw the mudguard rear section followed by the front section. The fork brace can then be unbolted, if required.

4 On refitting, take great care to ensure that all mounting components, particularly any spacers, are refitted correctly, so that the fork legs are not distorted as the mudguard mountings are tightened. Ensure that the brake hoses are correctly routed and secured by the clamps, guides or grommets provided.

Rear mudguard

5 Unlock and raise the seat; remove the tail storage compartment cover and slacken the nuts (either a wingnut or an ordinary nut covered by a cap) on the compartment floor. From underneath the tail lamp assembly, on the outside of the machine remove the two screws and withdraw the number plate bracket.

6 To remove the rear mudguard front section unscrew the two nuts in the storage compartment followed by the two nuts at the front mounting bracket. Withdraw both brackets, noting the arrangement of the mounting rubbers, pull the mudguard downwards at the rear and disengage it from the locating pins and rubber bushes set in the gearbox housing.

7 Refitting is the reverse of the above. Ensure that the mudguard is settled correctly and fully on its mountings before tightening the retaining nuts.

Radiator cover panels – K75, K75 C, K75 T, K100

8 On 75 models very carefully prise each panel's upper rear corner out of the rubber mounting grommet in the fuel tank, then pull it forwards until it is clear of the front mounting prongs and withdraw the panel assembly downwards and to the side.

9 If required, the mesh panel can be removed from inside the panel and the two securing nuts and bolts can be removed to separate the panel halves.

10 On K100 models, working from the front of the radiator cover, remove the three screws retaining the left-hand side cover, then very carefully pull the cover out of the rubber mounting grommet in the fuel tank and withdraw it. Pull the right-hand side cover out of its rubber mounting grommet and withdraw it, complete with the cover front panel. Note the mounting buffers bolted to each side of the radiator.

11 The mesh panel can be removed, if required, from inside the cover by unscrewing the retaining screws and withdrawing the frame, sealing strip and the mesh panel.

12 On all models refitting is considerably eased if the rubber grommets are coated with a film of rubber lubricant or even moistened with water.

Side panels

13 On all models note that the side panels are fragile and will crack easily if wrenched off their mountings; exercise care at all times and note that refitting is eased if the rubber grommets are first coated with a film of rubber lubricant or even moistened with water.

14 On 75 models carefully pull each panel outwards at the bottom to release the clip, swing it downwards away from the fuel tank mounting, and slide it to the front to release the rear locating pin.

15 Note that if the spring clip is loose, the side panels may work loose and drop off. Check first that the fuel tank is fully seated in its rear mountings and that the bottom mounting pins on the frame are not bent. Check that the spring clip is installed so that its retaining lug is seated correctly in the opening provided. If necessary, bend the spring clip (taking care not to damage the panel) or the frame mounting pin, so that the spring clip grips securely. Check that the protective moulding is in place along each tank bottom seam before refitting the panels.

16 On early (1984 and 1985 models, identified by the panel's angled bottom rear edge) 100 models carefully pull the panels outwards at the top front and rear corners to disengage them from their mounting grommets, then slide them gently to the rear to release them from the bottom mounting prongs.

17 On later (1986-on models, identified by the panel's straight bottom rear edge) 100 models carefully pull each panel outwards at its top front corner to disengage it from its mounting grommet, then swing it downwards just enough to release the bottom mounting hook and slide it to the front to release the rear locating pin.

Tail unit

18 Unlock and raise the seat and remove the tail storage compartment cover. Remove the tail lamp assembly, the seat and the rear mudguard. Remove the seat rear pivot mounting bracket and disconnect the rear turn signal lamp wires.

19 Unscrew the mounting screws and nuts and withdraw the tail unit. The pillion grab handles can be unbolted from inside the storage compartment, each is retained by a nut and a bolt.

Engine protection bars

20 Some models are fitted as standard with engine protection bars. Note that these cannot be fitted to machines with engine spoilers (belly fairings) and if they are to be fitted to K100 RS, K100 RT or K100 LT models, the fairing lower side panels must be provided with cutouts to permit the bars to be fitted. Any authorised BMW dealer should be able to provide the templates required to position the holes accurately.

21 Genuine BMW bars are rubber-mounted to absorb shocks without passing them directly to the frame or to the engine castings; this is preferable to the usual after-market type which is bolted rigidly to the engine and frame and can cause severe damage to the crankcase lower section or sump castings in even the most minor incident.

22 A large mounting plate is bolted to the (normally blanked-off) mounting points on each side of the crankcase lower section or sump (oil pan) castings. Bonded to or screwed into these plates are mounting points for the bar lower ends. At the top the standard engine mounting bolts are replaced by extended sleeve bolts into which are screwed rubber mountings. The outer end of each mounting is fitted into the bar upper end and secured by a nut; a blanking plug is fitted over the nut for the sake of appearance.

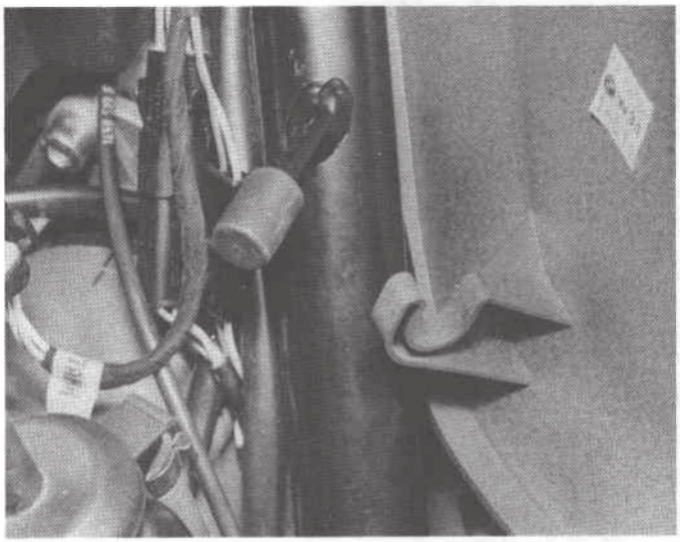
18 Mirrors: removal and refitting

1 The mirrors fitted to standard models are mounted on stalks which are fastened to the handlebar lever assemblies by nuts and washers, each nut being covered by a cap. If damaged or faulty, they must be renewed as complete assemblies.

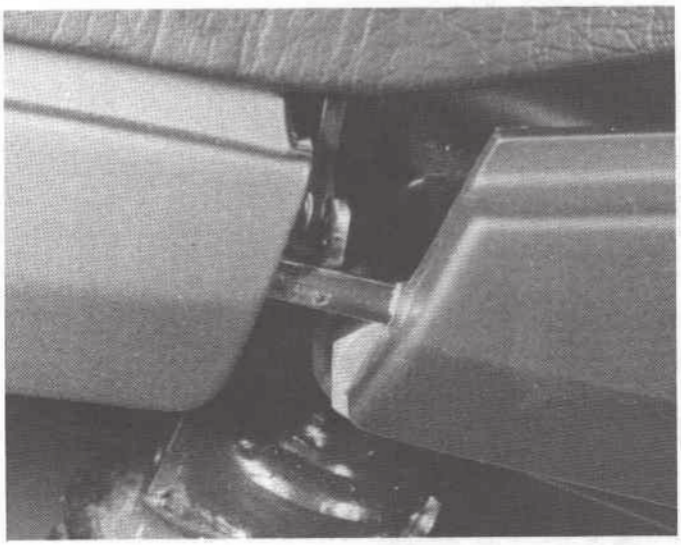
2 On K100 RS, K100 RT and K100 LT models the mirrors are attached to the fairing by mountings which are designed to break off on impact to minimise damage.

3 To remove the mirrors, hold each one firmly next to the fairing and strike sharply upwards with the palm of the other hand on the outside end of the fairing. This requires a considerable amount of force, so great care is required to ensure that no damage is done. Once one mounting has released the mirror can be manoeuvred off the remaining two. On K100 RS models disconnect the turn signal lamp wires, and withdraw the unit.

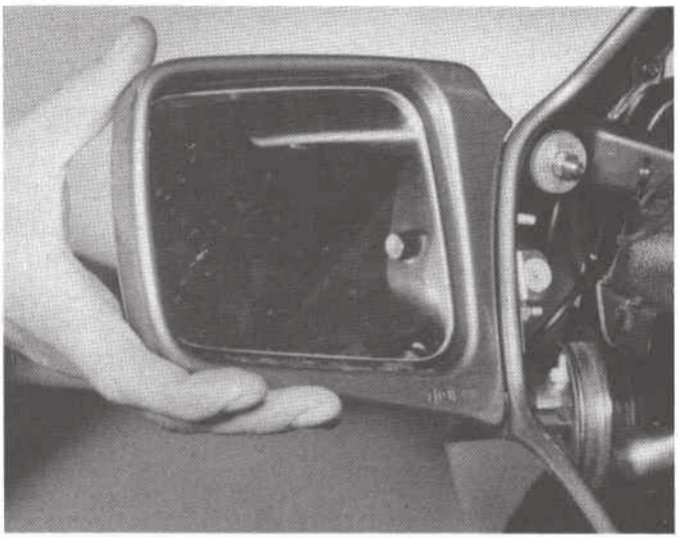
4 If they are cracked or damaged, the glasses of these mirrors can be renewed individually. Each is fixed by a ball and socket joint which is hinged to provide adjustment in the vertical and horizontal planes. Insert a lever, behind the glass, pad the edge of the mirror with a cloth to protect its finish and lever the glass out of its socket. Considerable force is again required, quite enough to break the mirror glass, so take great care not to damage the mirror housing. Apply a suitable lubricant to aid refitting.



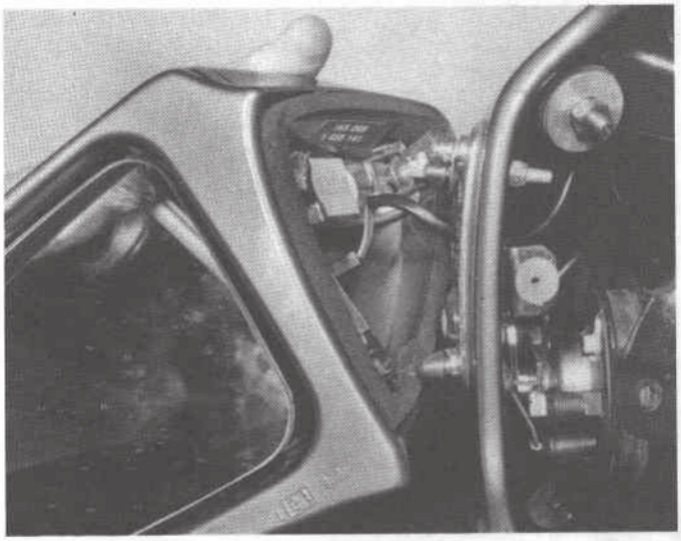
17.17a Be careful to disengage side panel front mountings as described ...



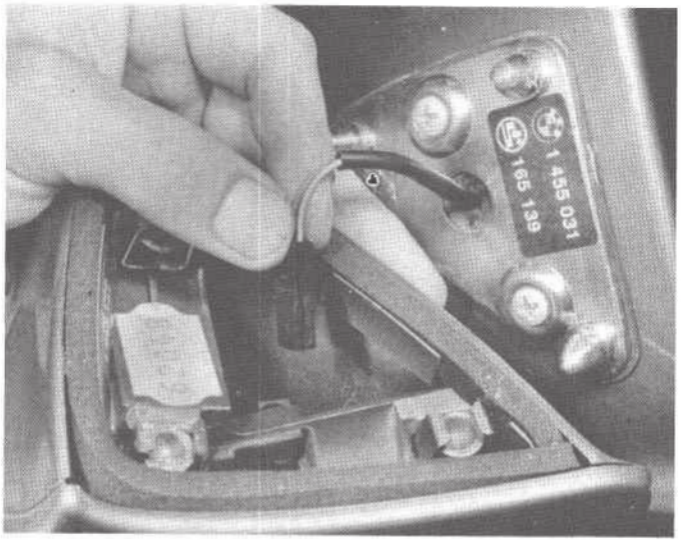
17.17b ... then move panel forwards to disengage rear mounting



18.3a Removing mirrors, K100 RS – strike sharply upwards ...



18.3b ... to unclip mirror from mountings



18.3c Do not forget to connect turn signal lamp wire on refitting

19 Luggage: removal and refitting

Panniers

1 The panniers are locked by a single catch to a cast alloy frame which is bolted between the footrest plates and the rear frame rails. All components are available as separate replacement parts, if required. The same panniers are available as optional extras for all models not fitted with them as standard.

Top box

2 The top box is attached to the rack on top of the tail compartment by an adaptor plate and is locked in place by a single locking plug which is rotated to engage or disengage the adaptor plate.

3 As with the panniers, all components are available as replacement parts and the assembly is available as an optional extra for any model not fitted with them as standard. Where a rack is not fitted as standard, it must be fitted with the topbox; it is retained by four bolts.

20 Instruments: removal, dismantling and reassembly

1 On all models the headlamp housing or handlebar fairing, the headlamp assembly or the fairing (as appropriate) must be either removed or partially dismantled to gain access to the instrument panel mountings. Refer to Section 15 for full details.

2 With the panel mountings exposed, remove its single retaining screw and withdraw the connector plug cover, then unplug both connector blocks.

3 Remove the four mounting screws or bolts and withdraw the panel assembly. **Note:** Check the panel rubber mountings very carefully and renew them if there is the least sign of wear or damage. The instruments are sensitive and will be damaged if subjected to excessive vibration levels. If the panel mountings are altered for any reason (such as fitting aftermarket fairings to standard models) great care must be taken to mount the panel correctly so that it is insulated from vibration.

4 To dismantle the assembly, invert it on a completely clean work surface and remove the screws around the periphery (there are seven on early 100 models, none on all 75 models and 1986 on 100 models). Withdraw the bottom cover and examine the sealing ring; this must be renewed if it is damaged in the slightest way to prevent moisture from entering.

5 All instrument illuminating and warning lamp bulbs may be removed at this stage, if required. Being very careful not to damage any component, especially the connector pins, use a pair of pliers to extract the bulb holder; the bulb is of the capless type which is pulled easily out of the holder. Ensure that the wire filaments are correctly inserted on refitting. Note that certain bulbs have a cap fitted over their envelopes; these must be replaced on the new bulb.

6 The printed circuit board is retained by two small black-finished screws, each immediately next to the instrument illuminating lamp bulb holder in the bottom left and right corners (looking at the unit as it is inverted on the bench), and by two larger plated screws at the bottom edge of the connector plug pins. Remove these screws and **very carefully** use a small screwdriver to prise the board up at all contact plug points, ie top left above the tachometer and bottom left, top right above the speedometer and at the bottom, just to the right of the connector plug pin. **Do not** use force; if the contact pins will not release easily take the assembly to an authorised BMW dealer to be dismantled by an expert. With the pins released, withdraw the board.

7 Using a small screwdriver to release the locking catches, front pair first and then the rear pair, lift the clock (where fitted) out to the top. Disengage the locking catches and lift out the warning lamp bulb holder frame.

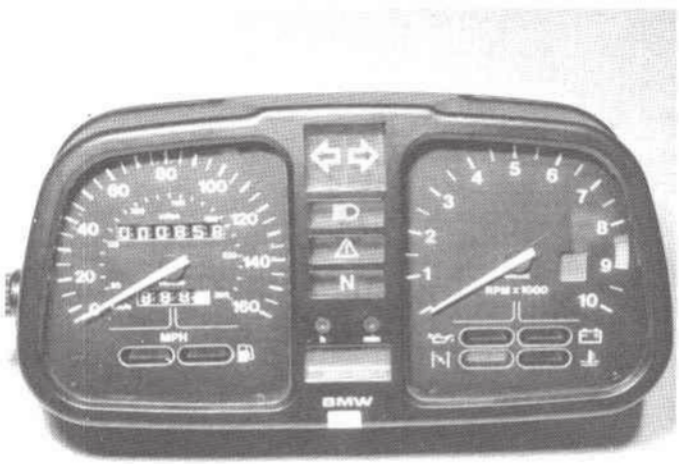
8 The fuel gauge circuit board is secured in the panel top left corner (looking at the unit as it is inverted on the bench) by two small screws (with either plated slotted heads or black-finished cross-heads). Remove the screws and carefully prise the circuit board off its connector pins.

9 Remove its two large, plated cross-head retaining screws and withdraw the tachometer assembly. Carefully lever off the needle, remove the retaining screws and withdraw the dial then turn the unit round, remove the two retaining screws and withdraw the gear indicator circuit board to one side, noting the spacer.

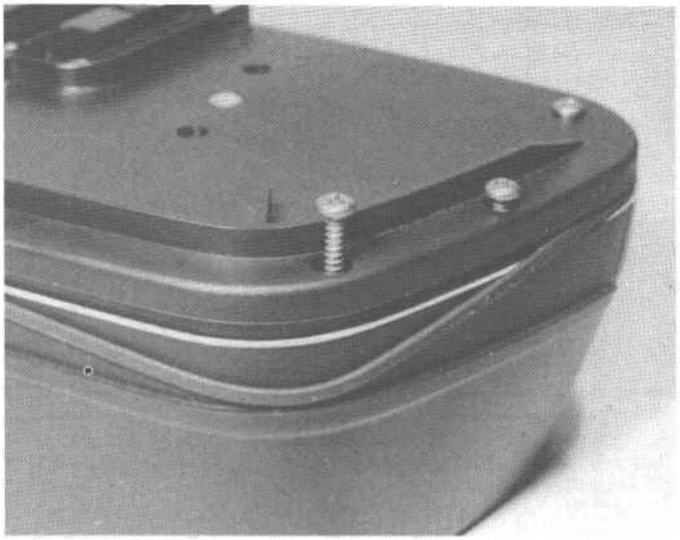
10 The speedometer circuit board is secured by two small screws (with either plated slotted heads or black-finished cross-heads) below the speedometer assembly. Remove the screws and carefully prise the circuit board off its connector pins.

11 Pull out as far as possible the speedometer trip reset button and remove the two retaining screws to release the unit.

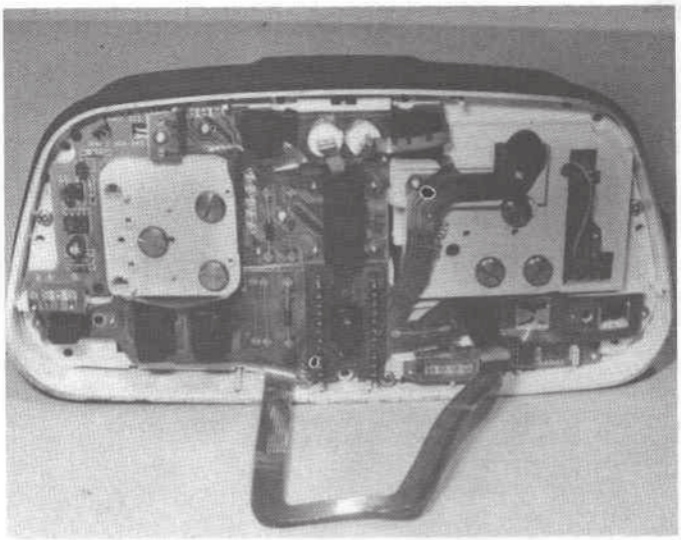
12 On reassembly, all components must be scrupulously clean and dry. Do not overtighten any mounting screws or use force to fit components, but ensure that all are correctly fastened and that all connector pins are fully seated. To rebuild the assembly, follow exactly the reverse of the removal procedure.



20.3 Instrument panel is very delicate – handle carefully



20.4 Remove screws to release bottom cover – note sealing ring



20.5 Removal of panel bottom cover gives access to panel bulb holders

Chapter 8 Final drive and rear suspension

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Specifications

Final drive		
Reduction ratio:	**Standard**	**Optional**
K75 S	3.20:1 (32/10T)	3.09:1 (34/11T)
All other 75 models	3.20:1 (32/10T)	3.36:1 (37/11T)
K100 RS	2.82:1 (31/11T)	2.91:1 (32/11T)
All other 100 models	2.91:1 (32/11T)	3.00:1 (33/11T)
Tooth backlash	0.070 – 0.160 mm (0.0028 – 0.0063 in)	
Crownwheel taper roller bearing preload:		
Tolerance	0.050 – 0.100 mm (0.0020 – 0.0039 in)	
Approximate equivalent, expressed in friction values	600 – 1600 N (134.89 – 359.69 lbf)	
Final drive lubrication		
Recommended oil	Good quality hypoid gear oil of API class GL-5 or to specification MIL-L-2105 B or C	
Viscosity:		
Above 5°C (41°F)	SAE 90	
Below 5°C (41°F)	SAE 80	
Alternatively	SAE 80W90	
Capacity	260 cc (0.46 Imp pint, 0.28 US qt)	
Rear suspension		
Travel	110 mm (4.33 in)	
Spring free length:		
K75 S	N/Av	
All other 75 models	271 – 277 mm (10.6693 – 10.9055 in)	
100 models – except K100 LT	265 – 269 mm (10.4331 – 10.5905 in)	
Spring wire diameter:		
75 models	9.00 mm (0.3543 in)	
100 models – except K100 LT	9.86 mm (0.3882 in)	

Torque wrench settings	**75 models**		**100 models**	
Component	**Nm**	**lbf ft**	**Nm**	**lbf ft**
Swinging arm fixed pivot stub retaining screws	9 ± 1	6.5 ± 0.5	N/Av	N/Av
Swinging arm adjustable pivot stub	7.3 ± 0.5	5.4 ± 0.4	7	5
Swinging arm adjustable pivot stub locknut	41 ± 3	30 ± 2	45	33
Final drive case/swinging arm bolts	40 ± 3	29 ± 2	40	29.5
Suspension unit mountings	51 ± 3	37.5 ± 2	58	43
Final drive pinion retaining nut	200 ± 20	148 ± 15	200 ± 14	148 ± 10
Drive pinion assembly/drive case retaining threaded ring	118 ± 12	87 ± 9	118 ± 11.8	87 ± 9
Final drive case cover screws or bolts	21 ± 2	15.5 ± 1.5	21 ± 1.4	15.5 ± 1
Speedometer impulse transmitter retaining screw	2.5	2	2.5	2
Final drive case oil filler plug	20 ± 2	15 ± 1.5	20	15
Final drive case oil drain plug	25 ± 3	18.5 ± 2	25.5	19

1 General description

From the gearbox output shaft the drive is transmitted by another shaft to the final drive assembly. The shaft consists of two tubular metal components bonded together by a rubber sleeve to form a single assembly, with a universal joint at the front to permit the shaft to move with the rear suspension, and splined couplings at both ends to allow for the alteration in effective length as the suspension moves through its travel.

The final drive assembly consists of the drive pinion which rotates on a combined ball and roller bearing and the crownwheel which rotates on a taper roller bearing at its right-hand end and a ball journal bearing at its left-hand end; since the rear wheel is bolted directly to a flange on the crownwheel left-hand end, these crownwheel bearings also serve as the rear wheel bearings. A castellated ring on the

crownwheel right-hand end serves as the rotor for the speedometer impulse transmitter which is mounted on the final drive housing.

The rear suspension is by an hydraulically-damped coil spring suspension unit acting on a single-sided swinging arm; the arm is a single large aluminium alloy casting which pivots on taper roller bearings that are set on stubs screwed into the rear of the gearbox housing. The final drive shaft rotates inside the swinging arm and the final drive housing is bolted to its rear end.

The K75 S model, and any other machine fitted with 'S' suspension, is fitted with a suspension unit that is stiffened to match the front forks. The K100 LT model is fitted with Boge Nivomat self-levelling suspension at the rear; this is described in detail in Section 10 of this Chapter and is listed as an optional extra for other models in the range.

2 Final drive: removal

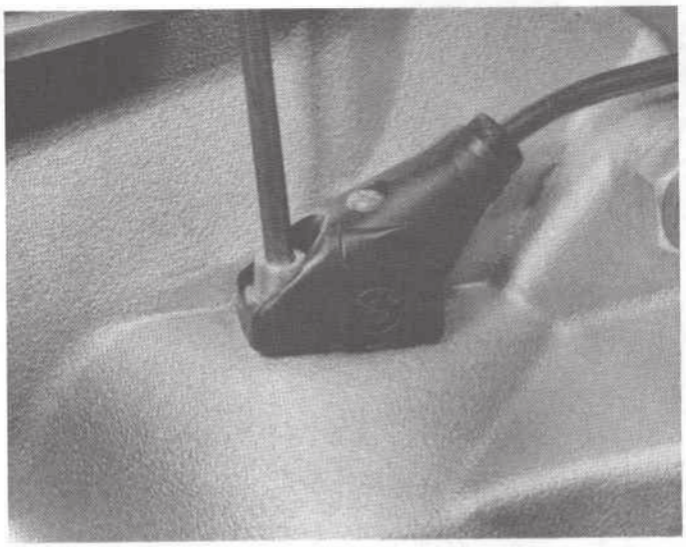
1 Remove the rear wheel. See Chapter 9.

2 Remove the single retaining screw and carefully prise the speedometer impulse transmitter out of the housing. If the final drive is to be dismantled, drain the oil as described in Routine Maintenance; if not, remember to store it upright to prevent any loss of oil and to keep the transmitter orifice plugged with clean rag to prevent the entry of dirt. Remove the transmitter wire from the guide provided.

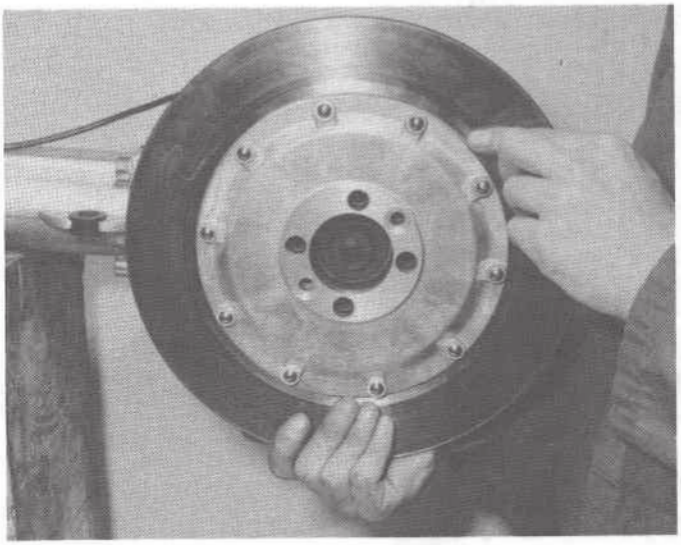
3 If the final drive is to be dismantled, on machines with disc rear brakes apply the rear brake firmly to prevent rotation and unscrew the disc mounting screws; on machines with drum rear brakes remove the brake shoes and the operating lever and camshaft. Whether the final drive is to be dismantled or not, on machines with disc rear brakes remove the brake caliper and press the brake pipe grommet sideways out of the locating clamp; on machines with drum rear brakes disconnect the brake operating rod.

4 Remove the suspension unit bottom mounting nut and washer then slacken the top mounting nut and bolt. **Note:** To prevent the risk of damage to the swinging arm or gearbox housing castings or the sealing gaiter, support the swinging arm in its normal working position ie no more than 349 mm (13.7 in) below the suspension unit top mounting. Either place a block of wood or similar under the arm or use a strong strap passed around the arm and the frame seat tubes to hold it at the required height. **Never** allow the swinging arm to drop suddenly and sharply. With the arm correctly supported, remove the suspension unit from its bottom mounting.

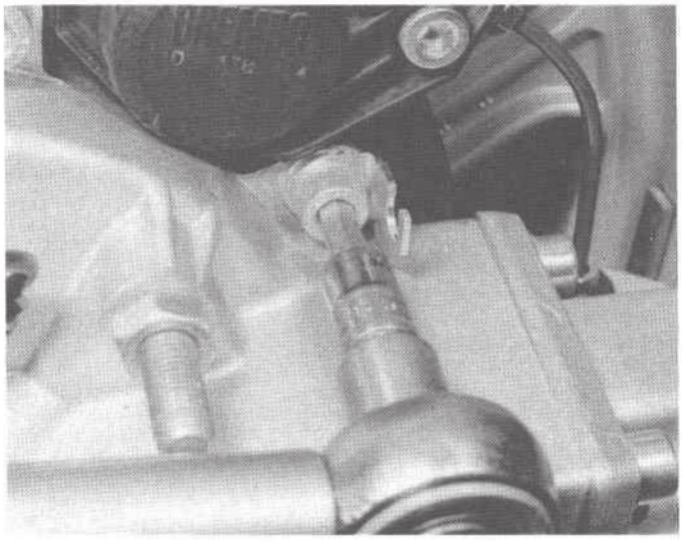
5 Unscrew the four mounting bolts and withdraw the final drive housing from the swinging arm rear end; if necessary use a soft-faced mallet to tap the housing backwards off the locating dowels. If any sign of rust or water is detected check carefully the sealing gaiter and any other possible points of entry.



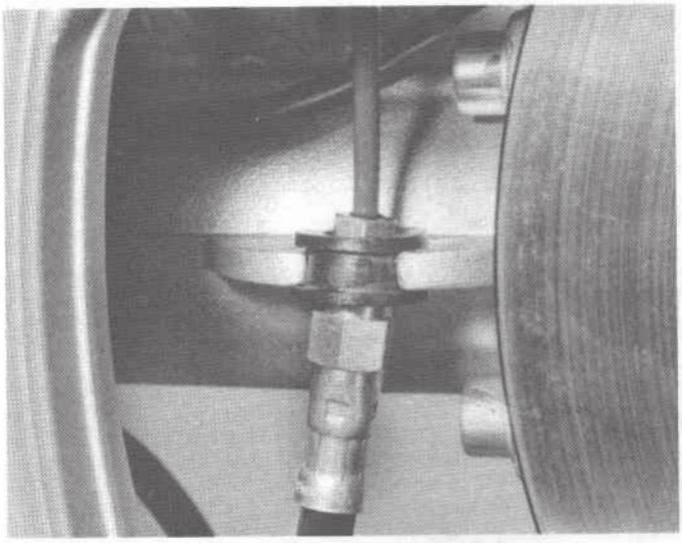
2.2 Speedometer impulse transmitter is retained by a single screw



2.3a Remove brake components if final drive is to be dismantled



2.3b Rear brake caliper is retained by two Allen bolts



2.3c Withdraw brake hose/pipe from swinging arm clamp

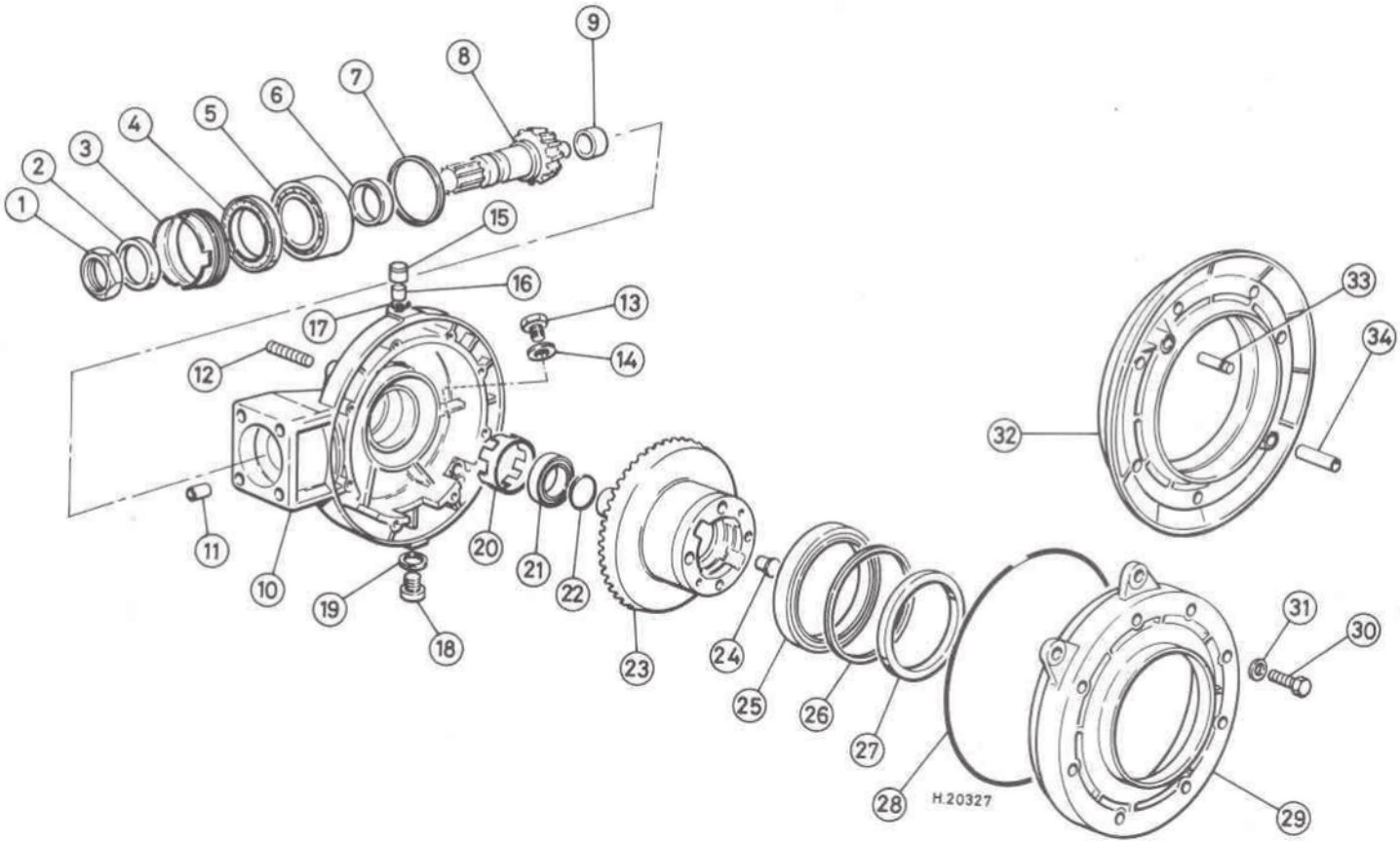


Fig. 8.1 Final drive assembly

1 *Nut*
2 *Compression ring*
3 *Threaded ring*
4 *Oil seal*
5 *Bearing*
6 *Thrust ring*
7 *Shim*
8 *Drive pinion*
9 *Needle roller bearing*
10 *Housing*
11 *Dowel – 2 off*
12 *Stud*
13 *Filler plug*
14 *Sealing washer*
15 *Breather cap*
16 *Sleeve*
17 *O-ring*
18 *Drain plug*
19 *Sealing washer*
20 *Speedometer rotor*
21 *Taper roller bearing*
22 *Shim*
23 *Crownwheel*
24 *Plug*
25 *Ball bearing*
26 *Shim*
27 *Oil seal*
28 *O-ring*
29 *Housing cover* △
30 *Bolt – 8 off*
31 *Washer – 8 off*
32 *Housing cover* ▲
33 *Brake shoe pivot* ▲
34 *Camshaft sleeve* ▲

△ *disc brake models*
▲ *drum brake models*

3 Final drive: examination and renovation

1 Dismantling the final drive is beyond the scope of the majority of amateur mechanics. Wear or damage will be indicated by a high pitched whine. Backlash between the crownwheel and pinion may be assessed by holding the wheel flange firmly and rotating the pinion shaft in both directions. Any lateral play in the crownwheel can only be checked with the assembly installed in the machine, by pulling and pushing the rear wheel.

2 If any wear or damage is found or suspected, take the unit to an authorised BMW dealer for reconditioning.

3 The only task which can be undertaken by the private owner is the removal of the cover to renew a faulty crownwheel oil seal or to attend to the speedometer impulse transmitter rotor.

4 If this is to be undertaken, drain the oil from the unit and mark the cover and housing across the joint face so that it can be correctly refitted on disc rear brake models; on drum rear brake models use a stepped drift of suitable size to tap the brake camshaft sleeve out of the cover to the housing right-hand side. Working progressively and evenly in a diagonal sequence remove the cover retaining bolts or Allen screws and withdraw the cover, applying a few firm taps from a soft-faced mallet to break the seal.

5 The crownwheel should be removed with the cover; since the shims are fitted between the taper roller bearing inner race and the crownwheel, or between the ball bearing and cover, they will not be disturbed at this stage.

6 First check that the speedometer rotor is firmly fixed on the crownwheel end and that it is undamaged; this applies mainly to early 100 models since the fit of these two components was improved on all 75 models and later 100 models. If it is to be renewed, the taper roller bearing inner race must be extracted first, using a knife-edged bearing puller; take careful note of any shims found and ensure that they are fitted in exactly their original positions on reassembly. If the rotor is loose but the mating surfaces are undamaged, all components should be thoroughly degreased and all traces of oil deposits or corrosion

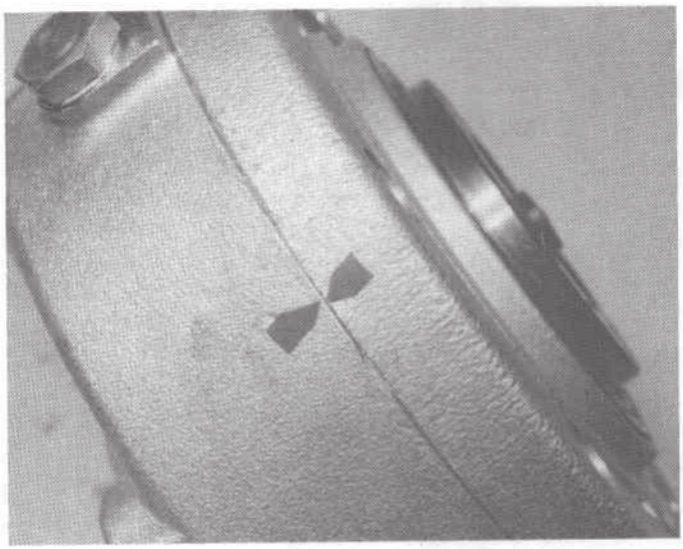
polished away. Apply a few drops of Loctite 638 or RC/620 (62040) adhesive to the contact faces and tap the rotor onto the crownwheel with a soft-faced mallet. When the rotor is seated fully against the crownwheel shoulder, leave the assembly for four hours so that the adhesive can cure. This can be speeded up to 30 - 40 minutes by heating the crownwheel and rotor to 120°C (248°F).

7 If the oil seal is to be renewed, tap out the crownwheel and bearing; BMW recommend that the cover be heated to approximately 80°C (176°F) to permit this. The ball bearing should stay on the crownwheel, in which case the shim behind it should be refitted exactly the same way round. The seal itself can then be driven out and the new seal fitted with a smear of grease around its outer edge. Fit the new seal by hand as far as possible, ensuring it remains square to its housing, then tap it into place using a hammer and a tubular drift which bears only on the seal hard outer edge. If a sufficiently large drift cannot be found, use either a soft-faced mallet with great care, tapping the seal evenly and squarely into its housing until it is flush with the cover, or take the assembly to an authorised BMW dealer to be rebuilt with the correct service tools.

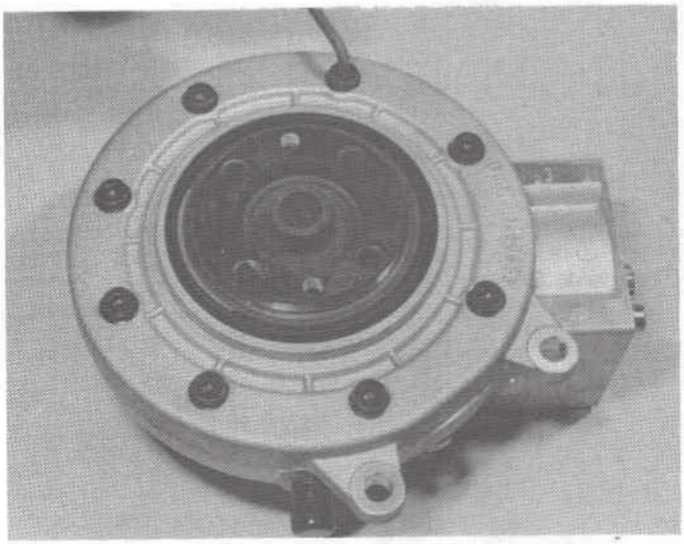
8 On very early (1984 models only) UK K100 models check that the breather is clear by removing the breather cap and inserting a length of wire into the breather passage. If the wire enters by more than 22 mm (0.9 in), down to 30 mm (1.2 in) approximately, the passage is clear and the wire can be removed and the cap refitted. If the wire cannot be inserted as far as this, the passage is blocked and must be cleared by the careful use of a 7.5 mm (0.3 in) diameter drill bit. With the breather cap and final drive housing cover removed, drill downwards to the outer annular cavity, taking great care not to damage the thin walls of the breather passage. Be very careful to clean away all traces of swarf and other debris. Note: This only proved necessary on very eary models after which the breather was checked at the factory. It is also very unlikely that any machine has survived unmodified.

9 Later 100 models were fitted with a modified type of breather incorporating an O-ring around the breather base and a cap with a 3 mm (0.12 in) hole drilled in it; note that the hole must face to the rear. This modification was to further seal the breather against the entry of water and is fitted as standard to all 75 models. If water is found in the final drive oil on early 100 models, take the machine to an authorised BMW dealer for checking.

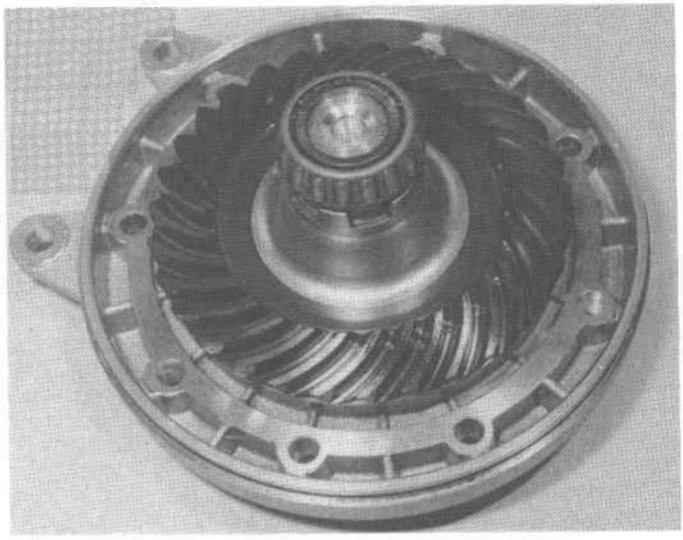
10 On reassembly, grease the seal lips and do not forget the shim as the crownwheel is fitted to the cover. Fit a new O-ring to the cover groove and grease it, then place the cover assembly on the final drive housing and align the marks made on removal (disc brake models) or the brake camshaft passages (drum brake models) before tapping the cover into place; ensure that the O-ring is not damaged or disturbed. Working progressively and evenly in a diagonal sequence tighten the cover retaining bolts or Allen screws to the specified torque wrench setting. Use the stepped drift to tap the brake camshaft sleeve back into place in the cover (drum brake models only).



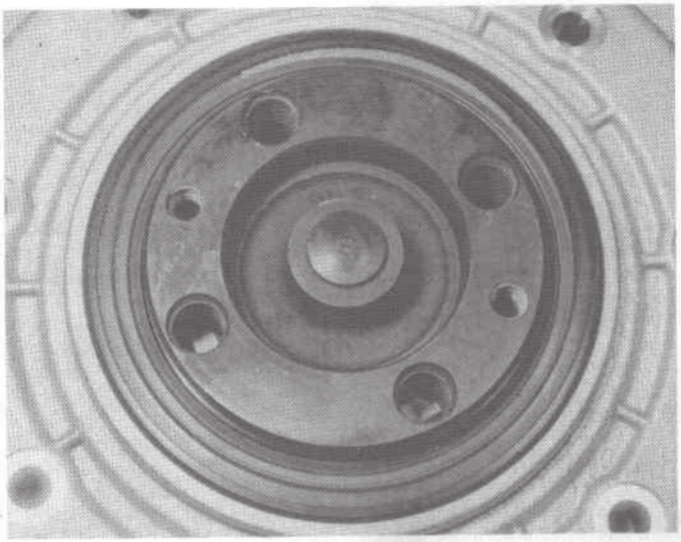
3.4a Disc rear brake models only – make reference marks to ensure correct reassembly ...



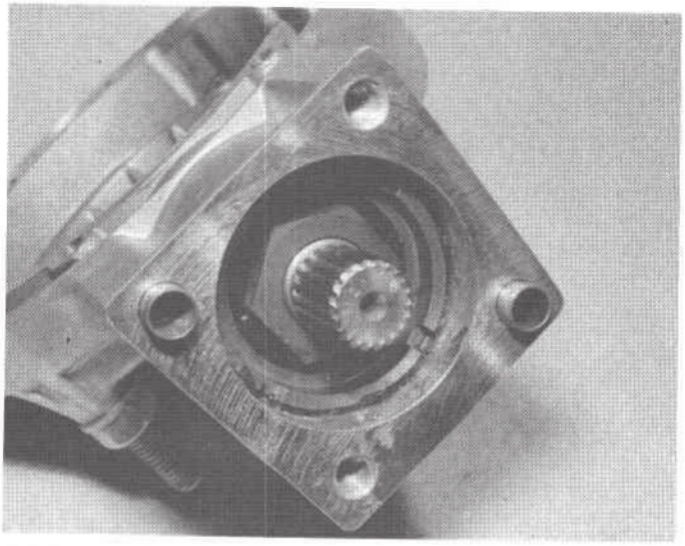
3.4b ... before removing final drive case cover



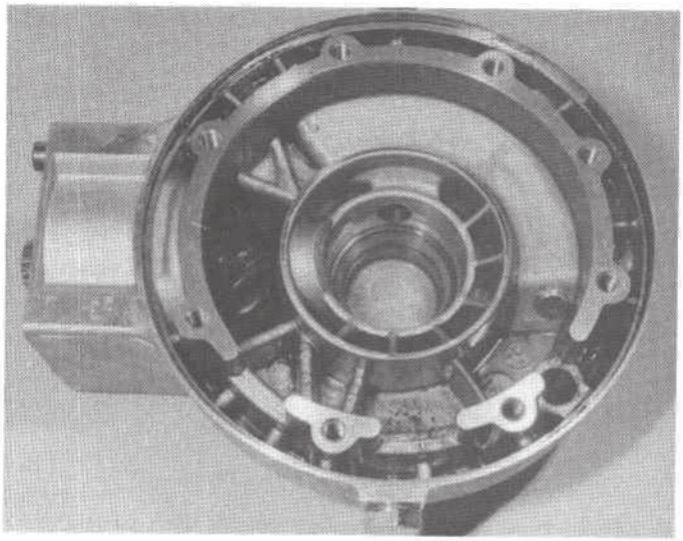
3.5a Crownwheel, bearing and speedometer rotor will be removed with cover ...



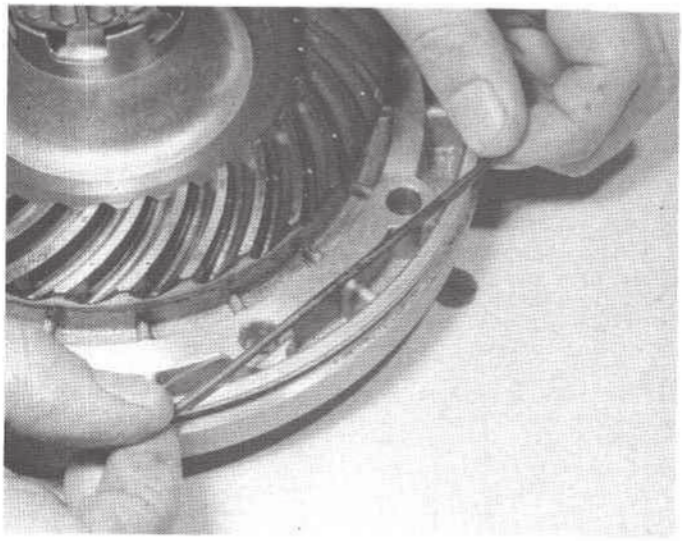
3.5b ... and must be tapped out if seal is to be renewed



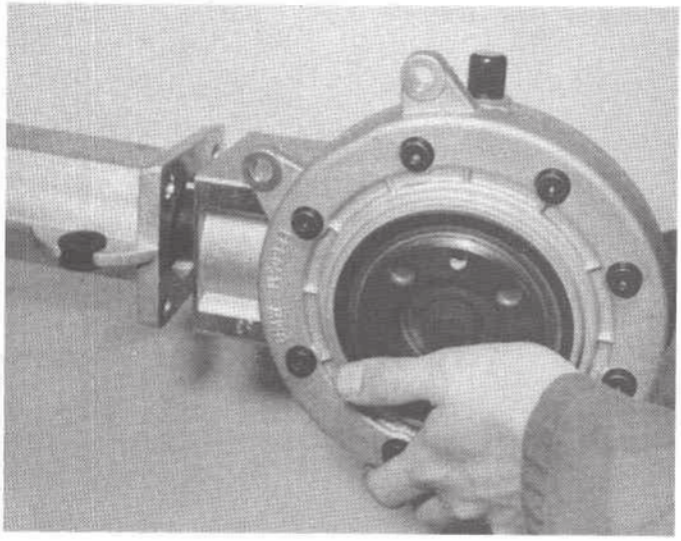
3.7 Do not attempt to disturb final drive pinion assembly



3.10a Thoroughly clean housing mating surfaces on reassembly ...



3.10b ... and always renew sealing O-ring



4.3a Rotate crownwheel flange to align shaft and drive pinion splines on refitting

4 Final drive: refitting

1 Before refitting the final drive assembly check the swinging arm gaiter is securely fixed and undamaged (especially if signs of water were noted in the swinging arm). Apply a coat of the specified lubricant (See Routine Maintenance) to the drive shaft splines and check that the swinging arm is securely supported at the normal working position.

2 Especially on early 100 models, but on any model which has been fitted with a new or different final drive housing or swinging arm, measure the depth of the tapped holes in the final drive housing into which are screwed the retaining bolts; they must be at least 17.5 mm (0.7 in) deep, measured from the joint face. The manufacturing limits of the swinging arm mounting flange thickness were increased and to ensure that the thread length remained sufficient the final drive housing holes were drilled and tapped deeper; longer bolts 45 mm instead of 40 mm were also used. The early swinging arm and final drive housing are identified by the external horizontal cast rib which is 3.5 mm (0.14 in) wide; on modified castings it is 10 mm (0.40 in) wide. To ensure that the bolts are long enough to clamp the housing threads securely but without bottoming in their tapped holes select bolts as follows. If a modified final drive housing is fitted to either type of swinging arm, bolts 45 mm long must be used, also if an unmodified final drive housing is fitted to a modified swinging arm; note however that in this latter case the 40 mm bolts must be used if the longer bolts bottom in the tapped holes. Obviously if two unmodified (early type) castings are being installed, the 40 mm bolts are required.

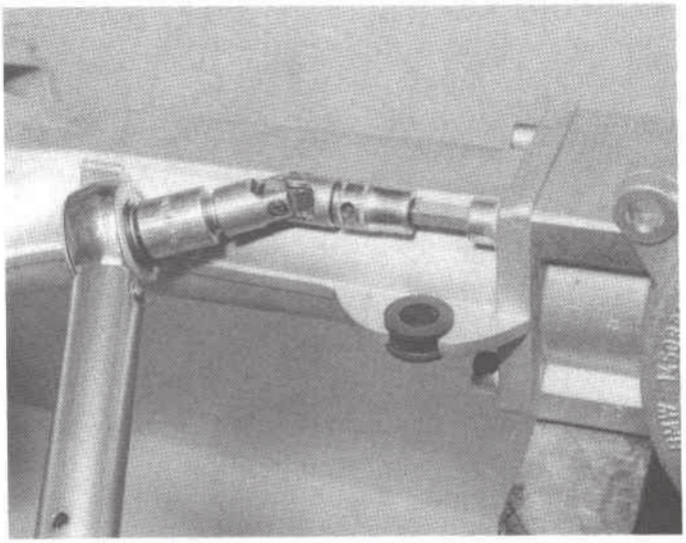
3 If water was found in the swinging arm apply a thin coat of sealant to the mating surfaces and check that the two locating dowels are securely fixed in the final drive housing surface. Refit the housing, aligning the drive pinion splines with those of the drive shaft rear end, then push the housing firmly into place. Refit and tighten the retaining bolts to the specified torque setting.

4 Refit the rear suspension unit to its bottom mounting and tighten the mounting nuts and bolts to the specified torque setting. Remove the swinging arm support.

5 Refit the rear brake components and rear wheel, as described in the relevant Sections of Chapter 9.

6 Press the speedometer impulse transmitter into the final drive housing, ensuring that it does not contact the rotor and that the sealing O-ring is coated with the specified oil to prevent any risk of damage. Fasten the retaining screw and secure the transmitter lead in the guide provided.

7 Where necessary, fill the housing with oil as described in Routine Maintenance, then check the oil level. Make a final check that all disturbed components are correctly refitted and fully secured, that the brake is correctly adjusted and working properly and that the rear suspension is working properly. Check also that the rear wheel is free to rotate smoothly and easily before taking the machine out on the road.



4.3b Tighten bolts to specified torque setting

5 Swinging arm and drive shaft: removal

1 Remove the final drive housing. See Section 2 of this Chapter.
2 Remove the exhaust silencer mounting nuts and unscrew its mounting Allen screws or bolts to withdraw the left-hand footrest plate. Similarly, remove the right-hand footrest plate complete with the rear brake components; if care is taken there is no need to dismantle the rear brake at all. On machines with disc rear brakes note that the fluid reservoir is secured to the battery carrier by a single bolt or nut.
3 Disconnect the clutch cable from the operating lever and withdraw it from the gearbox housing.
4 On the left-hand side of the gearbox housing slacken the large locknut and unscrew the swinging arm adjustable pivot stub.
5 On the gearbox right-hand side remove its three retaining Allen screws and carefully prise out the swinging arm fixed pivot stub; if it proves stubborn, screw a suitably sized bolt into its centre thread and use a large pair of pliers to draw it out, rotating it to break the seal.
6 With both pivot stubs removed, withdraw the swinging arm.
7 Using a small screwdriver to ease the circlip at its front end over the gearbox output shaft splines, pull the drive shaft sharply backwards to remove it.

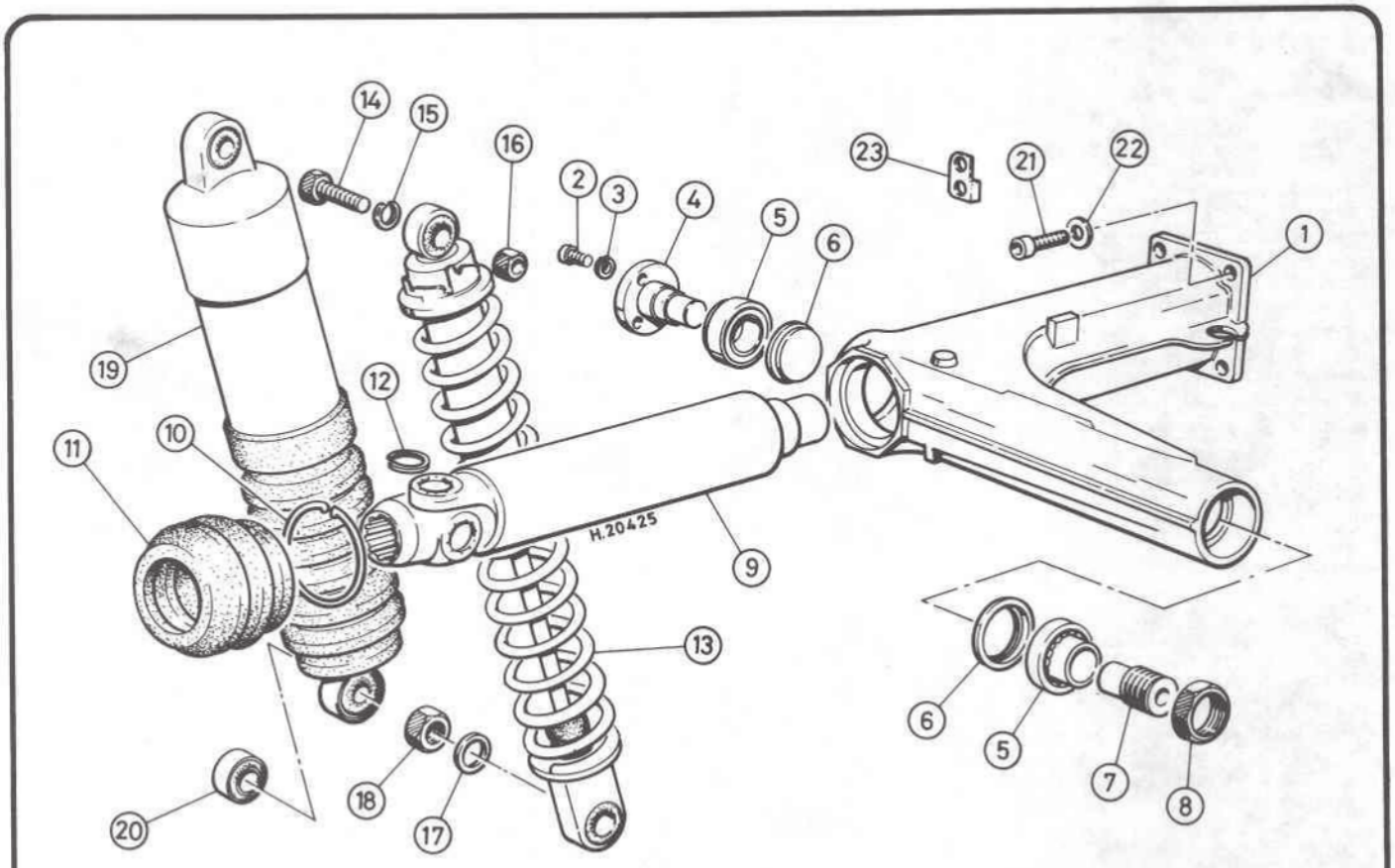
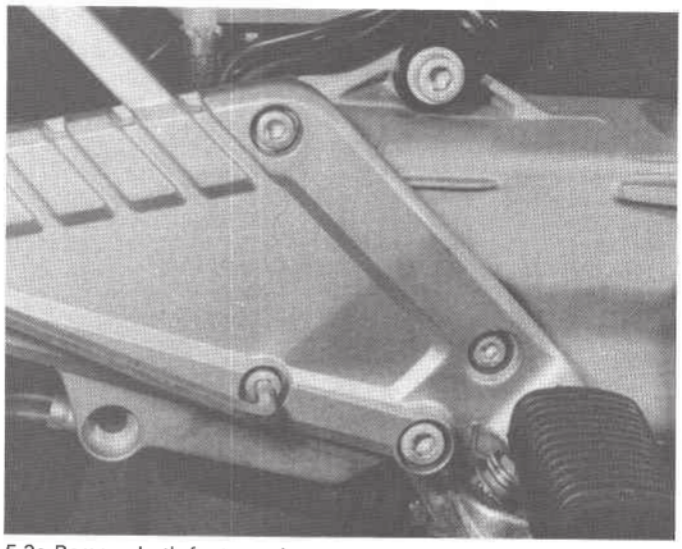
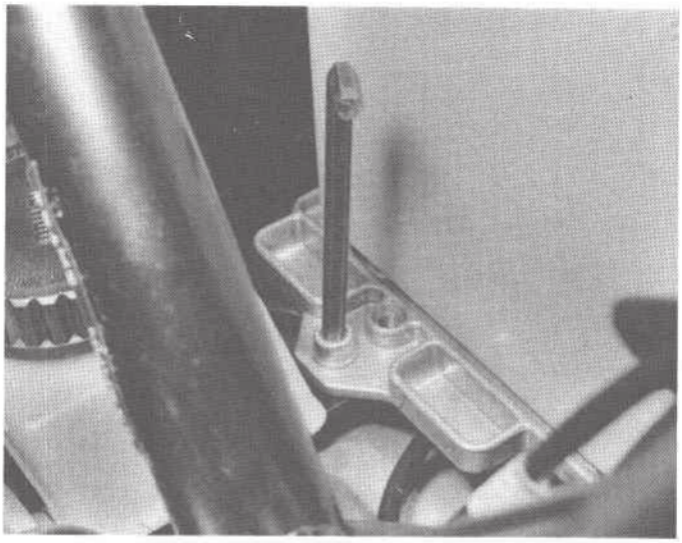


Fig. 8.2 Swinging arm and driveshaft

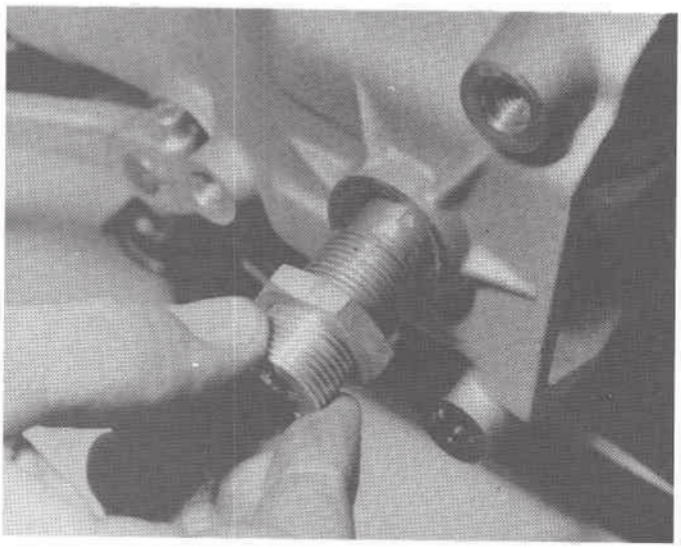
1 *Swinging arm*
2 *Bolt – 3 off*
3 *Washer – 3 off*
4 *Fixed pivot stub*
5 *Bearing – 2 off*
6 *Grease retainer – 2 off*
7 *Adjustable pivot stub*
8 *Locknut*
9 *Drive shaft*
10 *Circlip*
11 *Gaiter*
12 *Circlip*
13 *Rear suspension unit*
14 *Bolt*
15 *Washer*
16 *Nut*
17 *Washer*
18 *Nut*
19 *Nivomat suspension unit*
20 *Mounting bush*
21 *Bolt – 4 off*
22 *Washer – 4 off*
23 *Guide*



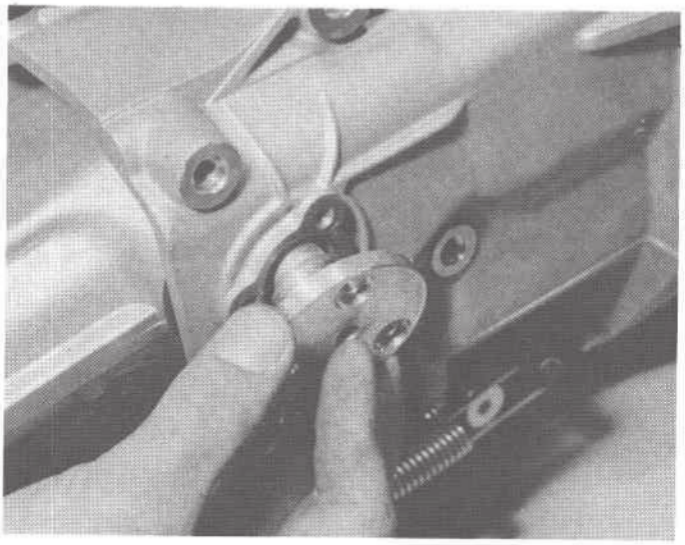
5.2a Remove both footrest plates to reach swinging arm pivots



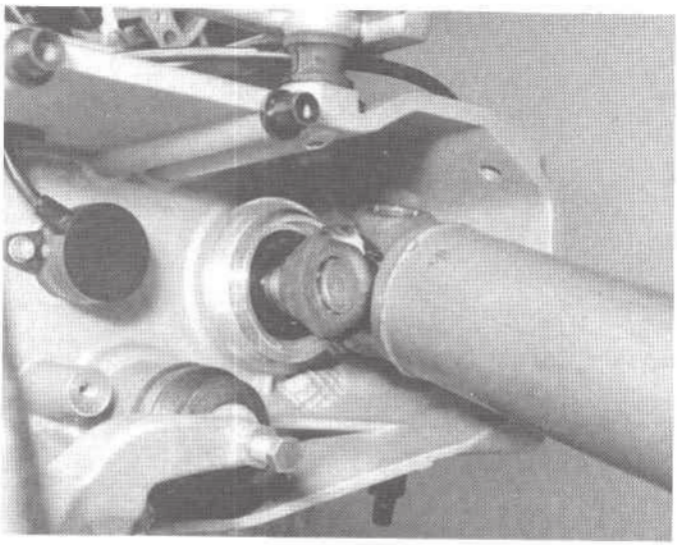
5.2b Disc rear brake models only – fluid reservoir is secured by single bolt to battery carrier



5.4 Unscrew swinging arm adjustable pivot stub ...



5.5 ... and remove fixed pivot stub to release swinging arm



5.7 Disengage circlip to release drive shaft from gearbox output shaft

6 Swinging arm: examination and renovation

1 The swinging arm pivot bearings incorporate seals and must be removed using a slide-hammer with the appropriate internally-expanding attachment.

2 Thoroughly clean all components, removing all traces of dirt, foreign matter and old grease from the bearings and from the swinging arm casting.

3 Check all components for signs of wear or damage, particularly the bearing outer and inner races, the rollers themselves and the bearing cage. Any component which is damaged or worn must be renewed.

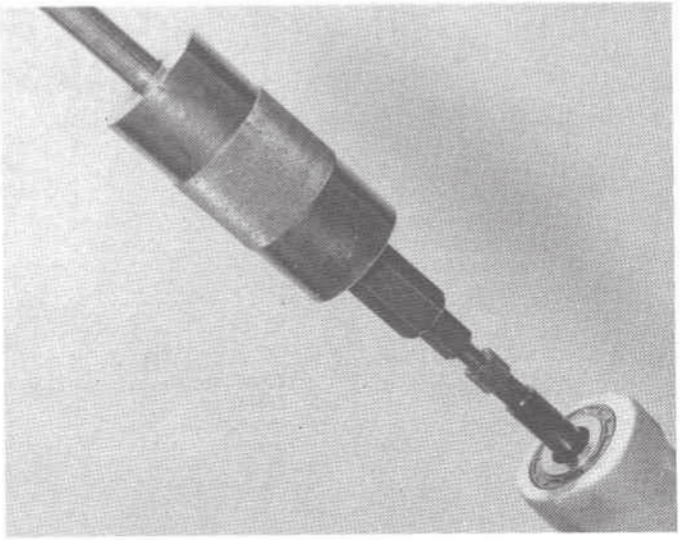
4 The bearing outer races must be extracted using a slide-hammer with the appropriate internally-expanding attachment. The grease retainer on the swinging arm right-hand side can be tapped out from the inside, if required, by passing a drift through the drive shaft aperture; the left-hand side retainer can then be tapped out from behind, passing a drift through the swinging arm cross tube.

5 On reassembly, the pivot bearing outer races can be tapped into place (after the grease retainers have been refitted) using a hammer and a tubular drift such as a socket spanner which bears only on the bearing outer edge. Tap each outer race into place until it seats on its

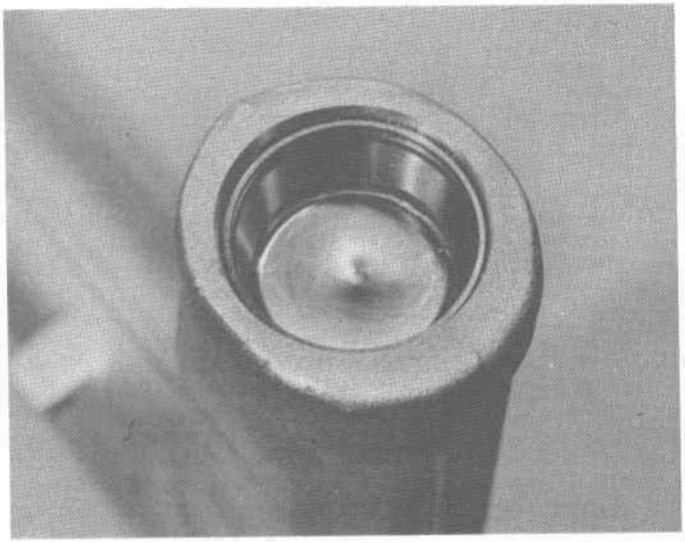
locating shoulder. Pack the bearing inner races liberally with the specified grease and fit them to the swinging arm.
6 Examine closely the condition of the sealing gaiter at the swinging arm front end; this must be renewed if it is split, torn, has deteriorated or is damaged in any way. To remove it, pull it out of the shaft, then remove the retaining circlip from inside it. On early 100 models the gaiter can be replaced by the modified type (with an additional internal front sealing lip to exclude water) fitted to all 75 models and to all later 100 models.
7 On refitting the gaiter, ensure that it is installed the correct way round, with the internal sealing lip at the front and the end with the internal circlip groove at the rear, inside the swinging arm. Refitting is eased if the gaiter's inside and outside sealing surfaces are coated with the lubricant specified for the final drive splined joints (see Routine Maintenance). Refit the large circlip to the gaiter groove with its open end aligned with the rib on the swinging arm cross tube.

7 Final drive shaft: examination and renovation

1 To renew the shaft locating circlip use a small screwdriver to prise it out of its groove and backwards towards the universal joint until it can be withdrawn. Fitting is the reverse of this procedure.



6.1 Slide-hammer with internally-expanding attachment is required to remove pivot bearings ...



6.4 ... and bearing outer races – note grease retainer behind outer race

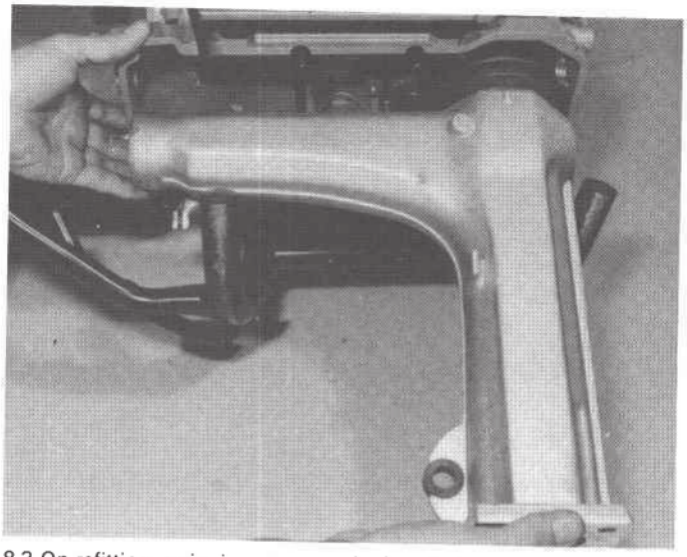
2 Holding the shaft front end in a vice with padded jaws, feel for free play in the universal joint bearings by pulling it backwards and forwards and twisting it to and fro in its normal direction of rotation.
3 If any free play is found in the joint, or if any other sign of wear or damage is detected, the shaft must be renewed as a complete assembly. Check with particular care the shaft splines and the bonded rubber section.

8 Swinging arm and drive shaft: refitting

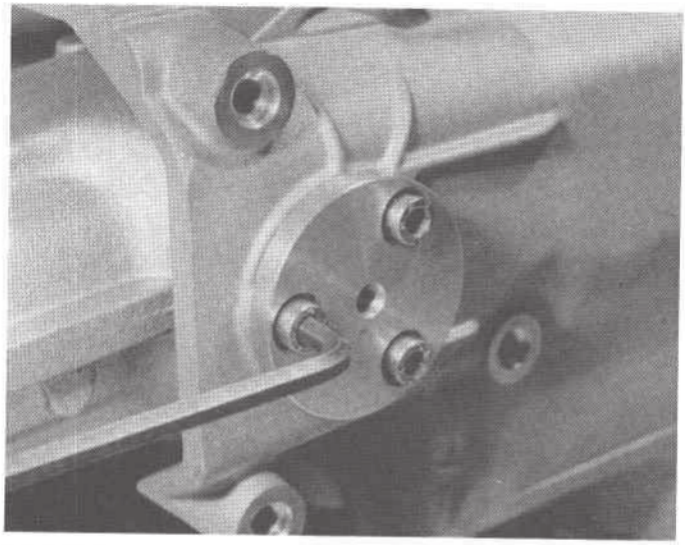
1 Apply a coat of the specified lubricant to the splines of the gearbox output shaft, to the splines at each end of the drive shaft and to the inside of the swinging arm rubber gaiter. Check that the swinging arm bearings are refitted and fully packed with clean grease and that their respective circlips are refitted inside the rubber gaiter and inside the drive shaft front end. Apply a coat of anti-seize compound such as Copaslip or Never Seeze to the swinging arm pivot stubs.
2 Note that the swinging arm must not be refitted with the drive shaft in place; the rubber gaiter cannot be correctly refitted to the gearbox if this is attempted.
3 With the gaiter and bearings in place, fit the swinging arm to the rear of the gearbox housing and manoeuvre it to and fro until the gaiter sealing lips have snapped into place on the gearbox flange; pull the swinging arm gently backwards to check that the gaiter is fully in place.
4 Refit the fixed pivot stub to the gearbox housing and pivot bearing, then refit and tighten securely the three retaining Allen screws to the specified torque wrench setting, if available.
5 Screw into the gearbox housing and left-hand pivot bearing the adjustable pivot stub. Tighten the stub as hard as possible by hand only, using an ordinary Allen key to preload the bearings, then slacken it fully and tighten it to the specified torque setting. Hold the stub in that position while the locknut is tightened securely, also to the specified torque wrench setting, if possible. Check that the swinging arm moves smoothly and easily throughout its full travel with no free play being discernible.
6 Checking that its splines are properly lubricated, insert the drive shaft into the swinging arm and move it forwards until the front end engages with the gearbox output shaft. Push the shaft on to the output shaft splines until the locating circlip is heard to snap into its groove; pull the shaft gently backwards to check its security.
7 Connect the clutch cable to the operating lever and adjust the release mechanism as described in Routine Maintenance.
8 Refit the footrest plates, tightening their mounting bolts and the exhaust silencer mounting nuts to the specified torque wrench settings, where available. Refit the brake components that were disturbed to withdraw the footrest.
9 Refit the final drive housing as described in Section 4 of this Chapter.



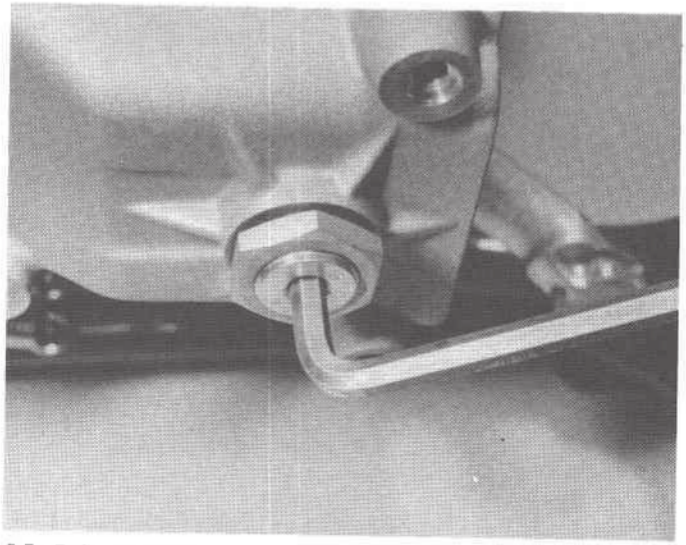
6.5 Pack bearings with specified grease on refitting



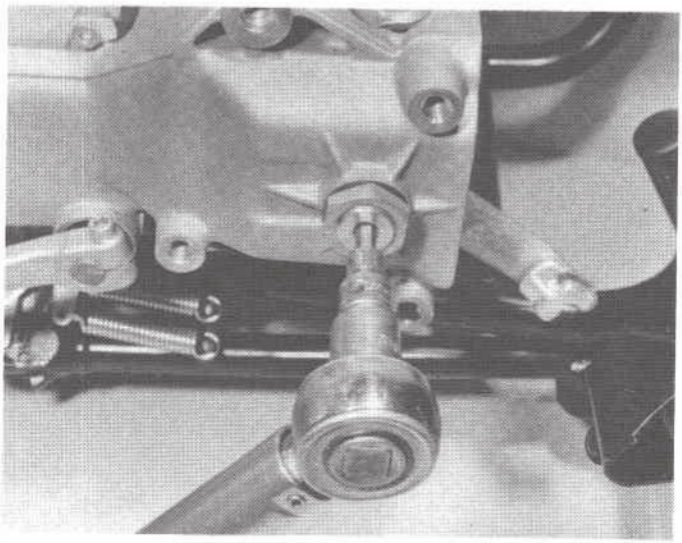
8.3 On refitting, swinging arm must be installed before drive shaft – check that sealing gaiter is securely fastened



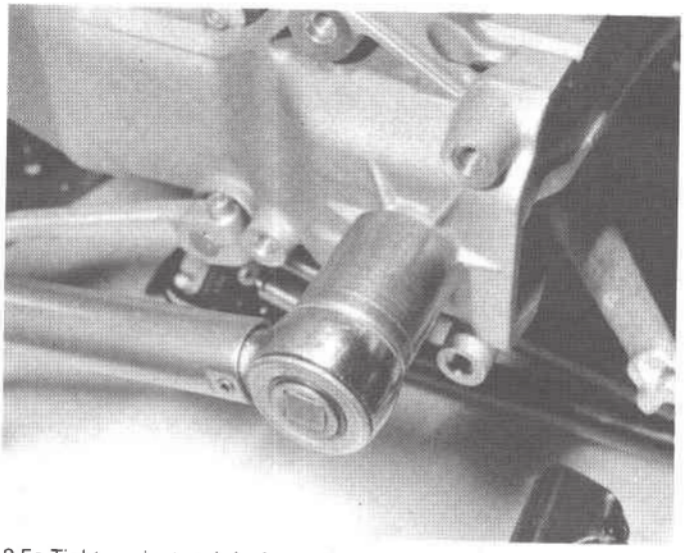
8.4 Refit fixed pivot stub and tighten screws securely



8.5a Refit adjustable pivot stub and tighten as hard as possible by hand to preload bearings



8.5b Slacken pivot stub and tighten to specified torque setting



8.5c Tighten pivot stub locknut securely, to specified torque setting if possible

9 Rear suspension unit: adjustment, removal and examination

1 The two-way hydraulically damped suspension unit may be adjusted to three spring load settings. Adjustment is effected by using a C-spanner to rotate the adjusting collar at the top of the unit to the desired setting; the normal setting for solo riding is at the top, and the stiffest setting for maximum loads is with the collar engaged on the lowest position.

2 Since the unit is sealed, unless any obvious damage is found such as oil leaks around the damper rod or if the unit's body is dented, the unit can only be checked by assessing its performance.

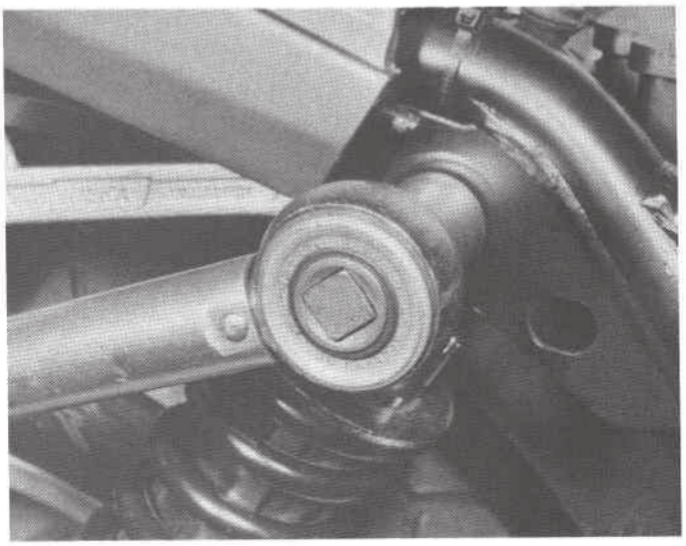
3 With the machine standing on its wheels press down on the rear and release sharply; the suspension should compress smoothly and return smoothly to the at rest position. If any signs of jerkiness is noted, or if any undue noises are heard the unit must be renewed. The most effective test, however, is to ride the machine. If it is taken to a person who is familiar with the type, he or she should be able immediately to spot a suspension fault to which the regular rider has become accustomed. If there is any evidence of faulty handling or cornering due to worn rear suspension, the unit must be renewed as soon as possible.

4 **Note:** before removing the suspension unit ensure that the swinging arm is supported by a block of wood or similar or by a strong strap passed around the swinging arm and frame tubes. If the swinging arm is secured in approximately its normal working position, ie not more than 349 mm (13.7 in) below the suspension unit, the risk of damage to the sealing gaiter or to the gearbox housing or swinging arm castings will be avoided. **Never** allow the swinging arm to drop suddenly and sharply.

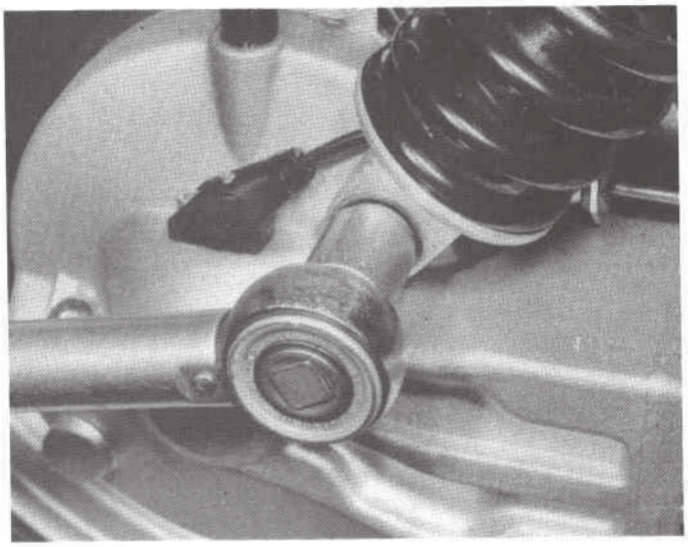
5 With the swinging arm supported, remove the suspension unit bottom mounting nut and top mounting bolt and withdraw the unit. On refitting, ensure that the mounting bolt and nuts are fastened to the specified torque wrench settings and that the unit is installed with the spring adjusting collar at the top.

6 As stated above, the unit can only be renewed if faulty; repairs are not possible since replacement parts are not available and the unit itself is sealed. The only exception to this are the unit mounting bushes which can be removed using a drawbolt arrangement or a vice and suitably sized socket spanners.

7 If the unit is to be stored for a long time, always keep it upright, except for K75 S models and others with 'S' suspension, where the unit should be stored with the damper rod upwards; in all cases this is to prevent the seals from drying out.



9.5a Suspension unit is installed with spring preload collar uppermost ...



9.5b ... both mountings must be fastened to specified torque wrench settings

10 Nivomat suspension unit: general

1 Nivomat suspension, developed in conjunction with the manufacturers, Boge, requires no adjustment or maintenance and is self-adjusting to provide the same ride height, ground clearance, suspension travel and performance for all loads up to the maximum

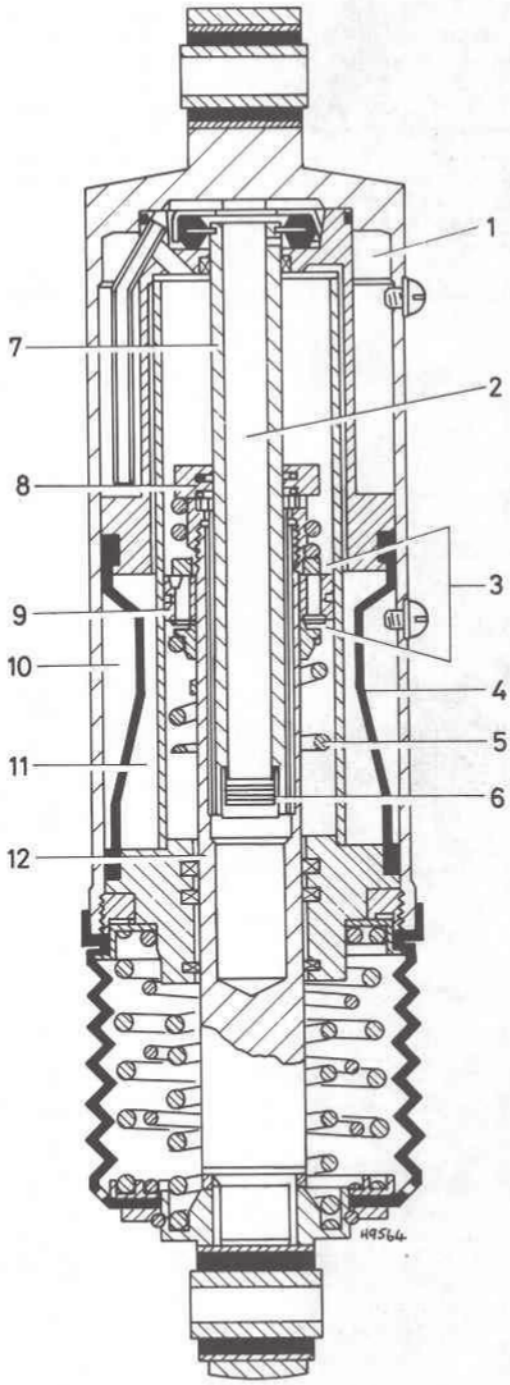


Fig. 8.3 Nivomat suspension unit

1 Low pressure chamber
2 Ride height control passage
3 Damper spring loaded valves
4 Rubber diaphragm
5 Rebound spring
6 Pump intake valve
7 Hollow pump rod
8 Pump check valve
9 Damper piston
10 Gas (high pressure)
11 High pressure chamber
12 Piston rod

permissible and at all speeds. Spring preload (or its equivalent) and damping action are adjusted automatically to be relatively soft during low-speed solo use and become progressively harder as the need arises.

2 The unit functions as follows (refer to the accompanying illustration): the pump rod is resiliently mounted to the top of the unit, the piston rod being attached to the bottom. As the suspension moves, the relative movement of these two components causes oil to be sucked from the low-pressure chamber via passages to the pump intake valve, from where it is forced through the pump check valve into the high-pressure chamber. This pressurises the gas, which is kept separate by a rubber diaphragm, increases the pressure in the unit's working parts and increases the spring preload to raise the machine to a pre-determined ride height. When this has been reached, a valve opens to allow the oil to flow through the unit back to the low-pressure chamber. Damping action is provided by the pumping action itself, in addition to the spring-loaded damper valves. Note that if the load limit is exceeded, a safety valve prevents excessive pressure from building up; this means that the full ride height will not be reached.

3 It is important to remember that the ride height and suspension travel will not reach their full values until the unit has pumped itself up. Therefore if the first few miles of a journey are on a completely smooth road, the rear suspension may not be ready to take a sudden bumps. Also if the load is suddenly altered, ie the rider takes all his weight on his legs when stopped at a traffic light, if a pillion passsenger mounts or dismounts, or if luggage is added or removed, the rear suspension will take a little while to adjust itself to the new requirements. This is not a fault, merely a function of the system's design and should not cause problems once the rider is familiar with it.

4 To test the unit, place a load on the rear of the machine, sufficient to noticeably compress the suspension, then with the machine stationary but on its wheels press down on its rear end (20 to 25 strokes of approximately 15–20 mm ($1/2$–$3/4$ in). The unit should be seen to pump itself up to the normal ride height.

5 **Warning:** do not attempt to dismantle the unit or to alter its performance. **Do not** touch the two screws in the unit body. If any fault is suspected in the rear suspension performance take the machine to a BMW dealer for attention. Note that a light film of oil on the damper piston rod does not necessarily indicate a fault, although any serious oil leakage will obviously warrant instant attention by a BMW dealer.

Chapter 9 Wheels, brakes and tyres

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Specifications

Wheels		
Size:	**Front**	**Rear**
K75, K75 C, K75 T	MTH 2.50 x 18E	MTH 2.75 x 18E
K75 S, all 100 models	MTH 2.50 x 18E	MTH 2.75 x 17E
Rim maximum runout – radial and axial	0.50 mm (0.0197 in)	
Brakes		
Type:	**Front**	**Rear**
K75, K75 C, K75 T	Twin hydraulic discs	SLS drum – rod operated
K75 S, all 100 models	Twin hydraulic discs	Single hydraulic disc
Disc brakes – front and rear		
Disc diameter	285 mm (11.22 in)	
Disc thickness:		
Standard	4.300 – 4.400 mm (0.1693 – 0.1732 in)	
Service limit	3.556 mm (0.1400 in)	
Disc maximum warpage	0.200 mm (0.0079 in)	
Brake pad friction material thickness:		
Standard – approximate	5.0 mm (0.1969 in)	
Service limit	1.5 mm (0.0591 in)	
Master cylinder piston OD	13 mm (0.5118 in)	
Caliper piston OD	38 mm (1.4961 in)	
Recommended brake fluid	DOT 4 – eg ATE 'SL'	
Drum brake		
Drum ID:		
Standard	200.00 mm (7.8740 in)	
Maximum	201.16 mm (7.9197 in)	
Brake shoe friction material minimum thickness	1.5 mm (0.0591 in)	
Tyres		
Note: *check with BMW importer/dealer for currently approved makes and types of tyre*		
Size	**Front**	**Rear**
K75, K75 C, K75 T	100/90 – 18 56 H, also 100/90 H 18	120/90 – 18 65 H, also 120/90 H 18
K75 S, all 100 models	100/90 V 18, also 100/90 x 18 56 V	130/90 V 17, also 130/90 x 17 68 V
Manufacturer's recommended minimum tread depth – at centre of tread:		
Front tyre	2 mm (0.08 in)	
Rear tyre – up to 80 mph (130 km/h)	2 mm (0.08 in)	
Rear tyre – above 80 mph (130 km/h)	3 mm (0.12 in)	
Tyre pressures – tyres cold	**Front**	**Rear**
75 models:		
Solo	29 psi (2.00 bar)	36 psi (2.50 bar)
Pillion	34 psi (2.30 bar)	42 psi (2.90 bar)
100 models:		
Solo	33 psi (2.25 bar)	36 psi (2.50 bar)

Tyre pressures – tyres cold

	Front	Rear
Pillion – up to 112 mph (180 km/h)	33 psi (2.25 bar)	39 psi (2.70 bar)
Pillion – above 112 mph (180 km/h)	39 psi (2.70 bar)	42 psi (2.90 bar)

Note: *information is correct at time of writing – check with machine's handbook or label on rear mudguard for updated information. Pressures apply to original equipment tyres only – check with BMW dealer/importer or tyre manufacturer or agent if non-standard tyres are fitted – pressures may vary.*

Torque wrench settings

Component	75 models		100 models	
	Nm	lbf ft	Nm	lbf ft
Front wheel spindle retaining collar Allen screw	33 ± 4	24 ± 3	33 ± 2.4	24 ± 2
Front wheel spindle clamp bolts	14 ± 2	10 ± 1.5	14 ± 1	10 ± 0.5
Rear wheel mounting bolts	105 ± 4	77.5 ± 3	105	77.5
Front brake disc mountings	29	21.5	29	21.5
Rear brake disc mounting screws	21 ± 2	15.5 ± 1.5	21.4	16
Brake caliper mounting bolts	32 ± 2	23.5 ± 1.5	32 ± 2	23.5 ± 1.5
Brake pipe retaining plastic nut at steering head – early 75 models, all 100 models	10 ± 1	7.5 ± 0.5	10	7.5
All brake hose or pipe unions	7 ± 1	5 ± 0.5	8	6
Brake caliper bleed nipples	7 ± 1	5 ± 0.5	N/Av	N/Av

1 General description

The wheels are one-piece cast alloy components with a rim configuration suitable for the tubeless tyres fitted to all models. Note that not only should the tyres always be of the specified size and speed and/or load rating for the wheel to which they are fitted, but that they should also always be of the same make and type from the selection approved by BMW. **Do not** fit any make or type of tyre that is **not** approved by BMW; the BMW importer or an authorised BMW dealer will be able to provide details of the current list.

The front brakes are of the hydraulically-operated twin disc type. The application of the handlebar lever moves the piston in the Magura master cylinder assembly producing an equivalent increase in pressure transmitted by the hydraulic fluid to all parts of the system. The Brembo brake caliper bodies are bolted rigidly to each fork lower leg and contain a separate aluminium alloy piston in each body half. The pistons are arranged facing towards each other on each side of each disc, so that the increase in pressure, magnified by the difference in piston sizes, causes each piston to move towards the disc, pressing the brake pad friction material against the disc surface. Given that none of the components are stuck with dirt or corrosion, exactly the same clamping force should be applied to each disc to slow the wheel. Each piston is surrounded by a fluid seal and a smaller dust seal to exclude any dirt or moisture. As the piston moves outwards the fluid seal distorts and, on release of brake pressure, springs back into shape, thus retracting the piston with it to prevent brake drag. As the pad friction material wears, the piston moves through the fluid seal to compensate for this wear, more fluid entering the system from the master cylinder reservoir to increase the system's capacity accordingly.

The rear brake fitted to K75 S and to all 100 models uses a Brembo-built master cylinder/fluid reservoir assembly operated by the rear brake pedal and mounted on the rear of the right-hand footrest plate. It acts on a single brake disc bolted to the final drive crownwheel flange via a Brembo caliper, in all other respects it is similar to the front brake system. Note that while early 1984 100 models were fitted with drilled rear brake discs, all later models are fitted with undrilled components.

Other 75 models are fitted with a rod-operated drum rear brake in which two shoes, with friction material bonded to their outer surfaces, are forced outwards against the inside of a drum, mounted in the rear wheel casting, by the rotation of a camshaft. On release of pedal pressure, the shoes are pulled clear of the drum by heavy return springs. Since only one cam is fitted, the brake is only of the single leading shoe type.

2 Front wheel: removal and refitting

1 Place the machine on its centre stand and wedge a wooden block or similar under the sump so that the front wheel is clear of the ground. Make a note of the tyre rotation arrow (or mark the wheel itself) to ensure that the wheel is refitted the original way round.

2 During wheel removal make a careful note of any washers and spacers fitted; these must be refitted in their original locations. Also wedge a piece of wood between the brake pads; do not apply the brake lever. It will be necessary to remove at least one brake caliper to permit wheel removal; depending on the type and make of front tyre fitted it may prove necessary to remove both.

3 To remove either caliper, first unscrew the brake hose/pipe clamp at the top of the fork lower leg (on models with two-piece mudguards it may well prove quicker to remove the mudguard rear section), then remove the two caliper mounting bolts and withdraw the caliper, wedging a spacer such as a clean piece of wood between its pads.

4 Unscrew the Allen screw which secures the spindle retaining collar on the right-hand side and withdraw it with the collar. Slacken the spindle clamp bolts, insert a tommy-bar into the spindle and pull out the spindle with a twisting motion. Note the two spacers.

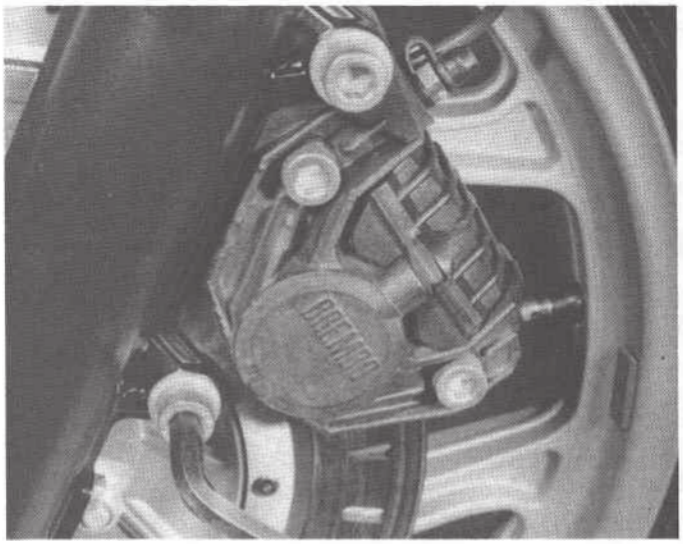
5 On refitting, grease the spindle to prevent corrosion and reverse the removal procedure. The wider of the two spacers fits against the hub left-hand side. Hold the spindle with the tommy-bar and tighten the Allen screw to the specified torque setting. Refit the caliper(s), if removed, and tighten the mounting bolts securely, to the specified torque wrench setting.

6 When the wheel has been refitted, tighten the spindle Allen screw to its specified torque setting, then push the machine off its stand and apply the front brake (having refitted the calipers, where applicable). Pump the forks up and down several times to align the fork lower legs on the spindle, then raise the machine on to its centre stand and tighten the spindle clamps to their specified torque settings. Apply the brake lever repeatedly to bring the pads back into contact with the discs.

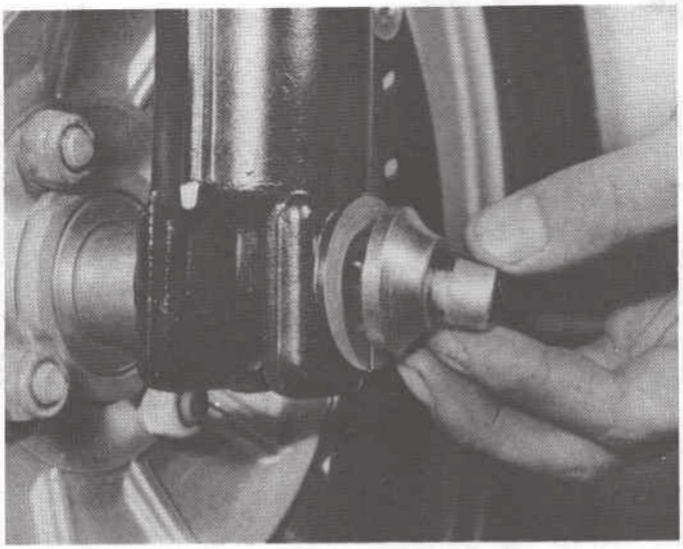
7 Check that the brake and front forks operate correctly, that the wheel is free to rotate easily, and that all disturbed fasteners are correctly tightened before riding the machine.



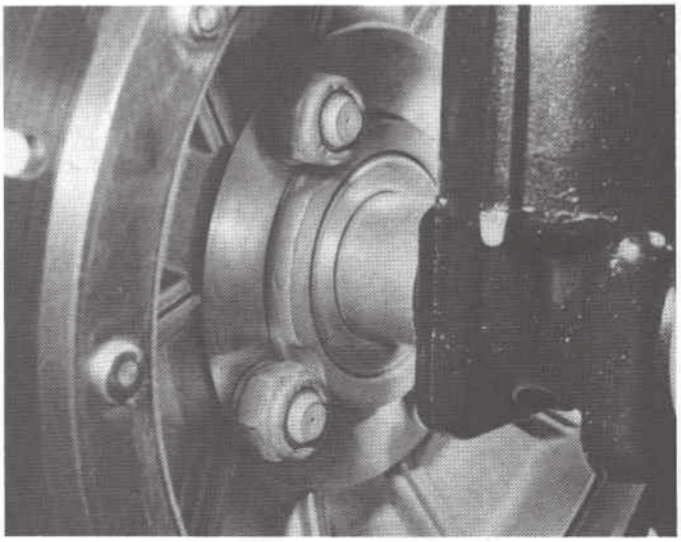
2.1 Before removing wheel, note tyre fitting mark and use to determine direction of installation



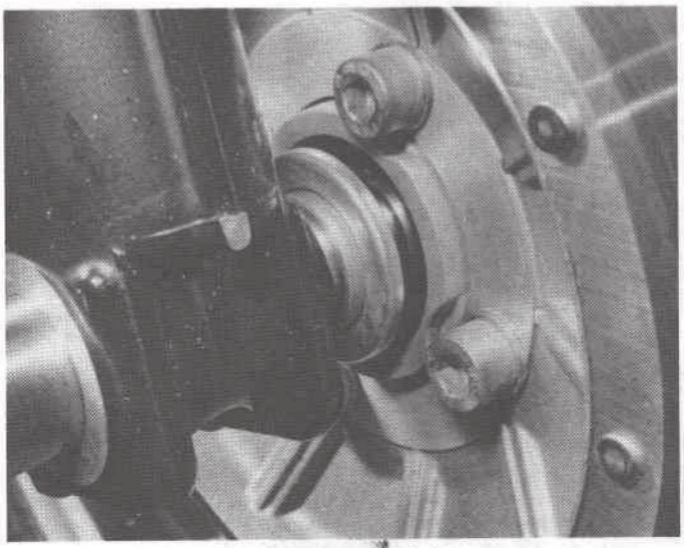
2.3 One caliper, possibly both, must be removed before the wheel can be withdrawn



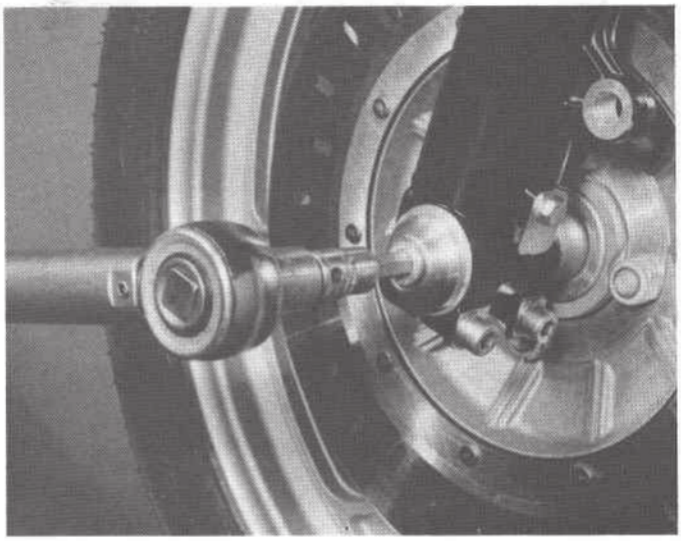
2.4 Unscrew spindle retaining Allen screw and withdraw retainer to release spindle



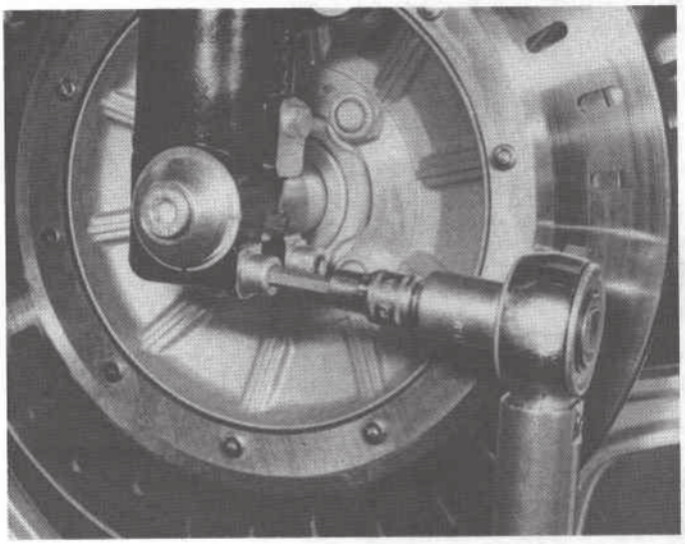
2.5a Note that wider spacer is on hub left-hand side ...



2.5b ... narrower spacer on hub right-hand side



2.6a Tighten spindle retainer Allen screw to specified torque setting and align fork legs on spindle ...



2.6b ... before tightening spindle clamp bolts to specified torque setting

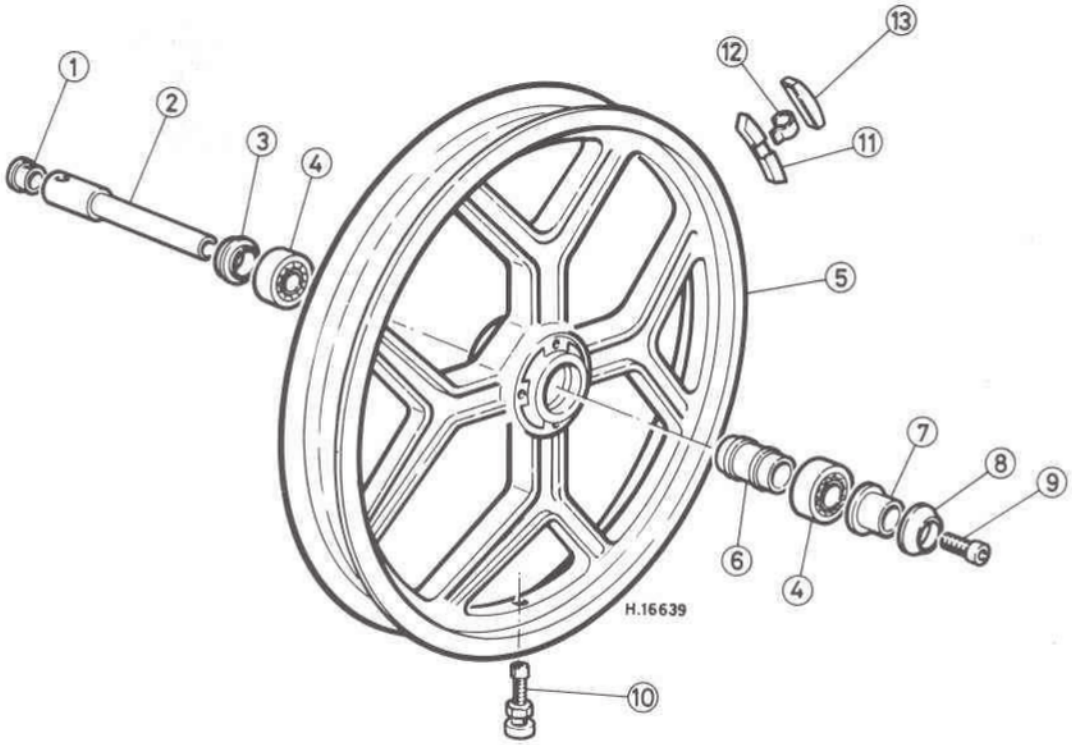


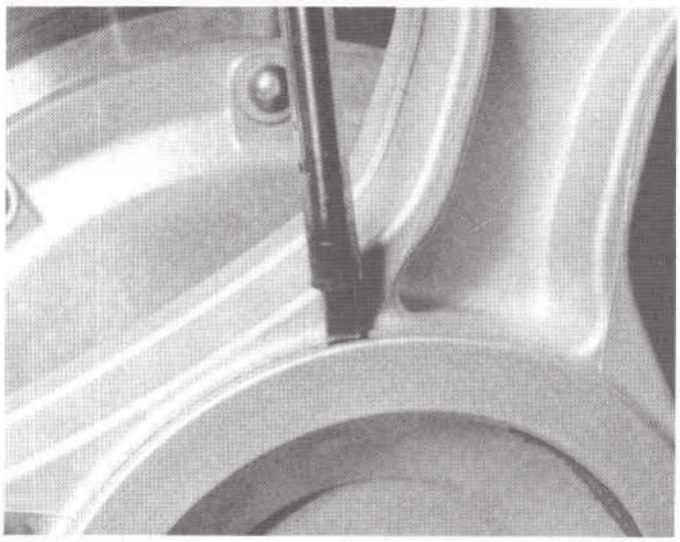
Fig. 9.1 Front wheel

1 *Spindle cap*
2 *Spindle*
3 *Spacer*
4 *Ball bearing*
5 *Wheel*
6 *Spacer*
7 *Spacer*
8 *Retaining collar*
9 *Allen screw*
10 *Tyre valve*
11 *Balance weight**
12 *Clip**
13 *Balance weight – later type*

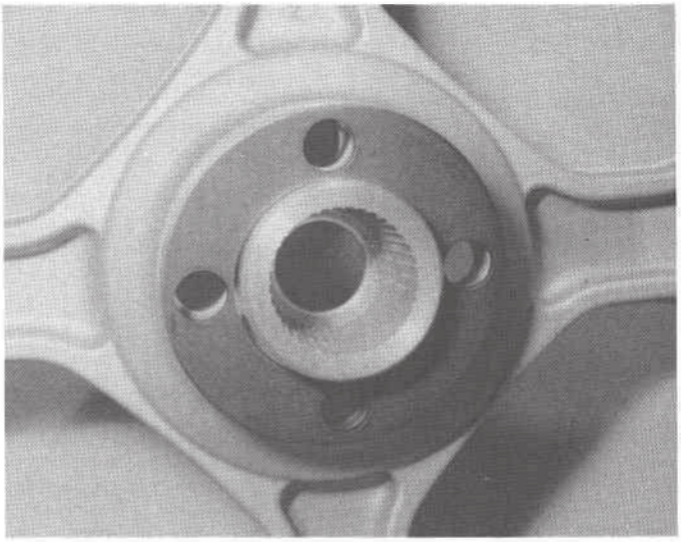
* *early 100 models only*

3 Rear wheel: removal and refitting

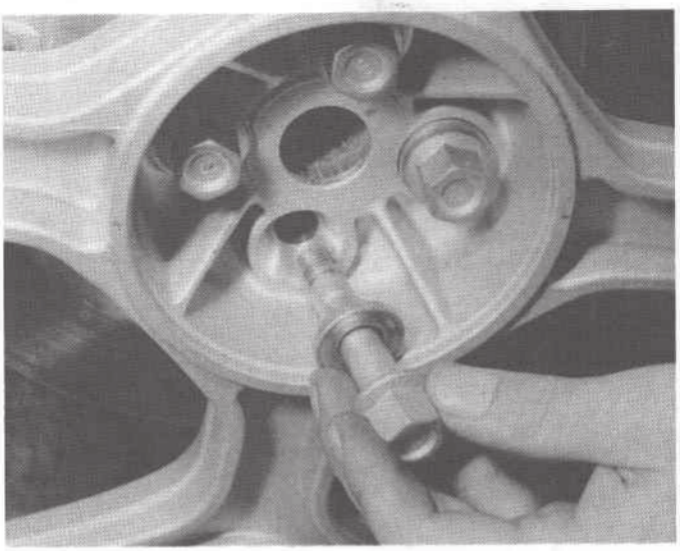
1 Place the machine on its centre stand so that it is supported securely with the rear wheel clear of the ground. Unlock and raise the seat then remove the tail storage compartment lid.
2 Slacken the two nuts (either wingnuts or ordinary nuts with plastic caps) on the floor of the storage compartment and remove (working from outside the rear of the tail unit) the two screws from underneath the tail lamp assembly. Withdraw the number plate bracket. On machines with disc rear brakes, prise off the wheel hub cover.
3 Either select top gear or apply the rear brake to prevent wheel rotation, then unscrew the mounting bolts, noting their conical spacers. Withdraw the wheel, noting the large metal washer fitted on disc brake models. On drum brake models, it may be necessary to slacken off the brake adjusting nut to release the wheel.
4 On refitting, check that the mating surfaces of the wheel and the final drive mounting flange are completely clean and free from grease, also the mounting bolts and their threads. On machines with disc rear brakes, do not forget to refit the large metal washer. Note also that the bolts are not interchangeable between models; drum brake models have bolts 55 mm long (indicated by the number 55 marked on the bolt heads) and disc brake models have bolts 60 mm long (indicated by the number 60 marked on the bolt heads).
5 Fit the rear wheel and mounting bolts. Ensure that the conical spacers under the bolt heads engage correctly with the wheel tapered surfaces. Tighten the mountings securely using a torque wrench or the machine's own tools. With its own tubular extension the wheel nut spanner provided will need only normal hand pressure to tighten the mounting to approximately the correct torque setting. Check the tightness of the mountings with a torque wrench as soon as possible.
6 Refit the wheel hub cover (disc rear brakes only) and the number plate bracket. Where appropriate, check the adjustment of the rear brake. See Routine Maintenance.
7 On machines with drum rear brakes, if the rear brake feels spongy or imprecise in operation at any time, but particularly after the rear wheel has been disturbed the shoes will probably need to be centralised on the drum. Slacken the wheel mounting bolts, spin the wheel and apply the brake hard. Maintain full pressure while the mounting bolts are tightened to the specified torque wrench setting. Re-check the brake adjustment.



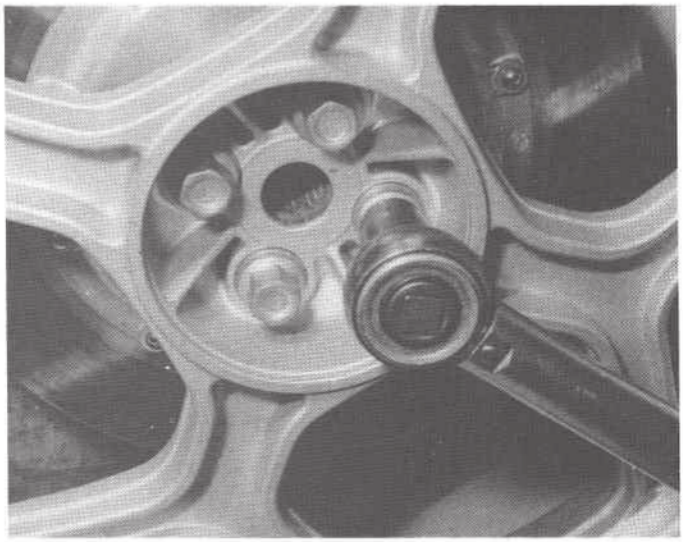
3.2 On machines with disc rear brakes prise off hub cover



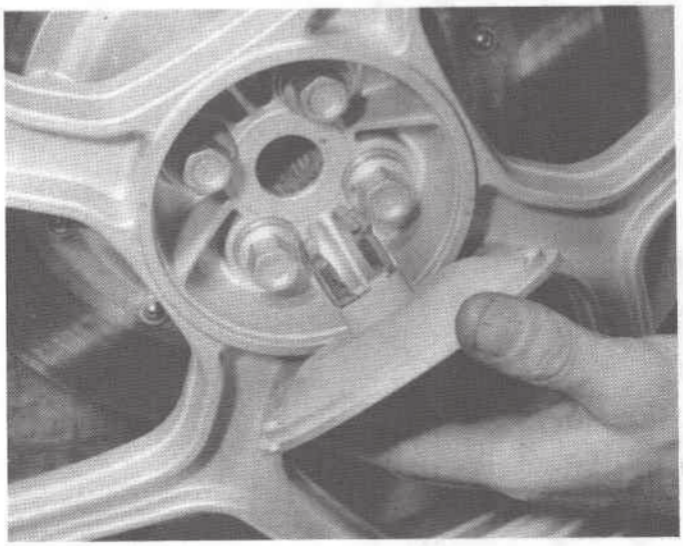
3.4 Mating surfaces must be absolutely clean on refitting – do not forget metal washer (where fitted)



3.5a Ensure conical spacers are refitted correctly ...



3.5b ... before tightening wheel bolts to specified torque setting



3.6 Do not forget to refit hub cover

4 Wheel bearings: removal, examination and refitting

1 Check the bearings for wear as described in Routine Maintenance.

Front wheel

2 Remove the wheel from the machine. See Section 2.

3 Note that BMW recommend that the wheel is heated to approximately 100°C (212°F) to install the wheel bearings. If this is to be done the brake discs, balance weights, tyre and valve should be removed first, as described in the relevant Sections of this Chapter, to prevent damage to them.

4 Due to the tight fit of the central spacer, the bearings can only be removed using a slide-hammer or other puller with the correct internally-expanding adaptor.

5 With the bearings removed, wash them in a high flash-point solvent and check them for wear or damage. If any signs of wear or damage is discovered, if free play was found at the wheel rim, or if either bearing rotates roughly both must be renewed. Pack the bearings with grease before reassembly.

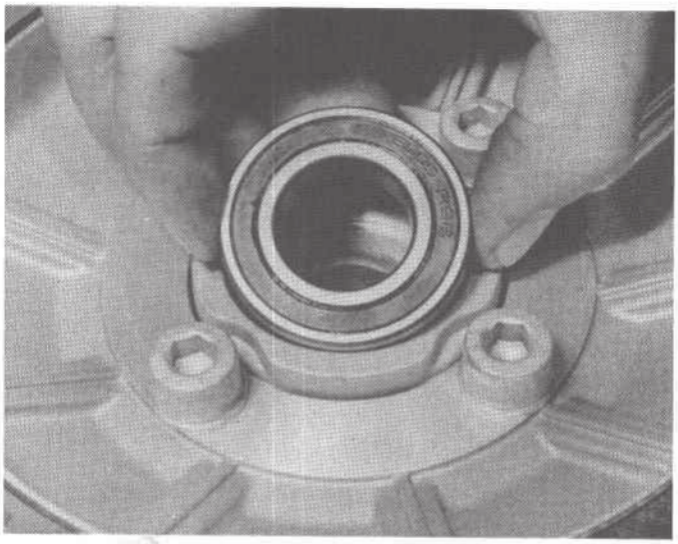
6 On reassembly, BMW recommend that the hub is heated to 100°C (212°F); heating such a large compound evenly will prove very difficult and must be done with great care. The simplest course may well prove to be stripping the wheel (see paragraph 3 above) and placing it in a large container, then slowly pouring boiling water over it, avoiding splashes. Take great care to avoid any risk of personal injury or of component damage when heating components or when handling components that have been heated.

7 Fit the first bearing into the heated hub with its sealed surface outwards and tap it firmly into place against its locating shoulder with a hammer and a tubular drift such as a socket spanner which bears only on the bearing outer race. Invert the wheel, check that both bearings are fully packed with the specified grease and refit the central spacer, followed by the remaining bearing, which is fitted as described above.

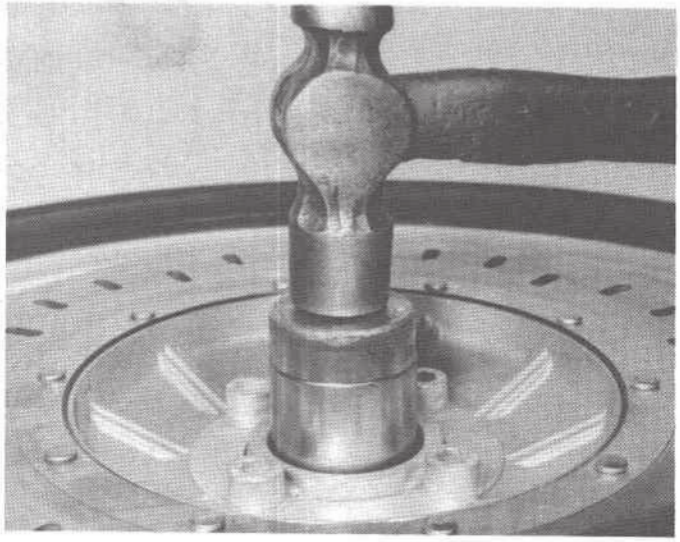
8 Refit the valve, tyre, balance weights and discs (if disturbed) and check that the wheel rotates freely and easily on the spindle before refitting.

Rear wheel

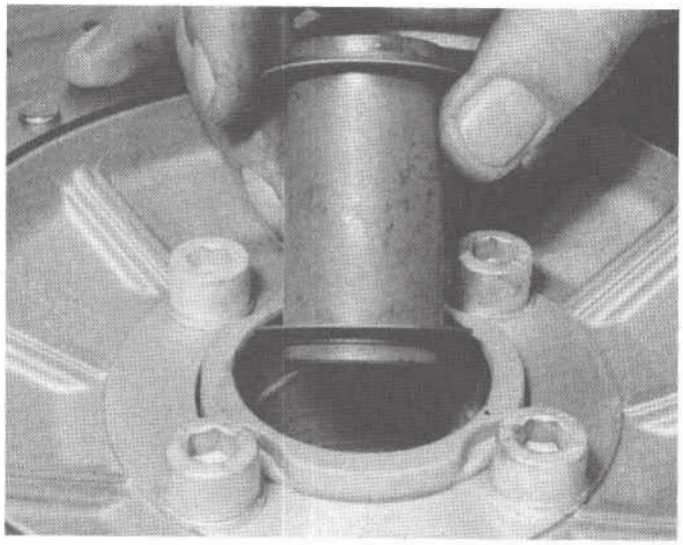
9 Note that the rear wheel is bolted to the flange of the final drive crownwheel and therefore has no bearings of its own. If play is detected at the wheel rim this can only be due (assuming the mounting bolts are securely fastened) to worn bearings in the final drive assembly. Since the overhaul of this is beyond the scope of this manual and of most owners, the machines should be taken to an authorised BMW dealer for attention.



4.7a Bearings are refitted with sealed surfaces outwards ...



4.7b ... and are tapped down to locating shoulder as shown



4.7c Do not forget to refit central spacer before second bearing is installed

5 Hydraulic brake overhaul: general

1 Before starting work on any component of a hydraulic brake system, note the following:

2 Caliper overhaul should be preceded by removing the pads, as described in Routine Maintenance.

3 Check carefully with a BMW dealer exactly what replacement parts are available to recondition the components; there is no point in attempting to dismantle an assembly if lack of pistons and seals means that it cannot be repaired. On the front brakes, both calipers should be always overhauled together to preserve brake performance.

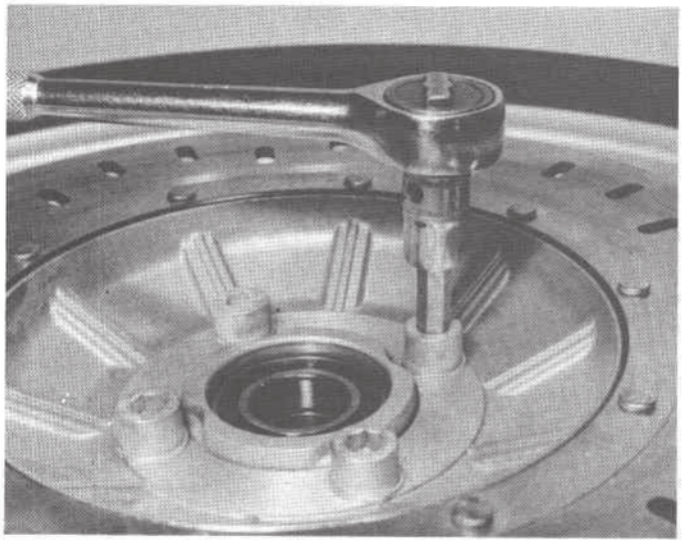
4 Remember that brake fluid is an excellent paint stripper and will also attack plastic components. If any is spilt, wash it off as soon as possible with fresh water. Use only new fluid from a freshly-opened sealed container as it is hygroscopic, which means that it absorbs water from the air. This eventually lowers the fluid's boiling point to an unsafe degree; fluid should never be re-used.

5 The brake discs can be checked for warpage by clamping a dial gauge to the fork leg or final drive housing; if runout exceeds the maximum limit specified, the disc(s) should be renewed. If they are worn at any point to less than the minimum specified thickness, or if they become scored for any reason, braking efficiency will be impaired. The discs should then be renewed; they are held on by bolts, which pass through the front wheel hub, secured by nuts. On refitting, ensure that these are tightened to the specified torque wrench setting. The rear brake disc is fastened to the final drive crownwheel flange by two countersunk screws which are treated with thread locking compound. They were found to be tight enough to distort noticeably under the pressure required to slacken them; owners would be wise to have new replacements on hand in case similar problems are encountered. Be careful to degrease and clean the mating surfaces and before refitting the disc, also the tapped holes in the crownwheel flange. Tighten the retaining screws to the specified torque wrench setting.

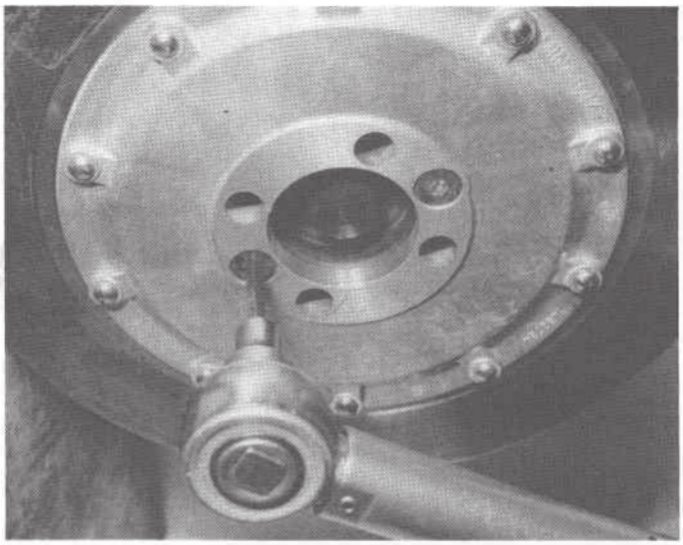
6 Examine the flexible hoses for cracks or scuffing and the metal pipes for cracks or corrosion. At the first sign of damage, they must be renewed. First drain the system. Unscrew the unions at each end of the hose and remove the hose, releasing it from any clamps or guides. After fitting a new hose, tighten it securely, re-fill the hydraulic system with new, clean fluid, and bleed the brake as described in Section 9 of this Chapter.

7 Check all unions for tightness. The hoses and brake pipes must not rub on an adjacent part.

8 If fluid leaks around the brake pads, the caliper seals are faulty. The handlebar lever will feel 'spongy'. Complete failure of the brakes, although there is pressure at the handlebar lever, may indicate a seized piston. In either case, the unit must be removed for servicing.



5.5a Front brake discs are secured by four bolts and nuts



5.5b Rear brake disc is secured by countersunk screws – fasten to specified torque setting

6 Caliper: removal, examination and refitting

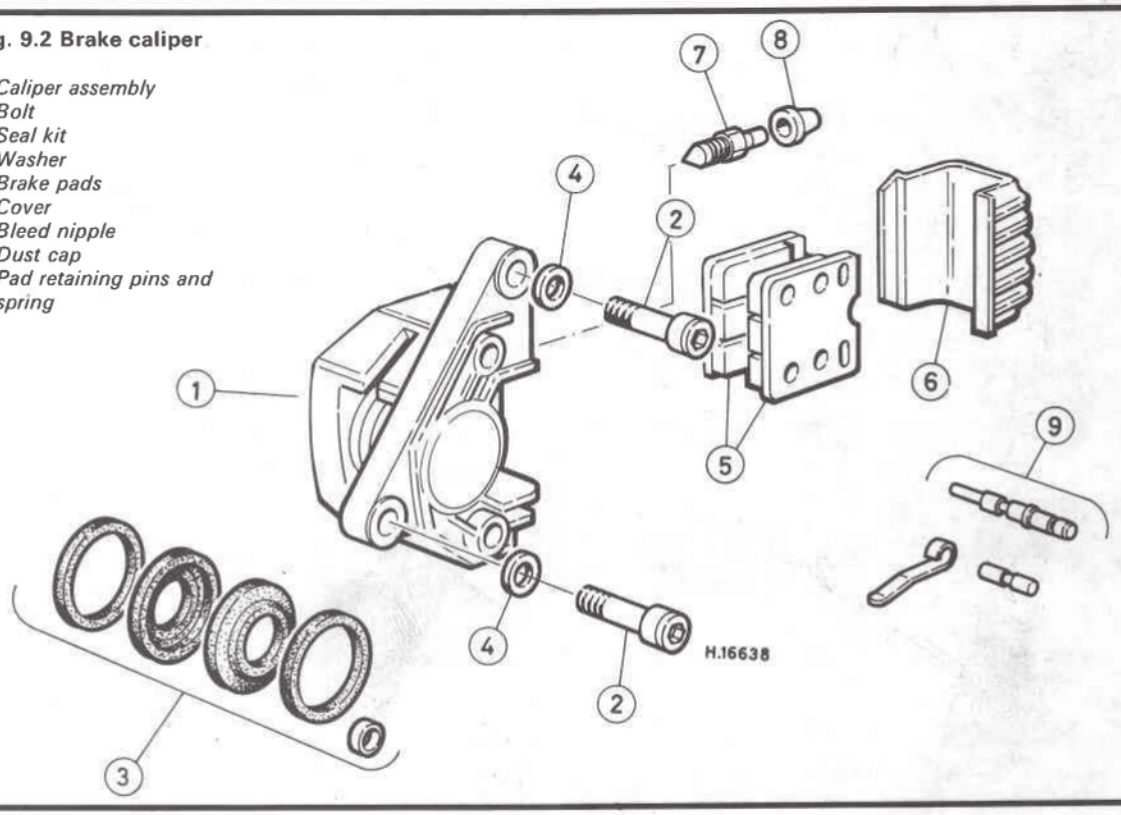
1 The caliper assemblies are identical in design and construction whether fitted to the front or to the rear brake. In both cases, it will be necessary to remove the caliper from the fork lower leg or from the final drive housing as appropriate. Each caliper is retained by two bolts.
2 The caliper units should be removed for overhaul if there has been any evidence of weeping from the seals. Note that seals can sometimes leak enough to admit air to the system without allowing the fluid to leak out. Whatever the case, immediate investigation is warranted. Start by disconnecting the brake pipe at the caliper gland nut and block the open pipe end with a suitable wooden or rubber plug. This will prevent the ingress of contaminants and the loss of hydraulic fluid.
3 Take great care during the dismantling and reassembly sequences, that no hydraulic fluid is allowed to come into contact with any painted or plastic parts. It will quickly destroy both of these surfaces, and if accidentally splashed, should be washed off immediately. Remove the plastic caliper cover and the pads as described in Routine Maintenance.
4 Remove the two socket screws which retain the caliper halves, to give access to each piston assembly. Remove the dust seal and withdraw the piston and seals from each side. If the pistons are difficult to extract, wrap the caliper in thick rag and apply compressed air to the fluid passage to force the pistons out. Examine all the components carefully. The seals should be renewed as a matter of course. The working surface of the piston should be highly polished with no scores or corroded areas. If these are evident, the piston must be renewed or it will rapidly destroy the new seals. The caliper bores are least likely to exhibit signs of wear or corrosion damage but if such evidence is present, it will necessitate renewal of the caliper body as a unit.
5 The component parts should be cleaned thoroughly with new brake fluid prior to reassembly. On no account use petrol (gasoline) or paraffin (kerosene) as these will ruin the seals. Reassemble, by reversing the dismantling sequence, ensuring that all parts are kept clinically clean. Lubricate the seal and piston with hydraulic fluid prior to fitting them to the caliper. Make sure that the brake pipe is fitted correctly. Before using the machine, bleed the brake system. See Section 9.

7 Front brake master cylinder: removal, examination and refitting

1 To dismantle the system, attach clear tubing to the bleed nipple of each of the brake calipers, open the nipples by one full turn, and apply the front brake lever repeatedly to expel all the fluid. When no more fluid can be seen issuing from the nipples, tighten down each one. Slacken and remove the single screw which retains the twistgrip top cover, then remove the cover and disconnect the throttle cable. Unscrew the single clamping screw and withdraw carefully the

Fig. 9.2 Brake caliper

1 *Caliper assembly*
2 *Bolt*
3 *Seal kit*
4 *Washer*
5 *Brake pads*
6 *Cover*
7 *Bleed nipple*
8 *Dust cap*
9 *Pad retaining pins and spring*



right-hand switch cluster from the rear of the twistgrip assembly.
2 Note that the master cylinder and fluid reservoir can be detached from the main handlebar unit by removing the two small Allen screws, or the entire unit can be removed from the handlebars by disconnecting the stop lamp front switch wire and the brake hose, by removing the handlebar end weight (where fitted) and slackening the single clamp screw.
3 Disconnect the brake hose either at the master cylinder end or (after removing the handlebar panel) at the union above the steering head. In either case place clean rags or similar around the area of the union to prevent brake fluid splashing on to any other components, particularly those that are painted or made of plastic.
4 With the master cylinder assembly disconnected and removed from the handlebar unit, remove the retaining screws and withdraw the reservoir cap with its gasket (fitted on early 100 models only) and diaphragm. If necessary, the reservoir body can be separated from the master cylinder by removing the single retaining screw and pulling off the reservoir with a twisting motion as if unscrewing it. The sealing O-ring fitted to the reservoir joint must be renewed whenever it is disturbed, regardless of its apparent condition.
5 Using a suitable sharp-pointed instrument, prise out the circlip from the master cylinder right-hand end, then pull out the piston assembly and return spring. Examine all the components closely, renewing any that are found to be worn or in any way damaged. Remember that it is essential that the master cylinder is maintained at peak efficiency if the brakes are to be in a safe and usable condition.
6 When purchasing new components note that the reservoir cover has been modified twice on early 100 models to improve its sealing properties; the second modification included the omission of the cover gasket, which applies to all 75 models. The piston assembly was also modified on early 100 models; only use the modified type of piston (identified by its dark grey coating as opposed to the earlier golden yellow finish) which is fitted as standard to all 75 models.
7 Carefully clean and lubricate all components prior to reassembly, using only clean hydraulic fluid. Reassembly is the reverse of the dismantling procedure described above, remembering that the use of new seals is recommended at all applicable joints and brake hose unions. Refill the system and remove all traces of air bubbles by bleeding as described in Section 9, then wash off any surplus brake fluid using copious quantities of fresh water and check for any fluid leaks which may subsequently appear.
8 Remember to check that the throttle cable is adjusted correctly and functioning properly, that any disturbed electrical circuits are operating correctly, that all the nuts and bolts are securely fastened, and that the brakes themselves are operating correctly and efficiently before the machine is taken out on the road.

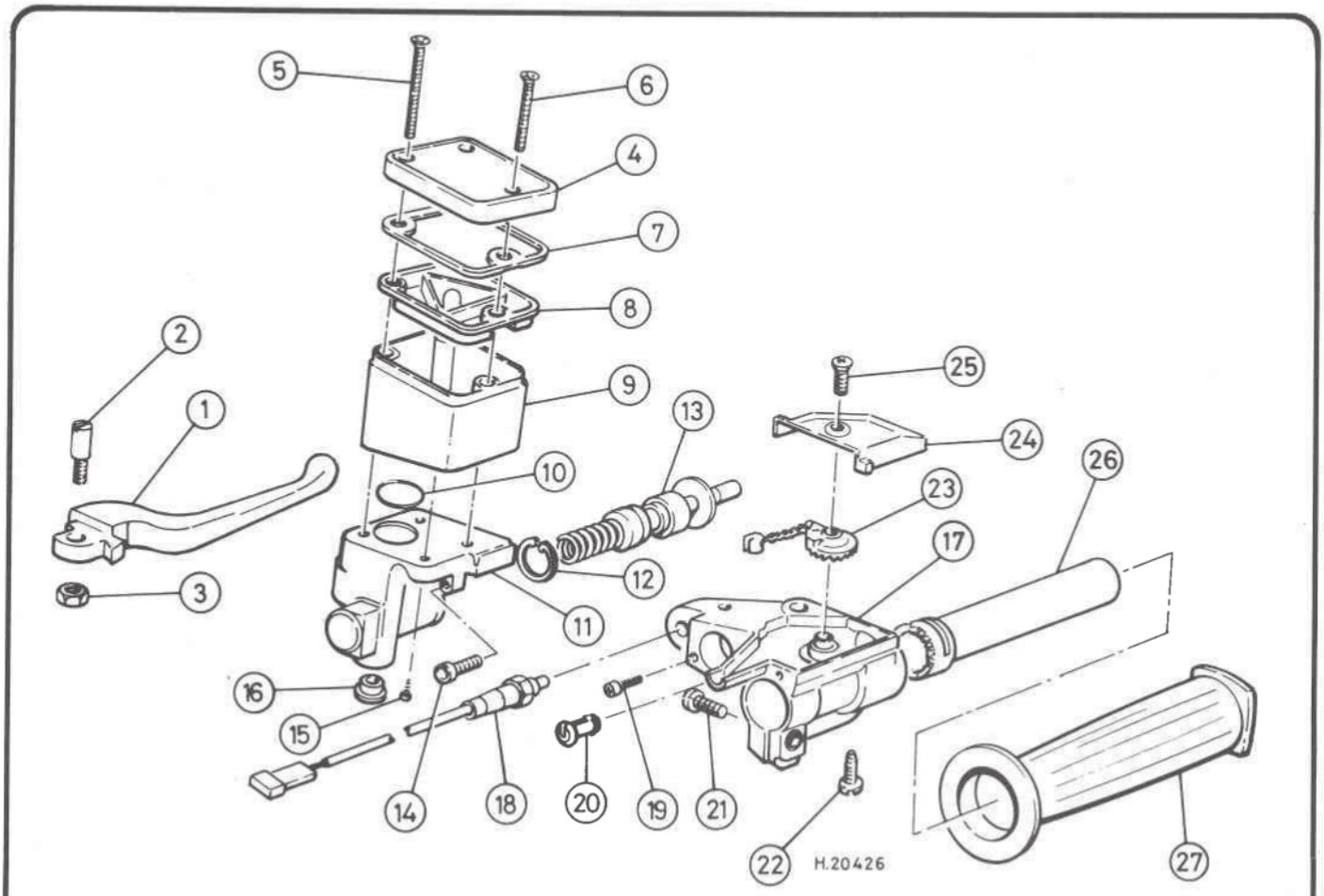


Fig. 9.3 Front brake master cylinder

1 *Brake lever*
2 *Pivot bolt*
3 *Nut*
4 *Reservoir cap*
5 *Screw – 2 off*
6 *Screw*
7 *Gasket (where fitted)*
8 *Rubber diaphragm*
9 *Fluid reservoir*
10 *O-ring*
11 *Master cylinder*
12 *Circlip*
13 *Piston assembly*
14 *Allen screw*
15 *Screw*
16 *Plug*
17 *Throttle twistgrip unit*
18 *Brake stop lamp switch*
19 *Screw*
20 *Cable support*
21 *Screw*
22 *Locking bolt – 100 models only*
23 *Throttle cable pulley*
24 *Twistgrip top cover*
25 *Screw*
26 *Twistgrip inner sleeve*
27 *Twistgrip rubber*

8 Rear disc brake master cylinder: removal, examination and refitting

1 To remove the master cylinder, attach a clear plastic tube to the caliper bleed nipple, open the bleed nipple by one full turn, and drain the fluid from the system by operating the brake pedal until no more fluid can be seen issuing from the nipple.
2 While the right-hand footrest plate is still attached to the gearbox housing, slacken the locknut securing the master cylinder adjuster to the brake pedal, the brake pedal pivot nut and bolt and the two screws securing the master cylinder to the footrest plate.
3 Withdraw the right-hand side panel and remove the single bolt or nut which secures the fluid reservoir to the battery carrier. Disconnect the fluid reservoir/master cylinder pipe at the hose clamp on the master cylinder top and withdraw the fluid reservoir.
4 Remove its retaining Allen screws or bolts and withdraw the footrest plate, then unscrew the retaining nut and dismantle the brake pedal pivot. Unscrew the pedal from the adjuster, if required, otherwise peel off the rubber dust cover from the front of the master cylinder and withdraw the pedal and adjuster.
5 Disconnect the brake hose at either end, then remove the master cylinder retaining screws and withdraw the cylinder assembly.
6 With the dust cover removed, clean the master cylinder and look carefully for the fastener which secures the piston components. A circlip is usually fitted which can be removed with circlip pliers or prised out with a sharply-pointed instrument, depending on the type used. If the piston components cannot be extracted easily, take the assembly to an authorised BMW dealer and seek expert advice. Note however, particularly on very early K100 and K100 RS models, that if the master cylinder components are sticking or appear badly corroded, the complete assembly should be renewed. Unless the cylinder bore is in perfect condition, merely renewing the piston seals will not provide a safe long term repair; if there is the slightest doubt about any of the

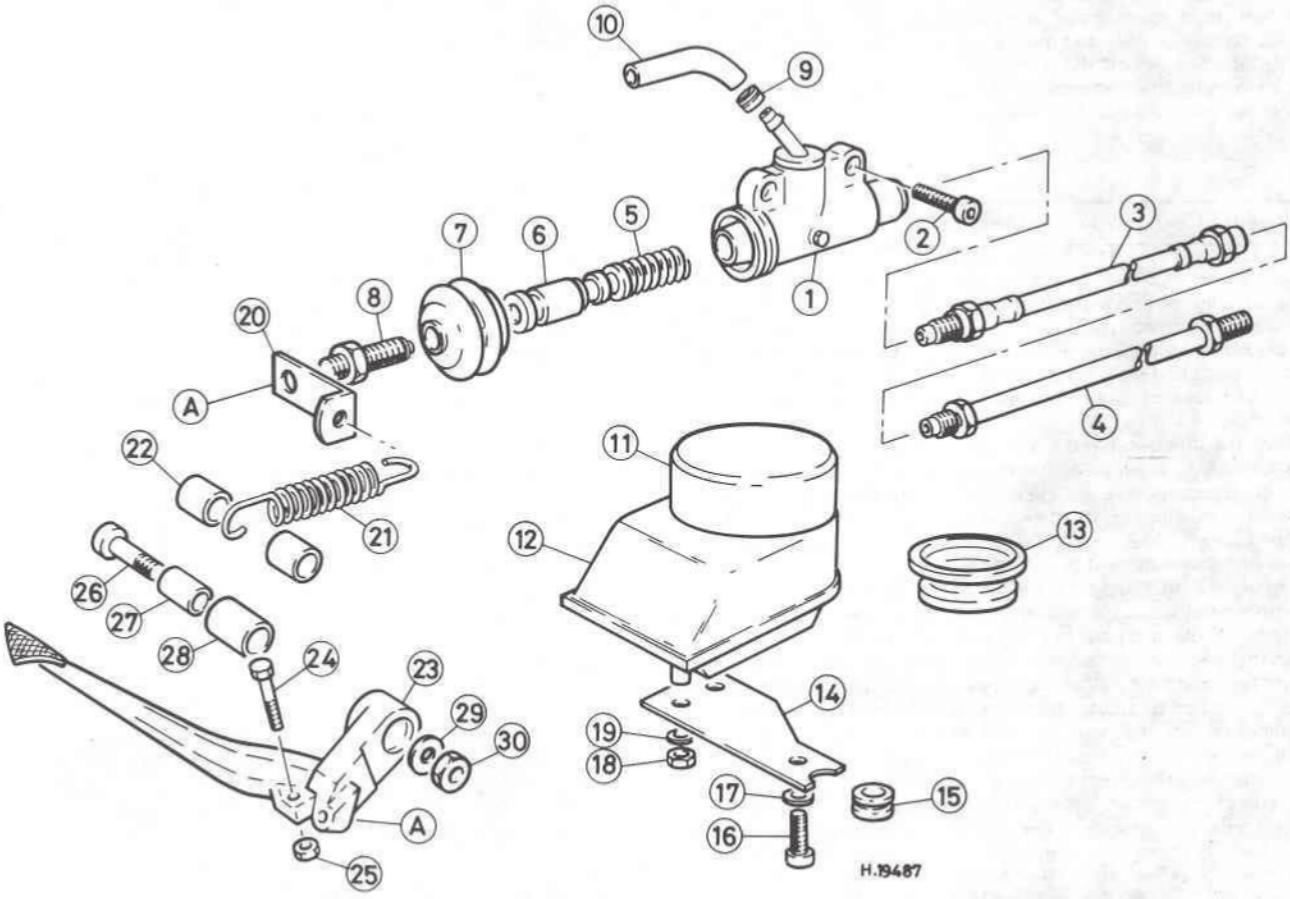


Fig. 9.4 Rear brake master cylinder

1 *Master cylinder*
2 *Bolt – 2 off*
3 *Brake hose*
4 *Brake pipe*
5 *Spring*
6 *Piston assembly*
7 *Dust cover*
8 *Adjusting screw*
9 *Clamp – 2 off*
10 *Fluid hose*
11 *Reservoir cap*
12 *Fluid reservoir*
13 *Rubber diaphragm*
14 *Mounting bracket*
15 *Grommet*
16 *Bolt*
17 *Washer*
18 *Nut – 2 off*
19 *Washer – 2 off*
20 *Bracket*
21 *Return spring*
22 *Bush – 2 off*
23 *Brake pedal*
24 *Bolt*
25 *Nut*
26 *Pivot bolt*
27 *Inner sleeve*
28 *Bush*
29 *Washer*
30 *Nut*

components of a brake system they should be renewed for safety's sake.

7 Carefully examine the seals and piston, renewing them if there is the slightest doubt about their condition, although the seals should be renewed as a matter of course whenever they are disturbed. If the slightest trace of damage is found in the master cylinder bore, the master cylinder should be renewed as a complete assembly.

8 Carefully clean each component and lubricate it with clean hydraulic fluid, then reassemble and refit the assembly following the reverse of the above instructions. To prevent water which leaks past the rubber dust cover from causing corrosion to form around the piston front end, pack the recess at the front of the master cylinder outside with silicone grease or a similar waterproofing agent which will not attack the rubber seals. Refit the dust cover. Pack the brake pedal pivot components with the specified grease (see Routine Maintenance) on reassembly.

9 Refill the system with clean brake fluid and bleed it, as described in Section 9 to remove all traces of air. Wash off all surplus hydraulic fluid and check that the brake operates correctly and efficiently before using the machine on the road.

10 When refitting the brake pedal note that its height can be adjusted via the threaded adjuster and locknut, but check always that there is free play (which is measured most easily at the pedal tip) between the end of the adjuster and the piston. While BMW do not specify the required free play, there should be a very small amount discernible at all times or severe brake drag will result.

9 Bleeding the hydraulic brake system

1 The method of bleeding a brake system of air as described below applies equally to either the front brake or to a rear brake of the hydraulically actuated type.

2 If the brake action becomes spongy, or if any part of the hydraulic system is disturbed it is necessary to bleed the system in order to remove all traces of air. The procedure is best carried out by two people.

3 Check the fluid level in the reservoir and top up with new fluid of the specified type, if required. Keep the reservoir at least half full during the bleeding procedure; if the level is allowed to fall too far air will enter the system requiring that the procedure be started again from scratch. Refit the cap onto the reservoir to prevent the ingress of dust or the ejection of a spout of fluid.

4 Remove the dust cap from the caliper bleed nipple and clean the area with a rag. Place a clean glass jar below the caliper and connect a pipe from the bleed nipple to the jar. A clear plastic tube should be used so that the air bubbles can be more easily seen. When working on the front brakes it may well prove necessary to connect both nipples at the same time and to operate them simultaneously. Pour enough clean hydraulic fluid into the jar(s) to immerse the end of the pipe; ensure that the pipe end remains submerged (to stop air returning into the system whenever the pressure is released) throughout the operation.

5 If parts of the system have been renewed, so that it must first be filled, open the bleed nipple about one turn and pump the brake lever until fluid starts to issue from the clear tube. Tighten the bleed nipple and then continue the normal bleeding operation as described below. Keep a close check on the reservoir level whilst the system is being filled.

6 Apply the brake as firmly as possible and hold it in this position against the fluid pressure. If the brake feels spongy it may be necessary to pump it rapidly a number of times until pressure is built up. With pressure applied, loosen the bleed nipple about half a turn. Tighten the nipple as soon as the brake lever or pedal has reached its full travel and then release. Repeat this operation until no more air bubbles are expelled with the fluid into the glass jar. When this condition is reached, the air bleeding operation should be complete, resulting in a firm feel to the brake lever or pedal. If sponginess is still evident, continue the bleeding operation; it may be that an air bubble trapped at the top of the system has yet to work down through the caliper.

7 The description above is an outline of what can be a very time-consuming operation; great care and patience should be exercised at all times. When working on the front brakes note that if the forks are held on full left lock the master cylinder becomes the highest point in the system; this may help to clear a bubble. On the rear brake the caliper can be dismounted and hung from the frame seat tubes (with a spacer wedged between its pads and care taken not to distort or damage the brake hose and pipe) to achieve a similar result. Note also that at approximately half the lever or pedal travel air bubbles can escape from the system back into the fluid reservoir; repeated, gentle applications of the lever or pedal to this point may well release a quantity of air.

8 In particularly stubborn cases bubbles may be released by tapping the brake pipes and hoses lightly or by topping up the reservoir and operating the brake rapidly (without splashing fluid or allowing air into the system) until the reservoir is nearly empty, to flush the system through. In some cases the only answer is to remove as much air as possible and then to leave the machine overnight (ensuring that the system is fully sealed against the entry of dirt or moisture by refitting the reservoir cap or cover and tightening the bleed nipples) so that the remaining air will build up into one bigger bubble at the top of the system.

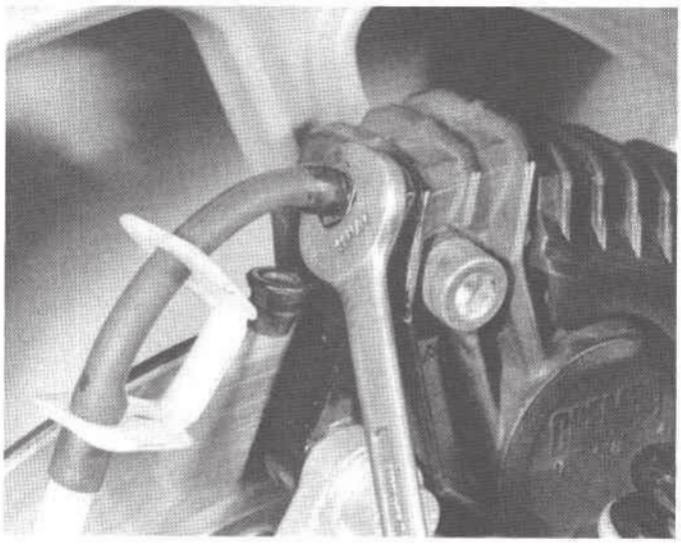
9 **Note:** A spongy brake can also be caused by fluid that has not been renewed at the required annual interval and has badly deteriorated, by defective brake hoses, by defective master cylinder or caliper seals or by a caliper piston that it sticking due to corrosion. All these points should be checked carefully if the brake remains spongy after thorough bleeding.

10 **Do not** confuse excessive lever or pedal travel with a spongy feel; if the brake discs are excessively warped, for example, or if the calipers or discs are not securely fastened, the brake pads and caliper pistons will be knocked back away from the disc as the wheel rotates. This will cause a marked increase in lever or pedal travel before normal pressure is achieved; when riding the difference may not be noticed. Disc runout should be checked carefully (see Section 5), as should the security of the brake system component mountings.

11 When all traces of air have been removed from the system, top up the reservoir and refit the diaphragm and cap or cover. Check the entire system for leaks, and check also that the brake system in general is functioning efficiently before using the machine on the road.

12 Brake fluid drained from the system will almost certainly be contaminated, either by foreign matter or more commonly by the absorption of water from the air. All hydraulic fluids are hygroscopic, that is, they are capable of drawing water from the atmosphere, and thereby degrading their specifications. In view of this, and the relative cheapness of the fluid, old fluid should always be discarded.

13 Great care should be taken not to spill hydraulic fluid on any painted cycle parts; it is a very effective paint stripper. Also, the plastic glasses in the instrument heads, and most other plastic parts, will be damaged by contact with the fluid.



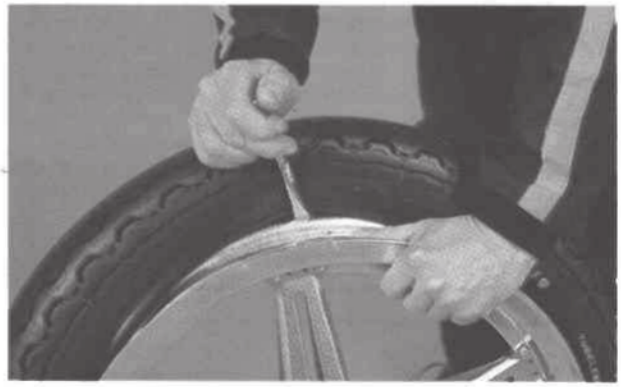
9.4 Be careful not to overtighten bleed nipples – use specified torque setting, where available



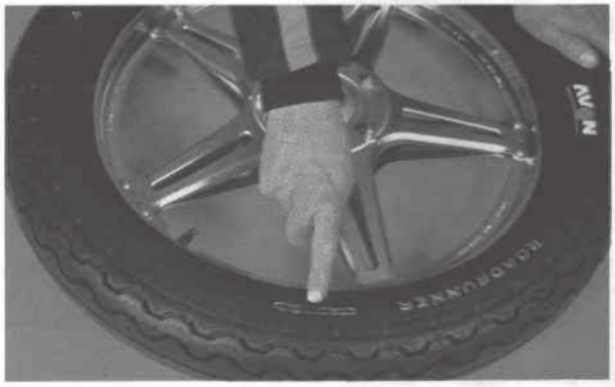
Tyre removal: Deflate tyre and insert lever in close proximity to tyre valve



Use two levers to work bead over tyre rim



When first bead is clear, remove tyre as shown



Tyre fitting: Replace first bead over rim noting arrow indicating correct direction of rotation



Start second bead under the rim opposite the valve



Work bead under rim towards and each side of valve using lever if necessary



Use lever in final section



Air hose may be required for initial tyre inflation

10 Rear drum brake: examination and renovation – K75, K75 C, K75 T

1 Adjust the rear brake (when necessary) and check the remaining thickness of brake shoe friction material as described in Routine Maintenance.
2 If the brake is to be overhauled, first remove the rear wheel. See Section 3.
3 **Note**: Before starting work, use a vacuum cleaner to remove all traces of loose dust, or at least wipe away all traces of dust using a rag well soaked in high flash-point solvent. The brake shoe friction material may contain asbestos which is toxic and especially dangerous when inhaled as loose dust particles, Refer to the warnings given in the Saferty First section of this manual.
4 Unscrew the adjuster nut to release the brake rod. If required, the pedal pivot can be dismantled after the pivot bolt retaining nut has been unscrewed from behind the footrest plate. The pivot bush and sleeve can be checked for wear and renewed if necessary.
5 Withdraw the retaining circlip from the brake shoe pivot and withdraw the brake shoes as a single unit, folding them inwards to form a 'V' to release spring pressure.
6 To ensure that the camshaft is correctly refitted, use a hammer and a punch to mark the shaft at the gap in the operating lever. Remove the operating lever pinch bolt, noting how the wear indicator plate is fitted to the lever, then carefully prise the lever off the camshaft splines. Tap out the camshaft to the left, noting the sealing washer at its right-hand end, the two O-rings, and the flat washer at its left-hand end.
7 If the brake shoe friction material is damaged, fouled with grease or oil, or worn at any point to a thickness of 1.5 mm (0.06 in) or less, the shoes must be renewed. If the friction material is still serviceable, clean the shoes thoroughly using a soft wire brush that is free from oil or grease and remove any areas of glazing using emery cloth. Check carefully that the shoe ends are smooth and unworn.
8 Examine the return springs with great care and renew them if there is the slightest doubt about their condition or if they show signs of stretching, fatigue, or wear. Later models will have a rubber damper fitted around the rearmost (camshaft side) return spring to prevent any risk of the spring vibrating to the point of breaking, a problem which also produces severe brake squeal. If a machine is found without a rubber damper, one should be fitted on reassembly; since two different types of damper are available, the brake shoes must be taken to an authorised BMW dealer for the correct type to be identified. Note that BMW also recommend that both return springs must be renewed whenever an unmodified machine is found.
9 Clean thoroughly and check for wear or damage to the brake drum interior and the final drive housing (noting the warning above about dust particles), the brake shoe fixed pivot and the camshaft and operating lever components. If any component is found to be faulty it must be renewed. Check particularly the camshaft and pivot bearing surfaces and the fit of the camshaft in its passage through the final drive housing. The camshaft sealing O-rings should be renewed whenever they are disturbed. If any sign of oil leakage is found the defective seal must be found and renewed. See Chapter 8.
10 Examine the drum surface. Scrape off any deposits of dirt, brake dust or rust and wipe the surface with a rag soaked in high flash-point solvent. If the necessary equipment is available, measure the drum's inside diameter at several points to check for ovality; none should be discernible. If the drum is heavily scored it can be reclaimed only by skimming on a lathe, a task which can be undertaken only by an expert

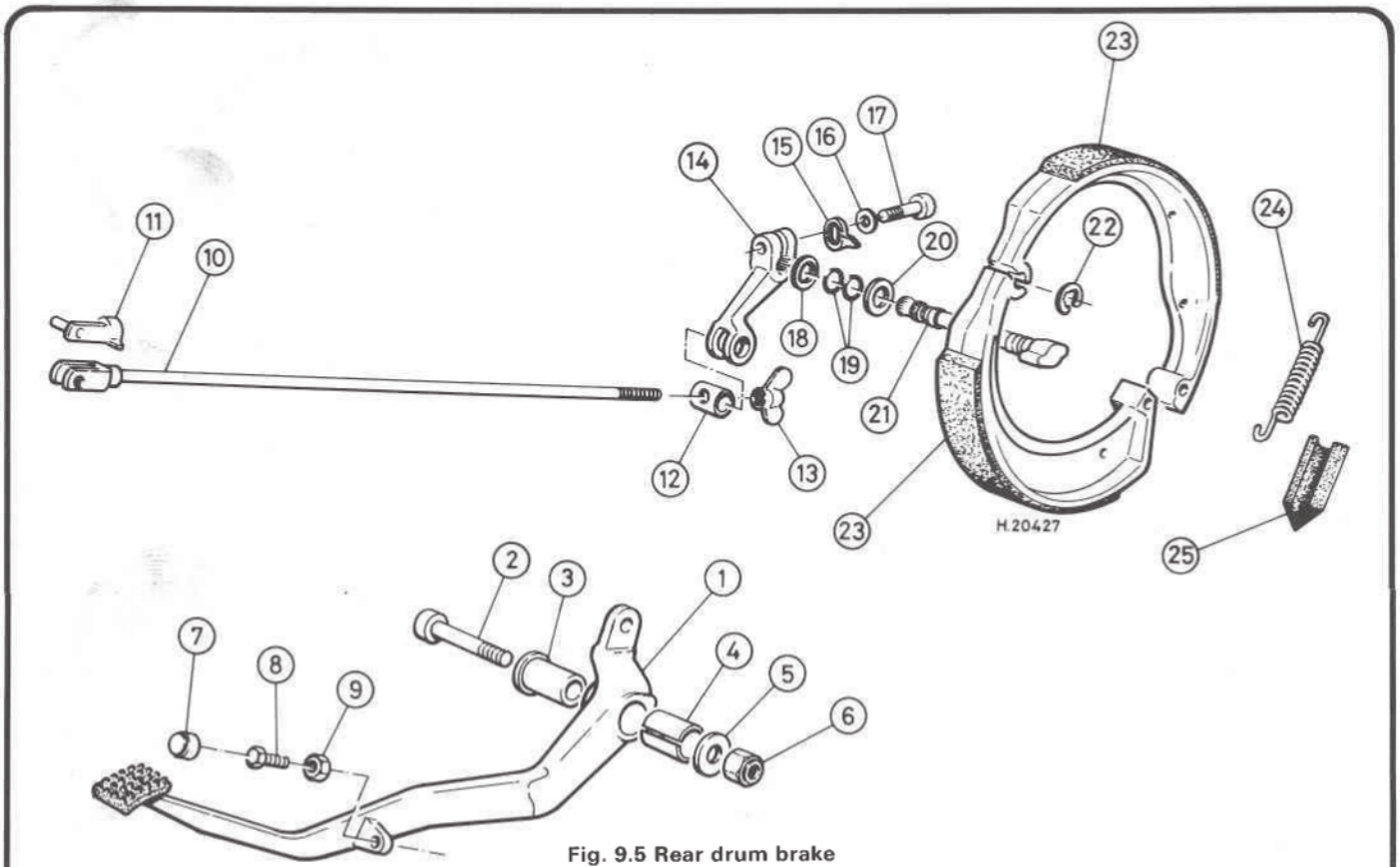


Fig. 9.5 Rear drum brake

1 *Brake pedal*
2 *Pivot bolt*
3 *Inner sleeve*
4 *Bush*
5 *Washer*
6 *Nut*
7 *Cap*
8 *Bolt*
9 *Nut*
10 *Brake rod*
11 *Retaining pin*
12 *Trunnion*
13 *Adjuster nut*
14 *Operating lever*
15 *Wear indicator pointer*
16 *Washer*
17 *Pinch bolt*
18 *Sealing washer*
19 *O-ring – 2 off*
20 *Metal washer*
21 *Camshaft*
22 *Circlip*
23 *Brake shoes*
24 *Return spring – 2 off*
25 *Rubber damper*

who has the necessary equipment. If the drum is worn at any point to the specified service limit or beyond, or if skimming will enlarge it to a similar degree, the rear wheel must be renewed.

11 On reasembly, fit the new camshaft sealing O-rings to their grooves and apply a coat of the specified grease to the bearing surfaces of the camshaft and its passage and to the fixed pivot. Refit the camshaft with its flat washer on its left-hand end; ensure that it is well greased, that the O-rings are not disturbed and that the sealing washer is pressed into place on its right-hand end. Rotate the camshaft so that the alignment mark made on removal is uppermost, then tap the operating lever onto its splines so that the mark aligns with the lever split. If the shoes are to be renewed, do not refit the pinch bolt yet.

12 Hook the return springs on to the shoes from left to right ie so that the springs are on the left-hand (wheel) side of the shoes. Apply a thin smear of grease to the shoe ends, fold them together and refit them to the fixed pivot and camshaft. Check that the shoes are securely and correctly positioned then wipe off all surplus grease and refit the retaining circlip to the fixed pivot. Fit the rubber damper to the rearmost (camshaft side) return spring so that the damper flat rear face touches the brake shoes and cam, and its chamfered side face is towards the wheel. Refit the rear wheel.

13 If the original shoes have been refitted, install the wear indicator plate and operating lever exactly as they were removed, adjust the rear brake and check that the brake operates correctly and that the rear wheel is free to rotate smoothly and easily.

14 If new shoes have been fitted, first check that the brake pedal height setting is correct (see Routine Maintenance) and connect the brake rod to the operating lever so that the angle between them is more than 90° when the brake is correctly adjusted and fully applied. See Routine Maintenance for details of this procedure, which may involve the repositioning of the operating lever on the camshaft splines.

15 When the operating mechanism is correctly set and adjusted, position the wear indicator plate pointer to align with the upper (Maximum) wear limit line on the final drive housing when the brake is fully applied. Hold the indicator plate steady while tightening securely the operating lever pinch bolt, do not disturb the plate after this without first marking its exact position on the operating lever. Check the rear brake adjustment and that the brake works correctly, also that the rear wheel is free to rotate smoothly and easily.

11 Tyres: removal and refitting

1 It is strongly recommended that should a repair to a tubeless tyre be necessary, the wheel is removed from the machine and taken to a tyre fitting specialist who is willing to do the job or taken to an authorised BMW dealer. This is because the force required to break the seal between the wheel rim and tyre bead is considerable and considered to be beyond the capabilities of an individual working with normal tyre removing tools. Any abortive attempt to break the rim to bead seal may also cause damage to the wheel rim, resulting in an expensive wheel replacement. If, however, a suitable bead releasing tool is available, and experience has already been gained in its use, tyre removal and refitting can be accomplished as follows.

2 Remove the wheel from the machine as described in Sections 2 or 3, as appropriate. Deflate the tyre by removing the valve insert and when it is fully deflated, push the bead of the tyre away from the wheel rim on both sides so that the bead enters the centre well of the rim. As noted, this operation will almost certainly require the use of a bead releasing tool.

3 Insert a tyre lever close to the valve and lever the edge of the tyre over the outside of the wheel rim. Very little force should be necessary: if resistance is encountered it is probably due to the fact that the tyre beads have not entered the well of the wheel rim all the way round the tyre. Should the initial problem persist, lubrication of the tyre bead and the inside edge and lip of the rim will facilitate removal. Use a recommended lubricant, a diluted solution of washing-up liquid or french chalk. Lubrication is usually recommended as an aid to tyre fitting but its use is equally desirable during removal. The risk of lever damage to wheel rims can be minimised by the use of proprietary plastic rim protectors placed over the rim flange at the point where the tyre levers are inserted. Suitable rim projectors may be fabricated very easily from short lengths (4 – 6 inches) of thick-walled nylon petrol pipe which have been split down one side using a sharp knife. The use of rim protectors should be adopted whenever levers are used and, therefore, when the risk of damage is likely.

4 Once the tyre has been edged over the wheel rim, it is easy to work around the wheel rim so that the tyre is completely freed on one side.

5 Working from the other side of the wheel, ease the other edge of the tyre over the outside of the wheel rim, which is furthest away. Continue to work around the rim until the tyre is freed completely from the rim.

6 Refer to the following Section for details relating to puncture repair and the renewal of tyres. Check with the importer or with a BMW dealer for a list of approved makes and types of tyre before purchasing; fit only those recommended. See also the remarks relating to the tyre valves in Section 13.

7 Refitting of the tyre is virtually a reversal of removal procedure. If the tyre has a balance mark (usually a spot of coloured paint) indicating its lightest point, as on the tyres fitted as original equipment, this must be positioned alongside the valve. Similarly any arrow indicating direction of rotation must be fitted pointing the right way. If only one arrow is found this must be fitted pointing in the direction of rotation on **rear** wheels, but **opposite** to the direction of rotation, to accept braking loads, on **front** wheels. Where two arrows (marked 'Front wheel' and 'Rear wheel') are provided, fit the tyre as indicated by them.

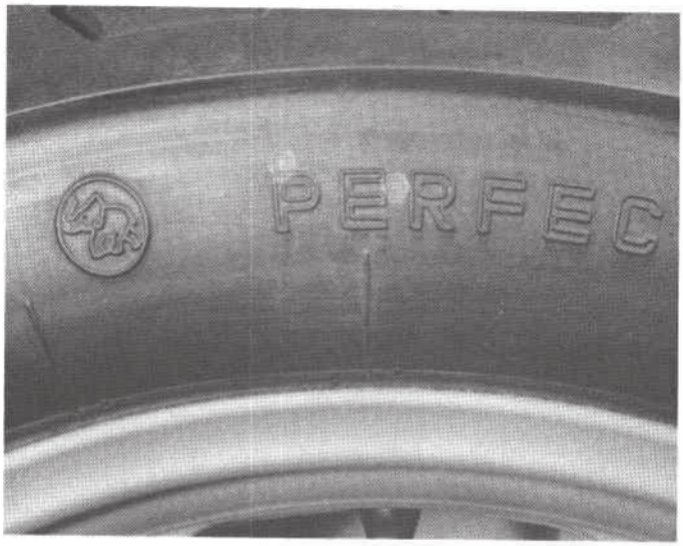
8 Starting at the point furthest from the valve, push the tyre bead over the edge of the wheel rim until it is located in the central well. Continue to work around the tyre in this fashion until the whole of one side of the tyre is on the rim. It may be necessary to use a tyre lever during the final stages. Here again, the use of a lubricant will aid fitting. It is recommended strongly that when refitting the tyre only a recommended lubricant is used because such lubricants also have sealing properties. Do not be over generous in the application of lubricant or tyre creep may occur.

9 Fitting the upper bead is similar to fitting the lower bead. Start by pushing the bead over the rim and into the well at a point diametrically opposite the tyre valve. Continue working round the tyre, each side of the starting point, ensuring that the bead opposite the working area is always in the well. Apply lubricant as necessary. Avoid using tyre levers unless absolutely essential, to help reduce damage to the soft wheel rim. The use of the levers should be required only when the final portion of bead is to be pushed over the rim.

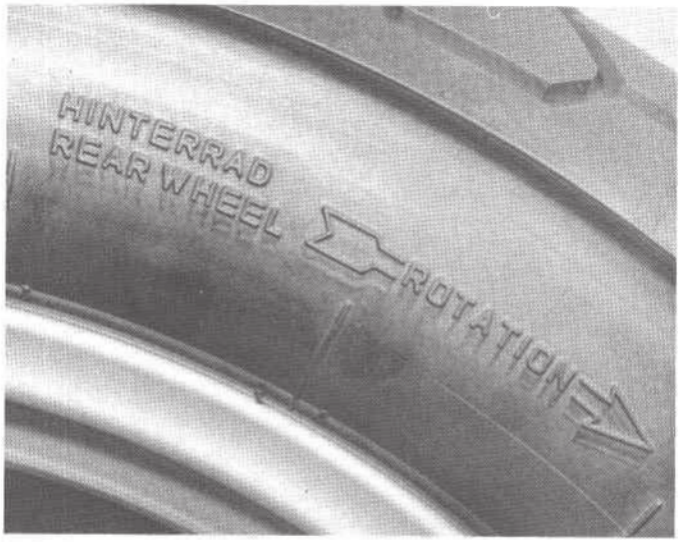
10 Lubricate the tyre beads again prior to inflating the tyre, and check that the wheel rim is evenly positioned in relation to the tyre beads. Inflation of the tyre may well prove impossible without the use of a high pressure air hose. The tyre will retain air completely only when the beads are firmly against the rim edges at all points and it may be found when using a foot pump that air escapes at the same rate as it is pumped in. This problem may also be encountered when using an air hose on new tyres which have been compressed in storage and by virtue of their profile hold the beads away from the rim edges. To overcome this difficulty, a tourniquet may be placed around the circumference of the tyre, over the central area of the tread. The compression of the tread in this area will cause the beads to be pushed outwards in the desired direction. The type of tourniquet most widely used consists of a length of hose closed at both ends with a suitable clamp fitted to enable both ends to be connected. An ordinary tyre valve is fitted at one end of the tube so that after the hose has been secured around the tyre it may be inflated, giving a constricting effect. Another possible method of seating beads to obtain initial inflation is to press the tyre into the angle between a wall and the floor. With the airline attached to the valve additional pressure is then applied to the tyre by the hand and shin, as shown in the accompanying illustration. The application of pressure at four points around the tyre's circumference whilst simultaneously applying the airhose will often effect an initial seal between the tyre beads and wheel rim, thus allowing inflation to occur.

11 Having successfully accomplished inflation, increase the pressure to 40 psi and check that the tyre is evenly disposed on the wheel rim. This may be judged by checking that the thin positioning line found on each tyre wall is equidistant from the rim around the total circumference on the tyre. If this is not the case, deflate the tyre, apply additional lubrication and reinflate. Minor adjustments to the tyre position may be made by bouncing the wheel on the ground.

12 Always run the tyre at the recommended pressures and never under or over-inflate. The correct pressures for original equipment tyres are given in the Specifications Section of this Chapter; check with the tyre manufacturers (if non-standard tyres are fitted) and use their recommended pressures, if different.



11.7a Spots of paint usually indicate tyre's lightest point (check with manufacturer) – align with tyre valve on refitting



11.7b Arrows on tyre sidewall indicate direction of rotation – see text

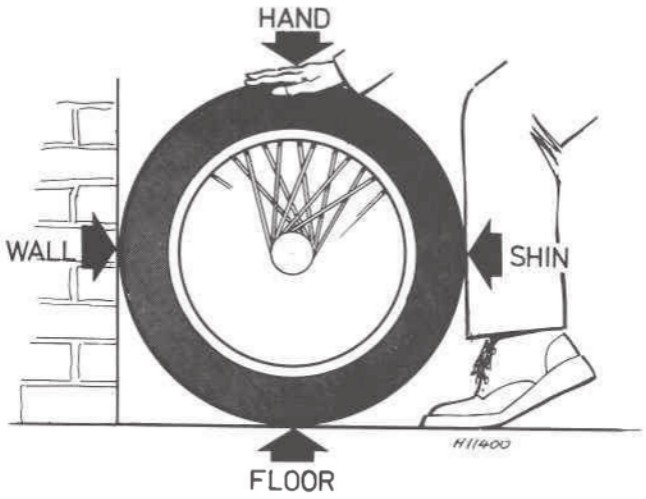


Fig. 9.6 Method of seating the beads on tubeless tyres

12 Puncture repair and tyre renewal: general

1 If a puncture occurs, the tyre should be removed for inspection for damage before any attempt is made at remedial action. The temporary repair of a punctured tyre by inserting a plug from the outside should **not** be attempted. Although this type of temporary repair is used widely on cars, the manufacturers strongly recommend that no such repair is carried out on a motorcycle tyre. Not only does the tyre have a thinner carcass, which does not give sufficient support to the plug, the consequences of a sudden deflation are often sufficiently serious that the risk of such an occurrence should be avoided at all costs.

2 The tyre should be inspected both inside and out for damage to the carcass. Unfortunately the inner lining of the tyre – which takes the place of the inner tube – may easily obscure any damage and some experience is required in making a correct assessment of the tyre condition.

3 There are two main types of tyre repair which are considered safe for adoption in repairing tubeless motorcycle tyres. The first type of repair consists of inserting a mushroom-headed plug into the hole from the inside of the tyre. The hole is prepared for insertion of the plug by reaming and the application of an adhesive. The second repair is carried out by buffing the inner lining in the damaged area and applying a cold or vulcanised patch. Because both inspection and repair, if they are to be carried out safely, require experience in this type of work, it is recommended that the tyre be placed in the hands of a repairer with the necessary skills, rather than repaired in the home workshop.

4 BMW provide an emergency repair kit for tubeless tyres as part of the machine's toolkit. This can be used, following the instructions provided, to repair holes up to 4 mm (0.16 in) in diameter but note that a repaired tyre should not be ridden above 37 mph (60 km/h) or for more than 250 miles (400 km). The kit is an emergency repair only; the tyre should be renewed as a safety precaution as soon as possible.

5 Owners stranded with no means of repairing a punctured tubeless tyre should note that the commonly-used trick of fitting a tube is not recommended by BMW or by the tyre manufacturers. If such a course of action is adopted as an emergency repair, against this advice, note that the cause of the puncture must be removed first, the tube valve stem must be supported in the rim by the fitting of a suitable spacer and the machine must be ridden as slowly as possible so as not to cause overheating of the tube. Certain makes of tubeless tyre use large internal supporting ribs which will rapidly destroy an inner tube due to chafing.

6 **The fitting of tubed tyres to these wheels is not recommended.**

13 Tyre valves: examination and renewal

1 Valve cores seldom give trouble, but do not last indefinitely. Dirt under the seating will cause a puzzling 'slow-puncture'. Check that they are not leaking by applying spittle to the end of the valve and watching for air bubbles.

2 The valve core is of the same type as that used with tubed tyres, and screws into the valve body. The core can be removed with a small slotted tool which is normally incorporated in plunger type pressure gauges. Some valve dust caps incorporate a projection for removing valve cores.

3 If the core is proved to be sound, make a similar check to ensure that air is not leaking from the valve body or from its sealing face. If this is found to be the case, the valve must be renewed, although it is worth checking that the early threaded-type valve's retaining nut (where fitted) is securely fastened.

4 To renew a valve, remove the wheel from the machine (Section 2 or 3) and take off the tyre (Section 11). On the early threaded-type valve

unscrew the locking nut to release the valve and ensure that it is securely fastened on reassembly. The later car-type rubber-bodied valve (fitted to all models after mid-1986) must be removed by cutting off its inner retaining shoulder and pulling the remains out of the rim. To fit a new valve, lubricate it thoroughly and push it through the rim from the outside towards the centre (having first removed its cap). It must then be drawn into place by screwing the correct tool on to its threaded end to provide purchase (the tool should be available at any tyre-fitting establishment). If great care is taken to avoid crushing the valve end it is possible to screw a suitably-sized nut on to the valve threads and to grip this with a large pair of pliers. Check that the rubber locating shoulders lock securely into place on each side of the rim. Refit the tyre and wheel.

5 A valve cap is a safety device, and should always be fitted. Apart from keeping dirt out of the valve, it provides a second seal in case of valve failure, and may prevent an accident resulting from sudden deflation.

14 Wheel balancing: general

1 It is customary on all high performance machines to balance the wheels complete with tyres and tube. The out of balance forces which exist are eliminated and the handling of the machine is improved in consequence. A wheel which is badly out of balance produces through the steering a most unpleasant hammering effect at high speeds.

2 Some tyres have a balance mark on the sidewall, usually in the form of a coloured spot. This mark must be in line with the tyre valve. Refer to Section 11. Even then the wheel may require the addition of balance weights, to offset the weight of the tyre valve itself.

3 If the wheel is raised clear of the ground and is spun, it will probably come to rest with the tyre valve or the heaviest part downward and will always come to rest in the same position. Balance weights must be added to a point diametrically opposite this heavy spot until the wheel will come to rest in ANY position after it is spun.

4 The wheels should be removed from the machine and mounted on a stand to eliminate brake or final drive drag. Weights are available from BMW in 5, 10, 15, 20, 25 and 30 gram sizes; these are attached to the rim by a spring clip, using special pliers, on early 100 models. On later 100 models and all 75 models a similar range of weights is available which are stuck to the rim with their adhesive backing; these can be fitted to all models and carry no risk of disturbing the tyre/rim seal, although the rim must be absolutely dry, clean, and degreased at the point of contact if the adhesive is to be effective. The weights are stuck to the rim flange, next to the spokes, as shown in the accompanying photographs. **Note:** all models – the sum of the weights fitted to any rim must not exceed 60 grams (2 oz).

5 Most tyre-fitting specialists have wheel-balancing equipment which can be used to balance the wheels in a very short time, making the labour charge reasonable.

Chapter 10 Electrical system

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Specifications

Electrical system	
Voltage	12V
Earth (ground)	Negative (–)
Battery	
Manufacturer	BMW – Mareg
Capacity:	
Standard – models up to 1986	20 Ah
Standard – models from 1987 on	25 Ah
Optional – all models	30 Ah (may be fitted to K100 LT as standard)
Electrolyte specific gravity	1.280 @ 20°C (68°F)
Alternator	
Type	Bosch 0.120.339.546. G1-14V 33A 27
Rated output	460W/14V 33Ah
Reduction ratio	1.5:1
Maximum speed	12 300 rpm
Voltage regulator	Bosch 1.197.311.001. EL 14V 4C
Charge starts at	950 ± 50 rpm
Regulated voltage	13.7 – 14.5 volts
Stator winding resistance – across phase outputs	0.28 ohm ± 10% @ 60°C (140°F)
Resistance between slip rings – exciter winding	4.0 ohm ± 10% @ 60°C (140°F)
Stator/rotor air gap	0.22 mm (0.0087 in)
Rotor maximum runout at claw poles	0.05 mm (0.0020 in)
Slip ring maximum runout	0.03 mm (0.0012 in)
Slip ring OD:	
Standard	27.8 mm (1.0945 in)
Service limit	26.8 mm (1.0551 in)
Brush projection:	
Standard	10 mm (0.3937 in)
Service limit	5 mm (0.1969 in)
Starter motor	
Type	Nippon Denso 028000 – 8990
Power	0.7kW (1 hp)
Reduction ratio – overall	27:1
Lockout effective above	711 rpm
Brush length – see text:	
Standard – approximate	12 mm (0.4724 in)
Service limit	50% of new length
Fuses	
Circuit protected:	**Fuse rating**
1 Instrument cluster, stop and tail lamps	7.5A
2 Parking lamp	7.5A

3 Turn signals, clock	15A
4 Power socket – where fitted	15A
5 Optional extra equipment – where fitted	15A
6 Fuel pump	7.5A
7 Horns, radiator fan	15A

Bulbs

Headlamp	12V, 60/55W
Parking lamps	12V, 4W
Tail lamp	12V, 10W
Stop lamp	12V, 21W
Turn signal lamps	12V, 21W
Turn signal warning lamps	12V, 4W
All other warning and instrument illuminating lamps	12V, 3W

Torque wrench settings

Component	75 models		100 models	
	Nm	lbf ft	Nm	lbf ft
Alternator shock absorber body retaining nut	50 ± 6	37 ± 4.5	31	23
Alternator mounting bolts	22 ± 3	16 ± 2	N/Av	N/Av
Starter motor mounting bolts	7 ± 1	5 ± 0.5	6	4.5

1 General description

The electrical system is powered by a three-phase 12 volt alternator driven from the rear end of the auxiliary drive shaft via a cush-type shock absorber with rubber blocks to damp out shock loads. The alternator is a self-contained unit which includes the diode pack to rectify the output and an electronic voltage regulator, mounted in the brush holder, to control the output which is used to maintain battery charge.

The starter motor drives through a series of reduction gears and a one-way clutch mounted on the auxiliary drive shaft.

Apart from a few components fitted to the more lavishly-equipped models, all models share basically the same electrical system; refer for details to the relevant wiring diagram at the back of this Manual.

2 Electrical system: general information and preliminary checks

1 In the event of an electrical system fault, always check the physical condition of the wiring and connectors before attempting any of the test procedure described here and in subsequent Sections. Look for chafed, trapped or broken electrical leads and repair or renew these as necessary. Leads which have broken internally are not easily spotted, but may be checked using a multimeter or a simple battery and bulb circuit as a continuity tester. This arrangement is shown in the accompanying illustration. The various multi-pin connectors are generally trouble-free but may corrode if exposed to water. Clean them carefully, scraping off any surface deposits, and pack with silicone grease during assembly to avoid recurrent problems. The same technique can be applied to the handlebar switches.

2 A sound, fully charged battery is essential to the normal operation of the system. There is no point in attempting to locate a fault if the battery is partly discharged or worn out. Check battery condition and recharge or renew the battery before proceeding further.

3 Many of the test procedures described in this Chapter require that voltages or resistances be checked. This necessitates the use of some form of test equipment such as a simple and inexpensive multimeter of the type sold by electronics or motor accessory shops.

4 If you doubt your ability to check the electrical system entrust the work to an authorised BMW dealer. In any event have your findings double checked before consigning expensive components to the scrap bin.

5 Note that on these machines many puzzling electrical faults can be caused by poor earths between the engine/transmission unit and the frame, particularly at the bellhousing/frame mountng bracket and the main frame earth. Clean the mating surfaces back to bare metal at these points, scraping away the frame paint, where necessary, and apply a thin coat of silicone grease or similar to prevent corrosion before bolting up the components again.

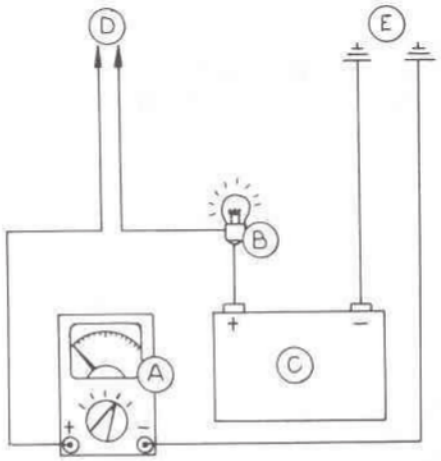


Fig. 10.1 Simple testing apparatus

A Multimeter
B Bulb
C Battery
D Positive probe
E Negative probe

3 Battery: examination and maintenance

1 Details of the regular checks needed to maintain the battery in good condition are given in Routine Maintenance, together with instructions on removal and refitting and general battery care. Batteries can be dangerous if mishandled; read carefully the 'Safety First' section at the front of this Manual before starting work, and always wear overalls or old clothing in case of accidental acid spillage. If acid is ever allowed to splash into your eyes or on to your skin, flush it away with copious quantities of fresh water and seek medical advice immediately.

2 When new, the battery is filled with an electrolyte of dilute sulphuric acid having a specific gravity of 1.280 at 20°C (68°F). Subsequent evaporation, which occurs in normal use, can be compensated for by topping up with distilled or demineralised water only. Never use tap water as a substitute and do not add fresh electrolyte unless spillage has occurred.

3 The state of charge of a battery can be checked using an hydrometer.

4 The normal charge rate for a battery is 1/10 of its rated capacity, thus for a 14 ampere hour unit charging should take place at 1.4 amp. Exceeding this figure can cause the battery to overheat, buckling the plates and rendering it useless. Few owners will have access to an

expensive current controlled charger, so if a normal domestic charger is used check that after a possible initial peak, the charge rate falls to a safe level. If the battery becomes hot during charging **stop**. Further charging will cause damage. Note that cell caps should be loosened and vents unobstructed during charging to avoid a build-up of pressure and risk of explosion.

5 After charging top up with distilled water as required, then check the specific gravity and battery voltage. Specific gravity should be above 1.270 and a sound, fully charged battery should produce 15 – 16 volts. If the recharged battery discharges rapidly if left disconnected it is likely that an internal short caused by physical damage or sulphation has occurred. A new battery will be required. A sound item will tend to lose its charge at about 1% per day.

4 Alternator: general

To avoid damage to the alternator semiconductors, and indeed to many other components, the following precautions should be observed:

a) Do not disconnect the battery or the alternator whilst the engine is running.
b) Do not allow the engine to turn the alternator when the latter is not connected
c) Do not test for output from the alternator by 'flashing' the output lead to earth
d) Do not use a battery charger of more than 12 volts output, even as a starting aid
e) Disconnect the battery and the alternator before carrying out electric arc welding on the vehicle
f) Always observe correct battery polarity

5 Alternator: checking the output

1 The charge warning lamp should light when the ignition is switched on and should remain lit as the engine is started, but should go out as soon as the engine speed increases significantly above idle. If this is not the case, first check the bulb itself and the connections to the instrument panel. Note that the lamp is connected directly to the alternator via the smaller, blue, wire which appears at the alternator connector plug, from the D + terminal. Note also that a faulty charge warning lamp operation is usually (but not always) caused by faulty brushes; a lot of time may be saved if these are checked first. See Section 7.

2 If the fault persists, remove both side panels to expose the battery terminals. Check that the battery and alternator connections are securely fastened and that the battery is fully charged.

3 Accurate assessment of alternator output requires special equipment and a degree of skill. A rough idea of whether output is adequate can be gained by using a voltmeter (range 0 to 15 or 0 to 20 volts) as follows.

4 Connect the voltmeter across the battery terminals. Switch on the lights (UK models only) and note the voltage reading: it should be between 12 and 13 volts.

5 Start the engine and run it at a fast idle (approx 1500 rpm). Read the voltmeter: it should indicate 13 to 14 volts.

6 With the engine still running at a fast idle, switch on as many electrical consumers as possible (lights, stop lamp, turn signals and any accessories). The voltage at the battery should be maintained at 13 to 14 volts. Increase the engine speed slightly if necessary to keep the voltage up.

7 If alternator output is low or zero, check the brushes, as described in Section 7. If the brushes are in good condition the alternator requires attention.

8 Occasionally the condition may arise where the alternator output is excessive. Clues to this condition are constantly blowing bulbs; brightness of lights varying considerably with engine speed; overheating of alternator and battery, possibly with steam or fumes coming from the battery. This condition is almost certainly due to a defective voltage regulator, but expert advice should be sought.

9 Note that the alternator voltage regulator can be renewed without removing the alternator from the machine. The procedure is part of brush renewal (Section 7).

6 Alternator: removal and refitting

1 Remove both side panels and the alternator cover.

2 Remove the fuel injection control unit and storage tray. See Chapter 5. Remove the battery, as described in Routine Maintenance.

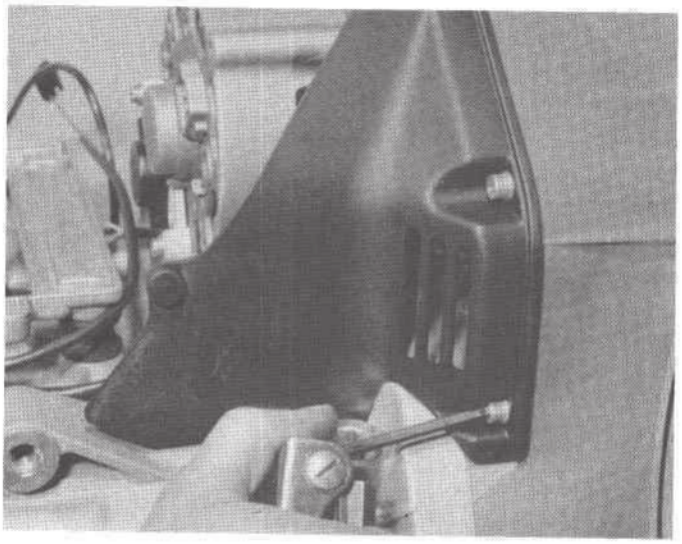
3 Disconnect the connector plug from the alternator rear end, then remove the three mounting bolts and pull the unit backwards out of the bellhousing.

4 If required, the shock absorber outer body and the cooling fan can be withdrawn from the alternator shaft. Clamping the body or fan as securely but as lightly as possible in a vice to prevent rotation, unscrew the retaining nut and withdraw the body and fan with the locating Woodruff key.

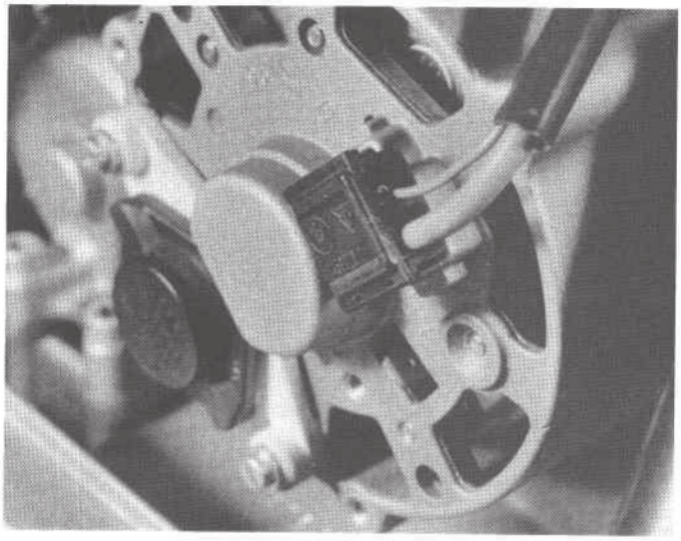
5 On reassembly, refit the locating key, then the fan and shock absorber body, aligning their keyways with the key. Fit the retaining nut and washer, lock the fan or body as firmly as possible without damaging them, then tighten the nut to its specified torque setting.

6 Refit the rubber blocks to the shock absorber body and apply a smear of lubricant to them to ease refitting as the alternator is placed on the drive flange. Tighten its mounting bolts securely to the specified torque setting where given.

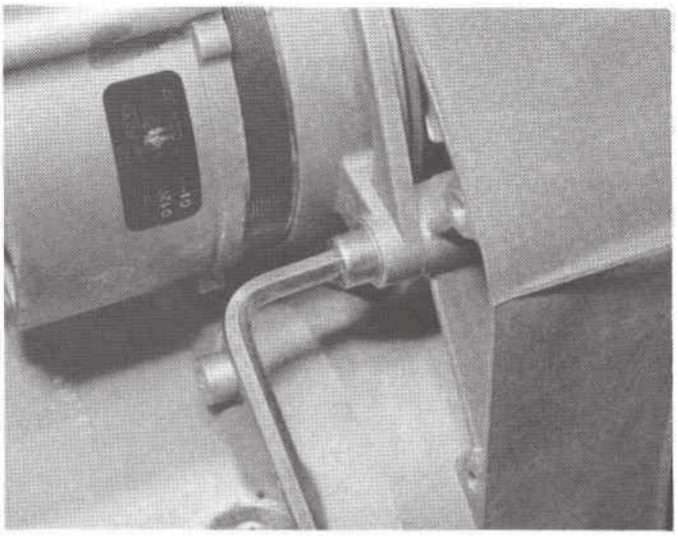
7 Refit the connector plug to the alternator rear end then refit all other disturbed components.



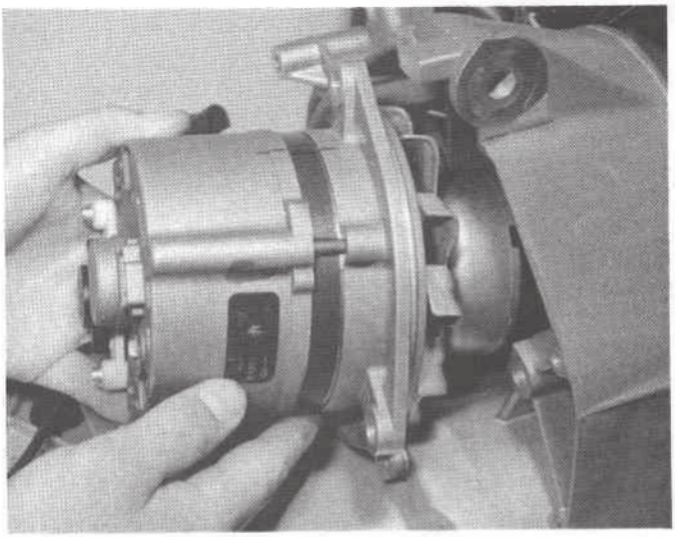
6.1 Alternator cover is retained by two Allen screws



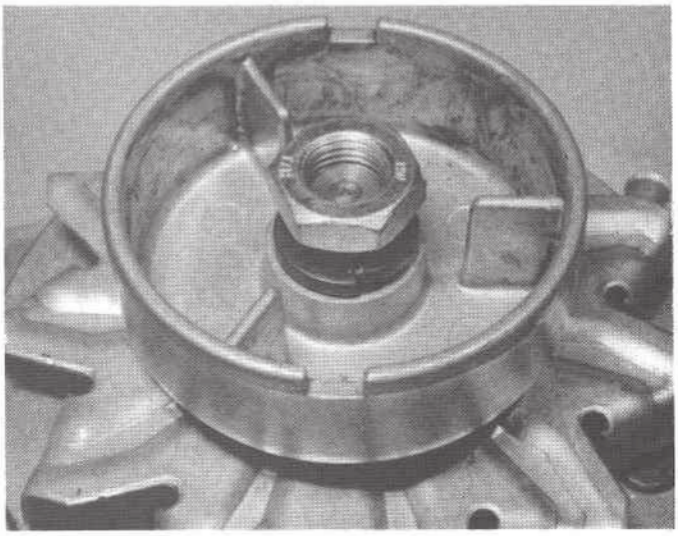
6.3a Disconnect the alternator connector plug ...



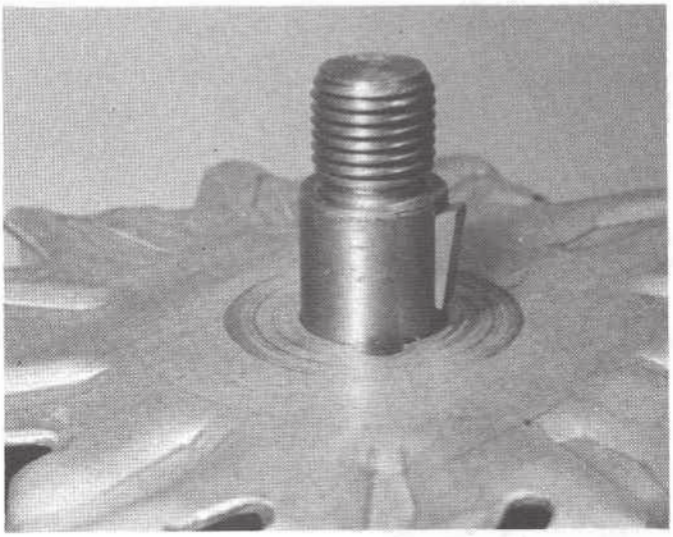
6.3b ... unscrew the three mounting bolts ...



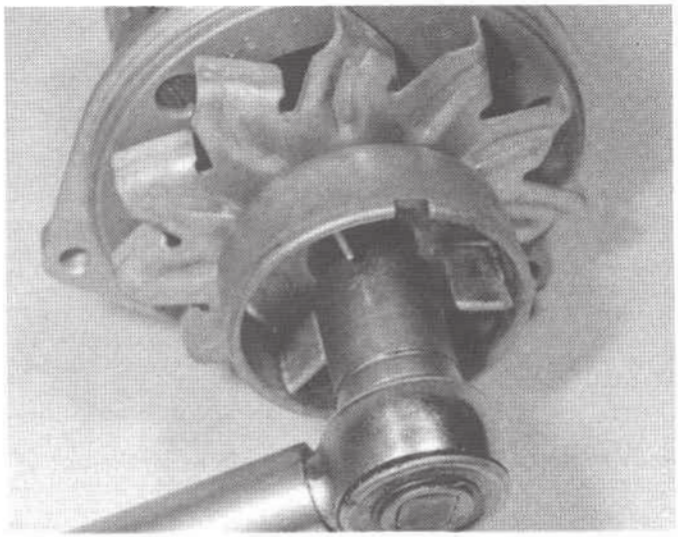
6.3c ... and pull the alternator away from the drive



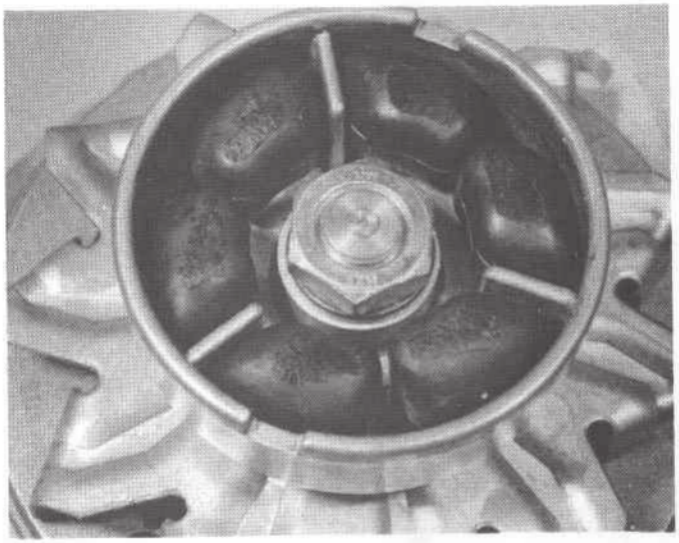
6.4 Unscrew retaining nut to release shock absorber body and fan



6.5a On reassembly refit cooling fan and Woodruff key



6.5b Tighten retaining nut to specified torque setting



6.6 Fit shock absorber rubbers as shown and lubricate to aid refitting

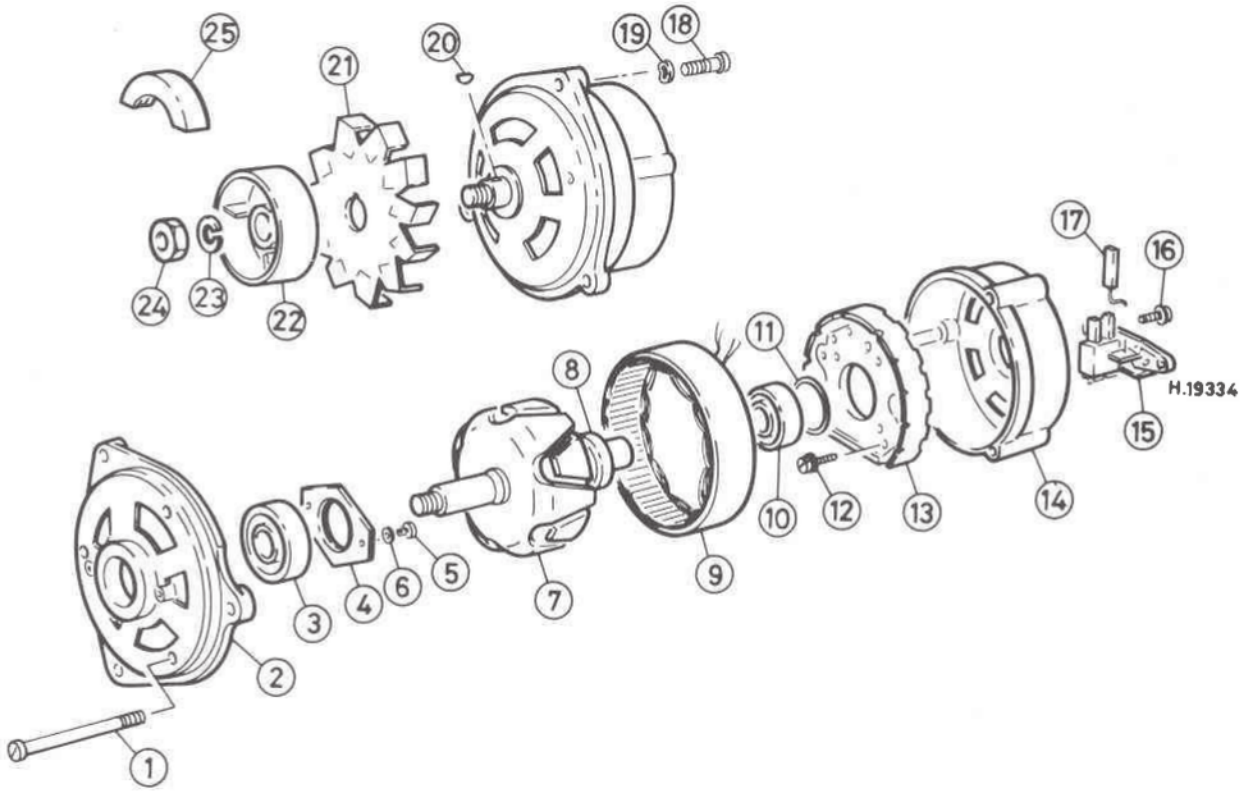


Fig. 10.2 Alternator

1 *Screw – 3 off*
2 *Front cover*
3 *Bearing*
4 *Retainer*
5 *Screw – 2 off*
6 *Washer – 2 off*
7 *Rotor*
8 *Slip ring*
9 *Stator*
10 *Bearing*
11 *O-ring*
12 *Screw – 4 off*
13 *Rectifier*
14 *Rear cover*
15 *Voltage regulator/brush holder*
16 *Bolt – 2 off*
17 *Brush – 2 off*
18 *Screw – 3 off*
19 *Washer – 3 off*
20 *Locating key*
21 *Cooling fan*
22 *Shock absorber body*
23 *Spring washer*
24 *Nut*
25 *Shock absorber rubber – 3 off*

7 Alternator: overhaul

1 Owners should note that since the alternator is a slightly modified version of a unit that can be found on many modern cars, particularly European models, most auto-electrical specialists will be familiar with it.

2 This means that it may be economically more sensible to take the unit to a specialist for overhaul than to attempt repairs; certainly an auto-electrical specialist will be able to test very quickly and thoroughly an alternator that is thought to be suspect, even if he cannot obtain the necessary replacement parts from his usual sources. Note also that the manufacturers, Bosch, have their own network of service agents. Owners should investigate the economics of all possibilities before starting work, and should ascertain whether exchange units are available before purchasing expensive replacement parts.

3 The alternator brushes can be inspected or renewed without removing the alternator from the machine, but disconnect the battery negative lead first.

4 From the rear of the alternator remove the two screws which secure the voltage regulator/brush carrier assembly. Withdraw the assembly.

5 Measure the length of each brush projecting from the carrier. If they are worn down to, or below, the minimum projection specified the old brushes will have to be unsoldered and new ones soldered into place. Some skill with a soldering iron will be required; excess heat from the soldering iron could damage the voltage regulator. When fitted, the new brushes must move freely in their holders; ensure that solder does not run down the brush leads. If the original brushes are still serviceable, check that they are both free to move easily in their carrier and that their ends bear fully on the slip rings.

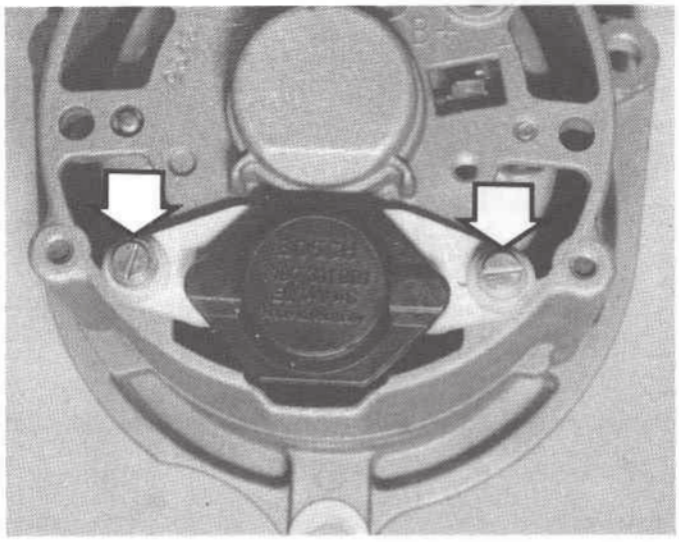
6 While the brush holder is removed, take the opportunity to clean the slip rings with a cloth soaked in high flash-paint solvent. If badly marked, use a piece of fine glass paper.

7 To dismantle the unit remove the brush carrier/voltage regulator as described above, and the shock absorber body and fan as described in Section 6. Mark the unit across the mating surfaces of the front housing, the stator windings and the rear cover so that all can be aligned correctly on reassembly. Remove the three retaining screws and withdraw the rear cover far enough to permit removal of the four small screws which secure the diode plate to the cover inside.

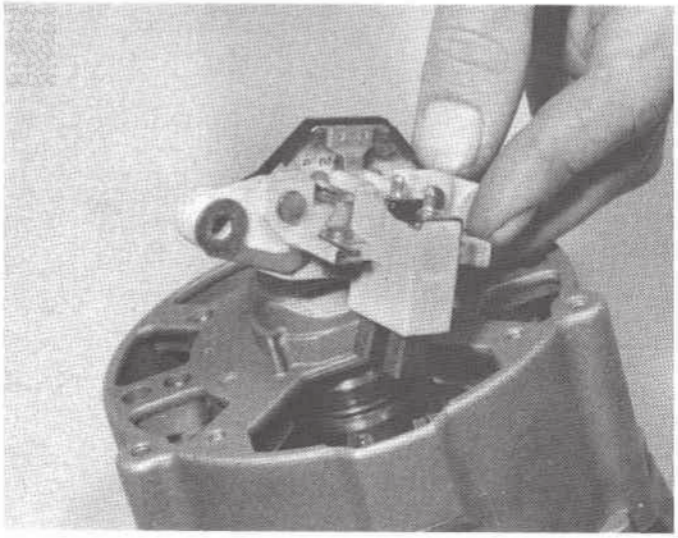
8 Test the diode plate using a battery and bulb test circuit or an ohmmeter or multimeter set to the resistance scale. When testing rectifier assemblies the important consideration is that each diode must allow current to flow in one direction only, ie current should flow or little resistance should be measured in one direction but when the tester probes are reversed no current should flow or much heavier resistance should be measured. Test between the diode plate surround (or alternator rear cover) and each stator winding end in turn, then between the B + terminal and each winding end, finally between the D + terminal and each winding end. If current flows in both directions or in neither during any of these tests, that diode is faulty and the plate assembly must be renewed. This means unsoldering the connections between the stator and the diode plate; take great care to ensure that the connections are properly re-made on reassembly.

9 Test the stator windings by measuring the resistance between each pair of phase outputs. If the readings obtained differ significantly from that specified, the stator is faulty and must be renewed. If its connections are first unsoldered, the stator can also be checked for short circuits to earth, testing between each wire end and the stator

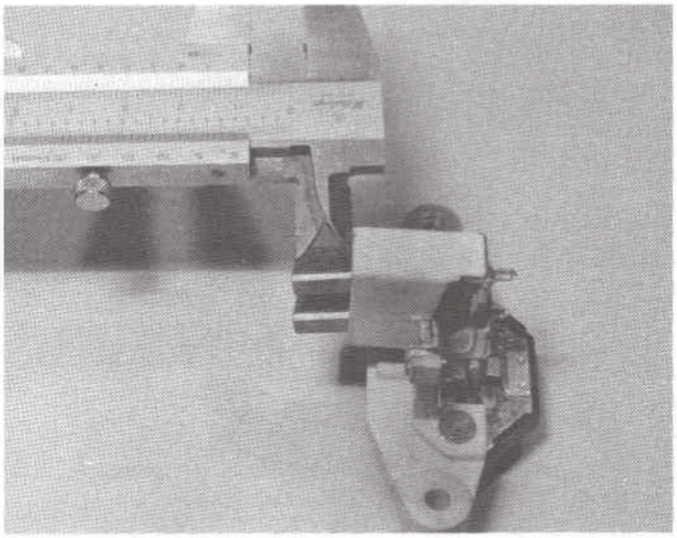
body; the coil windings should be completely insulated from the body.
10 The rotor need only be removed from its front bearing and the front housing if necessary; this task may require the use of a press. Check the rotor exciter winding by measuring the resistance across the slip rings; the reading obtained should be close to that specified. If the slip rings are worn, scored or distorted, they can be trued up by skimming in a lathe, provided that this does not reduce their outside diameter to less than the minimum specified.
11 Check the rotor by testing for continuity between both slip rings in turn and each of the rotor steel claw poles; applying up to 80 volts ac, there should be no continuity, ie infinite resistance. If the rotor or bearings are to be renewed, use a bearing puller to draw off the rear bearing and a hammer and a tubular drift which bears only on its inner race to refit the bearing. Once its retainer plate has been withdrawn, the front bearing can be removed and refitted using a hammer and a tubular drift which bears only on its outer race. Ensure the bearing is square in its housing.
12 On reassembly, fit the front bearing and fasten securely the retainer plate screws, then press the rotor shaft into the bearing. When soldering the stator connections use the bare minimum of solder possible to achieve a good joint and ensure that the wires are clear of the rotor. Do not forget to align the marks made on removal across the stator, the front housing and the rear cover when reassembling. Tighten securely the retaining screws but do not overtighten them.



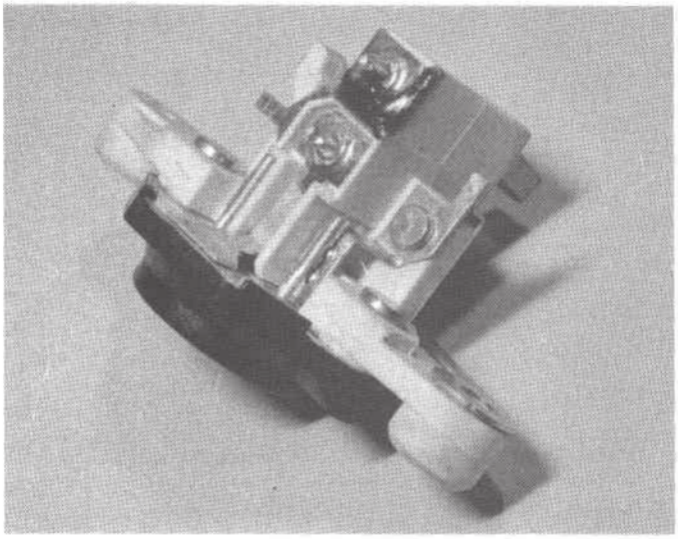
7.4a Remove retaining screws (arrowed) ....



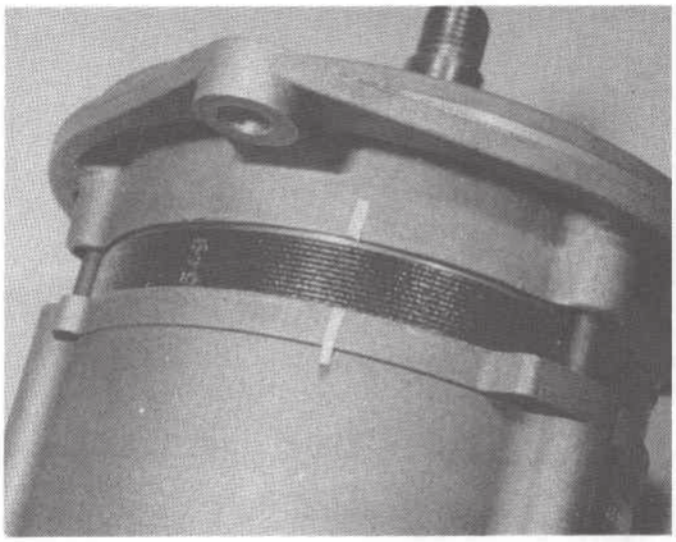
7.4b ... and withdraw voltage regulator/brush carrier to check brushes



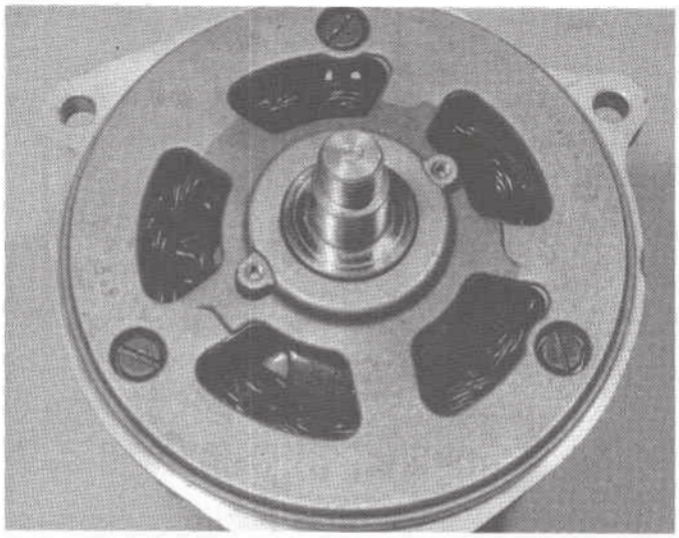
7.5a Measuring brush projection to determine brush wear



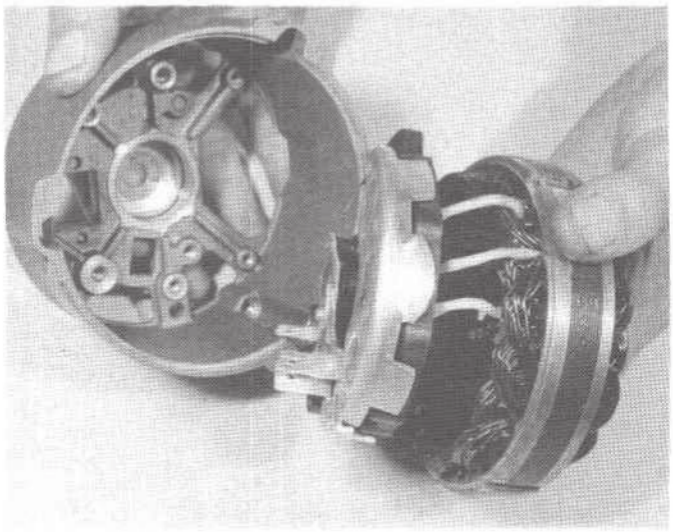
7.5b When fitting new brushes, great care is required when using soldering iron



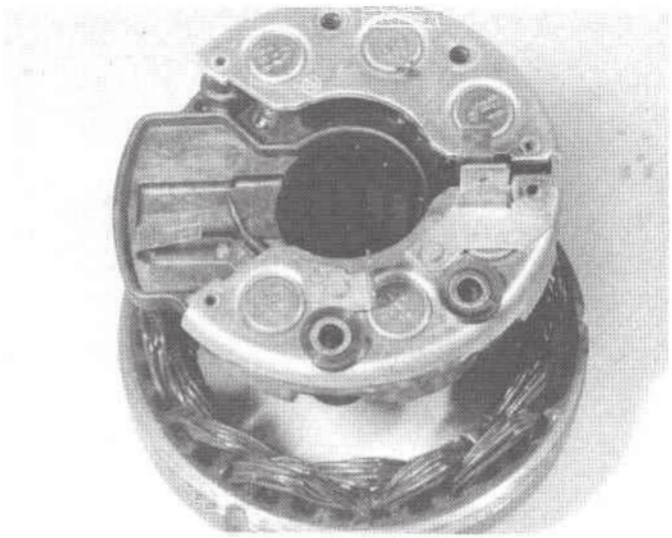
7.7a Before dismantling alternator make reference marks to ensure correct reassembly



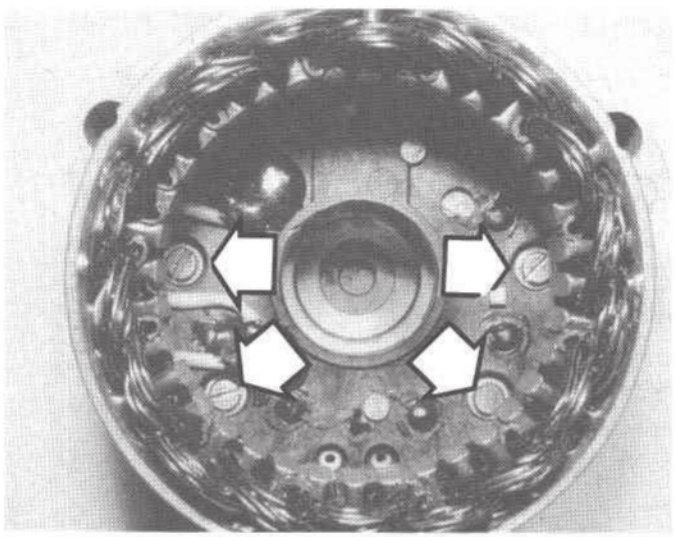
7.7b Remove three long screws from front cover to dismantle alternator



7.7d ... so that rear cover can be detached from stator and diode plate



7.8 Diode plate and stator can be tested as described



7.7c Remove four screws from inside alternator (arrowed) ...

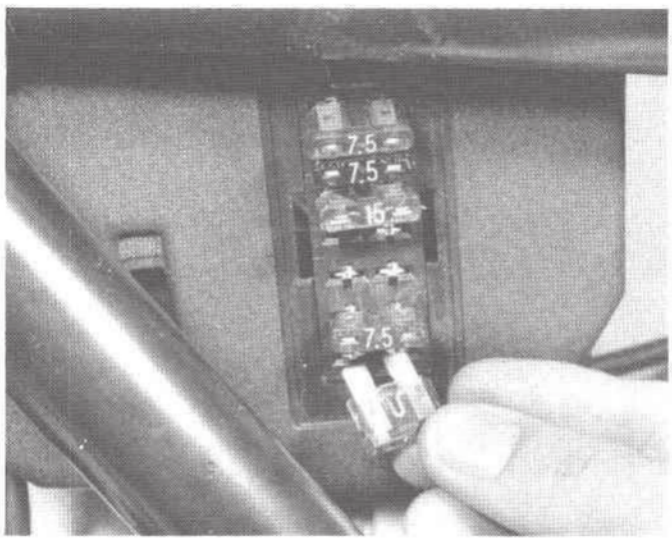
8 Fuses: general

1 Most circuits are protected by fuses of different ratings, details of which are given in the Specifications Section of this Chapter. Note that the circuits are identified by numbers in the Specification Section and in the wiring diagrams at the back of this Manual; these numbers correspond with those on the transparent plastic fuse box cover and also with the numerical order of the fuses, counted from top to bottom.

2 The fuse box is located behind the left-hand side panel, on the side of the electrical components box underneath the fuel tank. Remove the side panel, unclip the transparent plastic cover and pull out the faulty fuse.

3 Blown fuses can be recognised easily by the melted metal strip; each is clearly marked with its rating and must be replaced only by a fuse of the same rating. **Never** put in a fuse of higher rating or bridge the terminals with any other substitute, however temporary; serious damage may be done to the circuit components, or a fire may start. Always carry a supply of spare fuses of each rating on the machine.

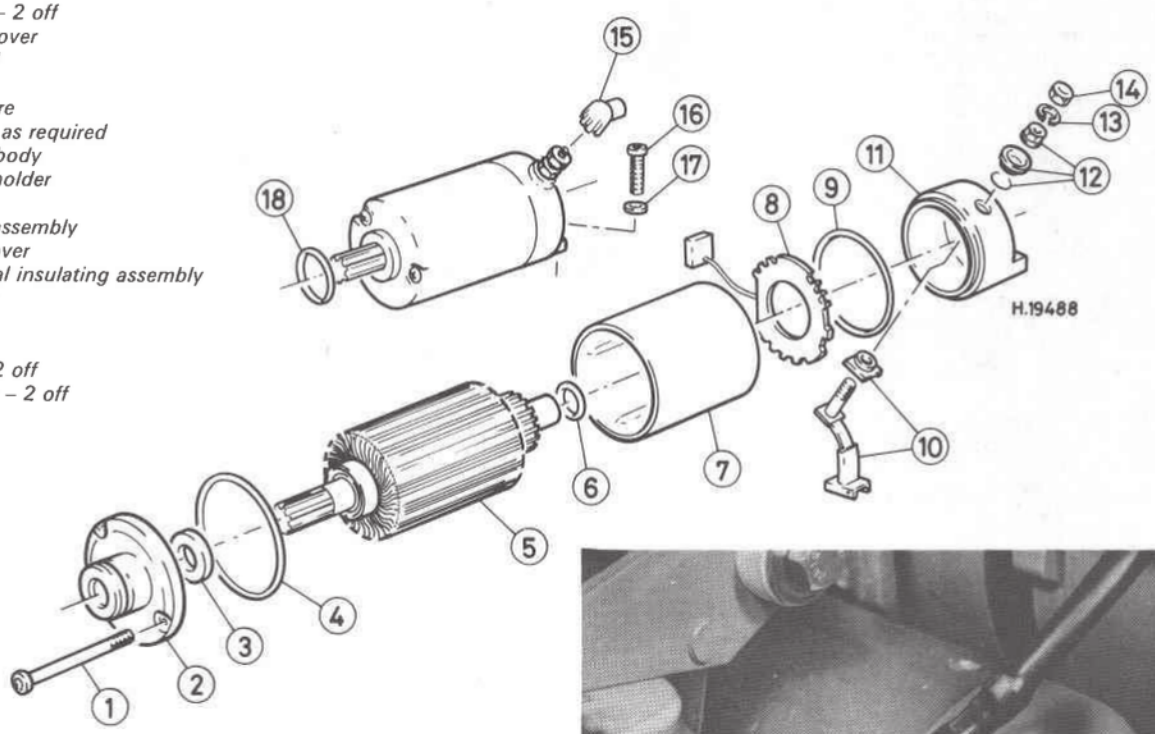
4 While an isolated fault may occasionally blow a fuse and never occur again, such cases are rare and generally due to faulty connections, although fuses do sometimes blow due to old age or similar factors. However, if the fuse for any circuit blows repeatedly, a more serious fault is indicated which must be traced and remedied as soon as possible.



8.2 Fuses are of spade type – always carry spares of correct type and rating

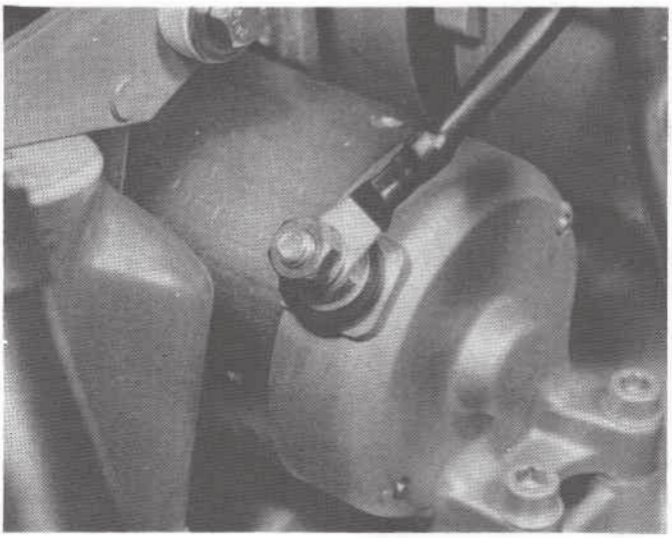
Fig. 10.3 Starter motor

1 *Screw – 2 off*
2 *Front cover*
3 *Oil seal*
4 *O-ring*
5 *Armature*
6 *Shim – as required*
7 *Motor body*
8 *Brush holder*
9 *O-ring*
10 *Brush assembly*
11 *Rear cover*
12 *Terminal insulating assembly*
13 *Washer*
14 *Nut*
15 *Cap*
16 *Bolt – 2 off*
17 *Washer – 2 off*
18 *O-ring*

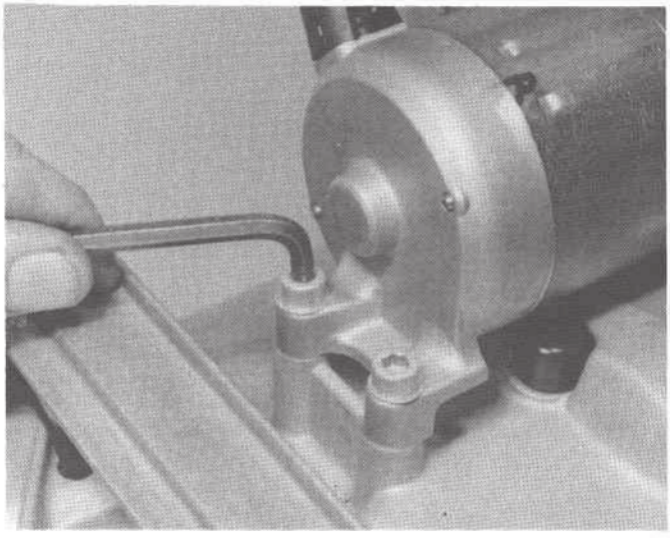


9 Starter motor: removal and refitting

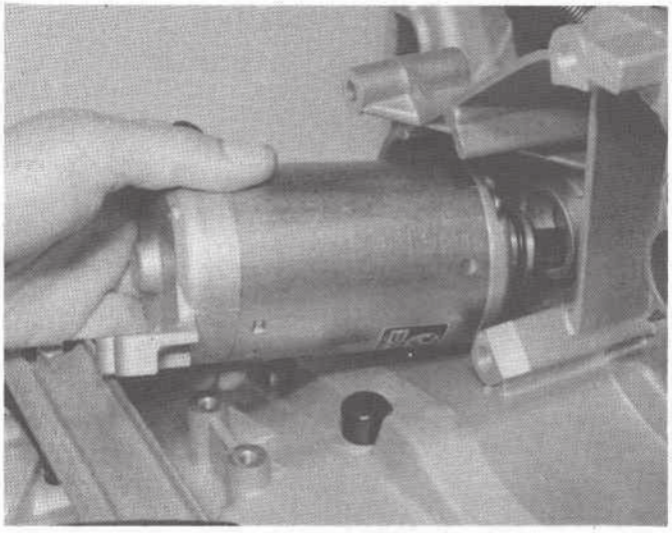
1 Remove both side panels.
2 Remove the fuel injection control unit and storage tray. See Chapter 5. Remove the battery as described in Routine Maintenance.
3 Disconnect the starter motor lead, remove the two retaining screws and withdraw the motor, manoeuvring it out to the rear.
4 Reassembly is the reverse of the removal procedure.



9.3a Disconnect battery before disturbing starter motor connection



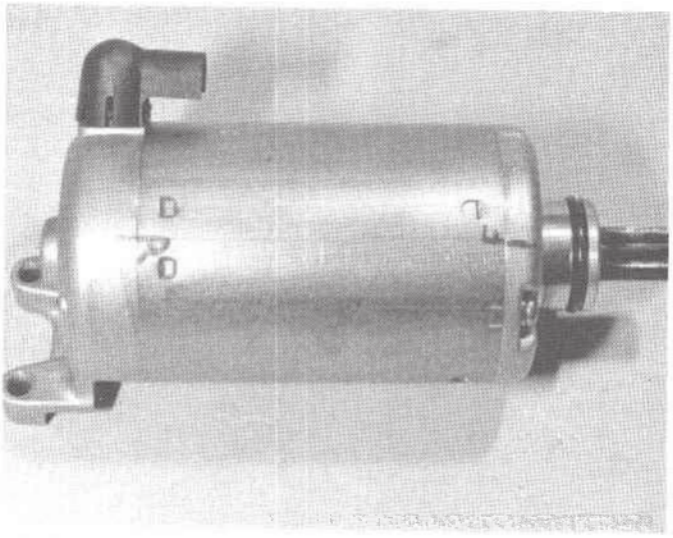
9.3b Unscrew two retaining screws to release starter motor



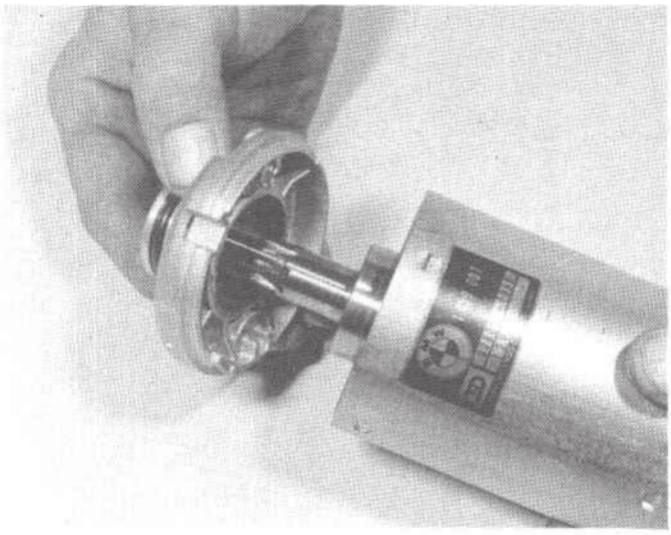
9.3c Renew sealing O-ring to prevent oil leaks

10 Starter motor: overhaul

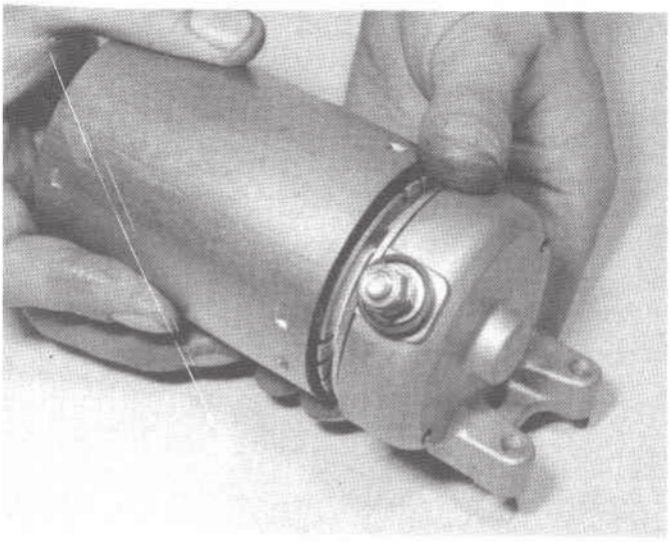
1 First mark the front and rear ends of the motor body and the end covers so that all can be refitted in their original locations.
2 Remove the two long retaining screws and withdraw the motor front cover noting the sealing O-rings around its locating boss and its mating surface; check carefully that no shims are fitted.
3 Carefully withdraw the motor rear cover; as the brushes slide off the end of the commutator they should be heard to extend under spring pressure. Withdraw the rear cover and brush holder plate as a single unit, noting the presence and number of any shims fitted to the armature shaft.
4 Carefully ease the springs out of the brush holders to release the brushes then lift off the brush holder plate. Push the armature out of the motor body. Unscrew the terminal retaining nut, withdraw the metal and insulating washers and the O-ring, then remove the field coil brush assembly. The plastic insulator can be removed if necessary.
5 Measure the length of each brush; they are worn out if reduced to half their original length or less. BMW do not specify the original length, so this can be determined only by measuring the length of new components in a BMW dealer's stock. As a guide, the brushes fitted to the machine featured in the accompanying photographs measured 12 mm (0.47 in) long, which would give a minimum length of 6 mm (0.24 in). Whenever new brushes are fitted, measure their length and note for future reference the minimum length derived from this. Note that one brush is soldered to the motor terminal and must be renewed with the terminal, while the other brush is crimped to the brush holder plate; this also must be renewed as a single assembly.
6 Check that the springs exert firm pressure on the brushes, that the brushes are not chipped or damaged and that they bear fully on the commutator; check also that each brush is free to slide easily in its holder. The springs are not available separately and will be renewed with the holder plate.
7 Clean the commutator segments with a rag soaked in methylated spirits and inspect each one for scoring or discoloration. If any pair of segments is discoloured, a shorted armature winding is indicated. The manufacturer supplies no information regarding skimming and re-cutting the armature in the event of serious scoring or burning, and so by implication suggests that a new armature is the only solution. It is suggested, however, that the advice of a vehicle electrical specialist is sought first; professional help may work out a lot cheaper.
8 The cleaning of the commutator segments with abrasive paper is not recommended due to the risk of particles becoming embedded in the soft segments. It is suggested, therefore, that an ink eraser be used to burnish the segments and remove any surface oxide deposits before installing the brushes.
9 Using a multimeter set on the resistance scale, check the continuity between pairs of segments, noting that anything other than a very low resistance indicates a partially or completely open circuit. Next check the armature insulation by checking for continuity between the armature core and each segment. Anything other than infinite resistance indicates an internal failure.
10 Check the field coil brush by testing for continuity between it and the terminal; no resistance should be encountered. Check also that the terminal is completely insulated from the motor body. Finally, check that continuity (ie little or no resistance) exists between the field coils, then that each coil is completely insulated from the motor body. If continuity is found between the field coils and the body there is a breakdown in insulation which means that the complete assembly must be renewed.
11 If oil is found in the starter motor, the seal pressed into the front cover is faulty and must be renewed. Check the bearing at each end of the armature by reassembling the motor and feeling for free play. Spin the front bearing and check for signs of roughness, wear, or other damage. The bearing must be renewed if at all worn, but note that neither this nor the seal are available separately; the apparent solution is to purchase a new starter motor assembly. To avoid unnecessary expense, an automotive parts supplier or specialist bearing supplier may be able to find suitable replacements. Ensure that all relevant dimensions and seal or bearing markings are noted so that the correct items can be selected; if necessary take the motor assembly to provide a pattern.
12 The front bearing can be removed using a knife-edged bearing puller and is refitted using a hammer and a tubular drift such as a socket spanner which bears only on the inner race. Ensure that the armature is fully supported. The oil seal can be levered out of the front cover and a new component can be tapped evenly and squarely into place. The bearing in the rear cover cannot be removed without risk of damage and so should be renewed as part of the cover, if necessary.



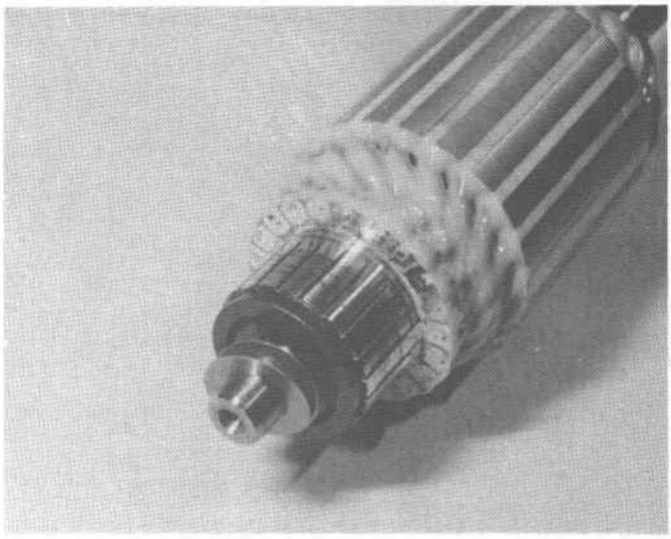
10.1 Mark motor covers and body before dismantling to ensure correct reassembly



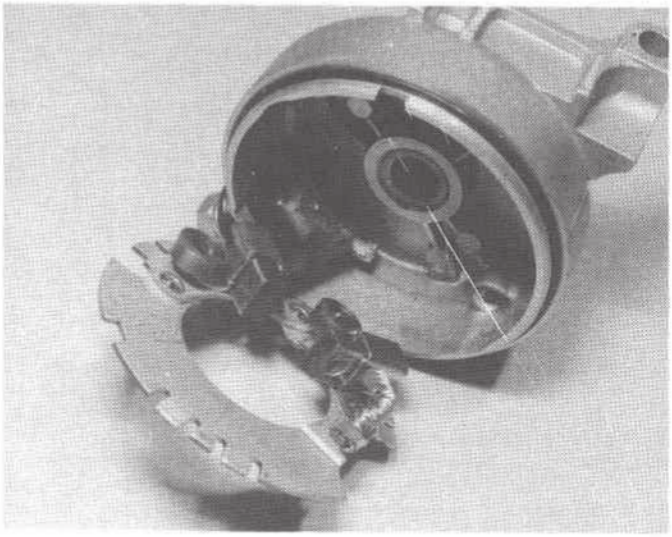
10.2 Remove two long screws to release motor front cover



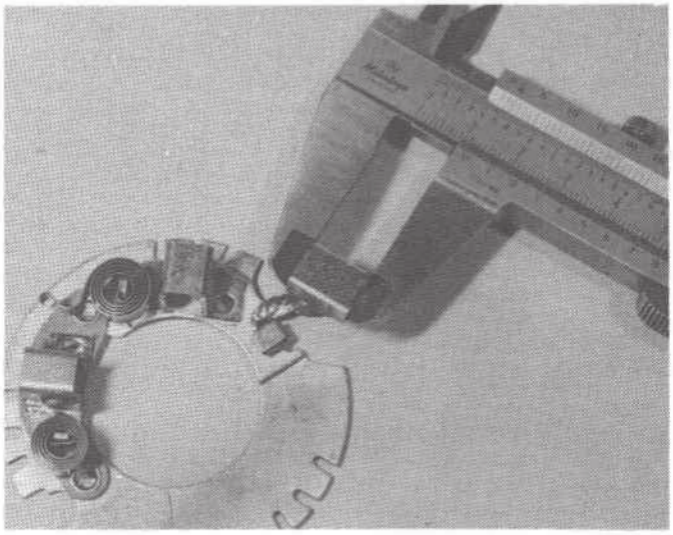
10.3a Be careful not to damage brushes when removing and refitting rear cover ...



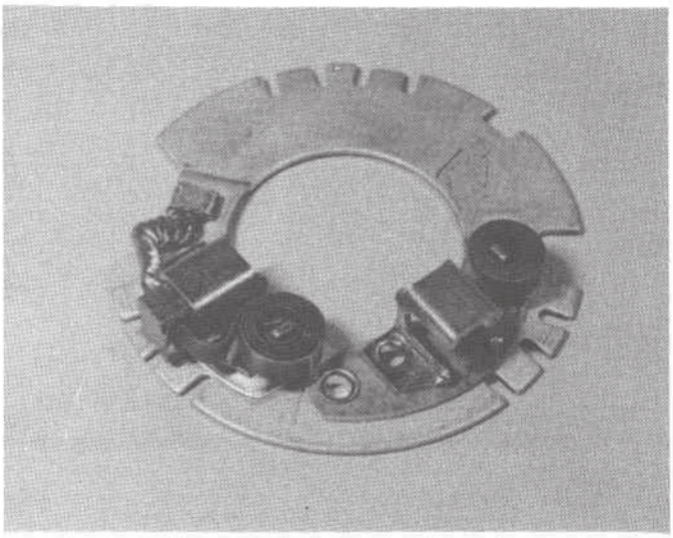
10.3b ... and note presence of any shims fitted to armature shaft



10.4 Dismantle terminal assembly to release brush holder from rear cover



10.5a Measuring brush free length



10.5b Note method of wedging brush in retracted position with spring end

11 Starter system: checks

1 In the event of a starter malfunction, always check first that the battery is fully charged. A partly discharged battery may be able to provide enough power for the lighting circuit, but not the very heavy current required for starting the engine.

2 Remove the fuel tank and note the location of the starter relay. This is mounted in the electrical components box and can be identified by the two heavy duty cables connected to two of its four terminals. Switch on the ignition and press the starter button. If the relay is operating a distinct click will be heard as the internal solenoid closes the starter lead contact. A silent relay can be assumed to be defunct.

3 Disconnect the heavy duty starter lead at the motor terminal and connect a 12 volt test bulb between it and a sound earth point. Operate the starter switch again. If the bulb lights, the motor is being supplied with power and should be removed for overhaul.

4 To test the relay itself, disconnect all cables and wires and check that there is continuity across the relay battery and starter motor cable terminals when a fully-charged 12 volt battery is connected to the relay switch terminals. If this is not the case, the relay is faulty and must be renewed.

5 If the relay is working properly, but not receiving any power, check

back through the circuit, there may be a fault in the clutch interlock switch, the gear position indicator switch or in the diode between them. Test each as described below.

Gear position indicator switch

6 This switch is secured to the rear of the gearbox housing, fitted over the end of the selector drum. Depending on the position of the selector drum, the switch either lights the neutral warning lamp in the instrument panel or causes the number of the gear selected to appear in an LCD unit set in the panel. If the switch is faulty, it must be renewed, but check first that the apparent fault is not due to slack switch mounting screws, or to poor connections.

Clutch interlock switch

7 A small plunger-type switch is incorporated in the clutch lever, serving to prevent operation of the starter circuit when any gear has been selected, unless the clutch lever is held in. Check that there is continuity across the switch terminals only when it is extended (clutch lever applied). If defective, it must be renewed, as there is no satisfactory means of repair. The switch can be unscrewed and disconnected, when required.

Interlock circuit diode

8 A small diode unit is fitted in the interlock circuit to ensure that the clutch switch can override the neutral switch, ie so that the machine can be started in gear when the clutch lever is pulled in. The diode is a small component mounted in the instrument panel components.

9 To test the diode, check that there is current flowing one way only, in the direction indicated in the relevant wiring diagram. If current flows in both directions, or in neither, the unit is faulty but cannot be renewed individually.

Load-shedding relay

10 This component is also to be found in the electrical component box under the rear of the fuel tank. Its function is to cut off the power supply to all non-essential circuits that may be in use whenever the starter button is pressed, so that full battery voltage is available. If it is faulty the relay must be renewed.

Starter button

11 This is incorporated with the engine kill button in the handlebar right-hand switch cluster. Although repairs are not likely to be successful in the long term, if the switch proves faulty at any time there is nothing to be lost by attempting to dismantle it for cleaning and possible repairs. See the general notes in Section 17.

12 Oil pressure warning lamp circuit: testing

1 This circuit consists of a simple pressure switch mounted on the oil pump body which lights a warning lamp in the instrument panel whenever the ignition is switched on; as soon as the oil pressure rises above a certain point, the lamp should go out.

2 If the lamp fails to light, first check the bulb and renew it if blown. If not, disconnect the switch wire and earth it briefly to the crankcase; the lamp should light. If it does not light, the switch is faulty and must be renewed.

3 If the lamp lights while the engine is running, declutch and stop the engine immediately; serious engine damage may be done if the engine is run with a faulty oil supply. Check first the level of oil in the crankcase and top up if necessary; if this does not cure the problem, the lubrication system must be checked further. If the warning lamp circuit is thought to be faulty, the switch can be tested only by the substitution of a new component.

4 Note however that the light may stay on or flicker due to corrosion at the switch terminal caused by an improperly-fitted switch cover. To cure this, thoroughly clean the switch connections and terminal, then apply a liberal quantity of water dispersant lubricant such as WD40 or CRC556. On refitting, ensure that the wire protective sleeve fits well inside the switch cover and that the cover itself is correctly installed to seal the switch. If corrosion has penetrated to the internal contacts, the switch must be renewed.

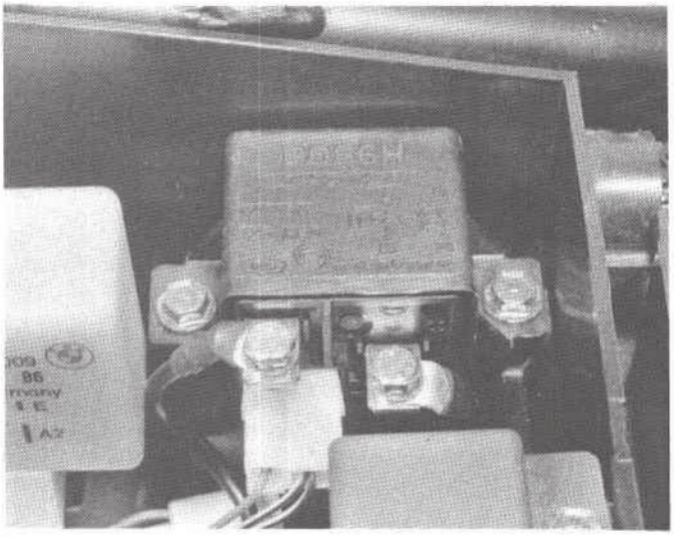
13 Coolant overheat warning lamp circuit: testing

1 This circuit consists of the switch, screwed into the coolant pipe stub on the cylinder head, which controls the operation of the coolant overheat warning lamp, mounted in the instrument panel, and the fan motor, mounted on the back of the radiator, through the temperature sensing switch unit, mounted in the electrical components box under the rear of the fuel tank.

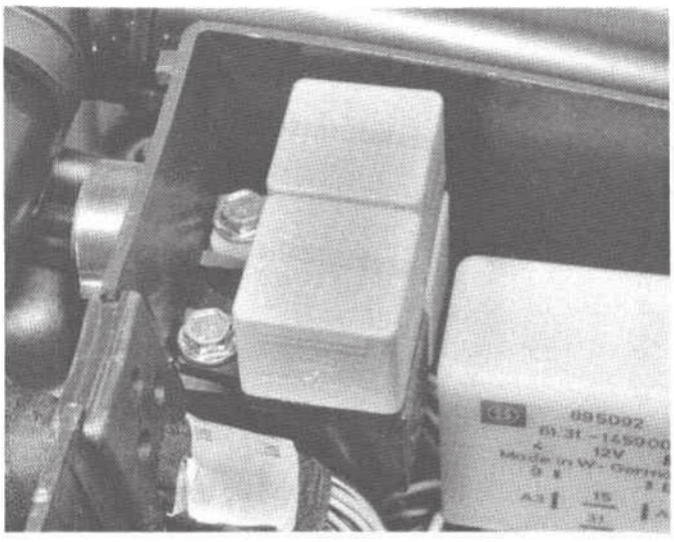
2 Although detailed information is not available, if the fan and coolant warning lamp do not cut in at the specified temperature, the switch can be considered faulty. The only certain test, however, is to try a new component and to note its effect on performance.

3 The fan motor is tested as described in Chapter 4. If the circuit is still faulty, the temperature sensing switch unit must be considered at fault and tested by substitution.

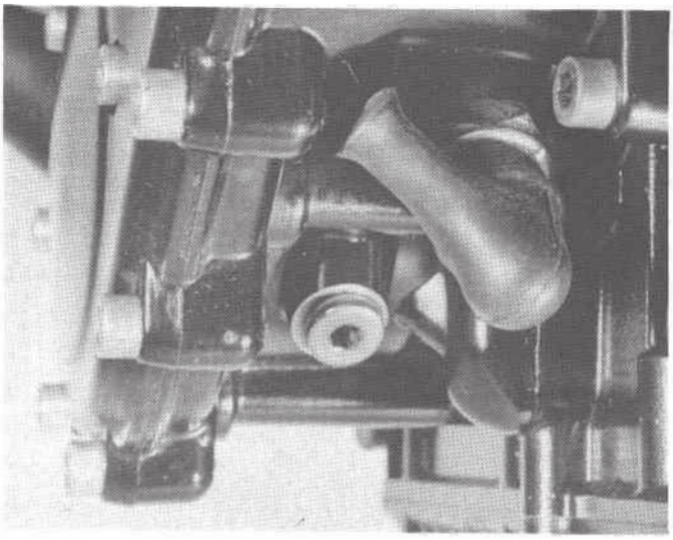
4 Note that this circuit is one of those that can suffer from a poor earth contact at the frame earth and the bellhousing/frame mounting bracket. If the fan and warning lamp operate when the engine is still cold, the earths must be cleaned carefully to ensure good contact. Refer to Section 2 of this Chapter or to Chapter 1 or 4 for details.



11.2 Starter relay is mounted in electrical components box



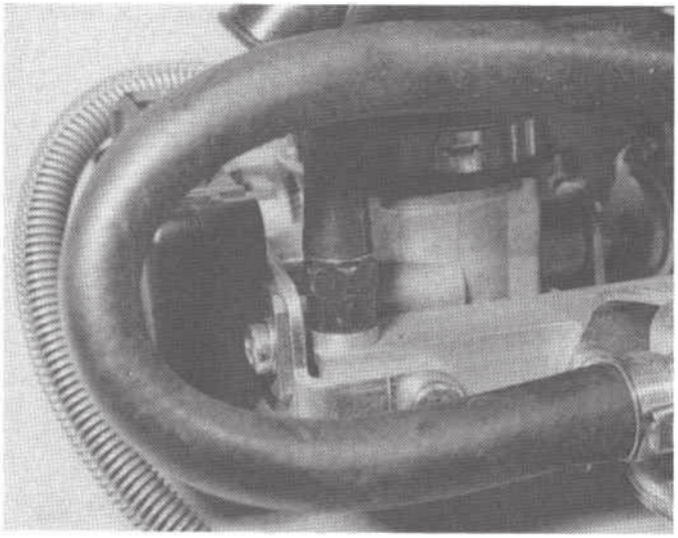
11.10 Do not confuse horn relay with load-shedding relay – use wire colours to identify



12.1 Oil pressure switch is mounted on oil pump body – ensure switch is waterproofed

14 Fuel level gauge circuit: testing

1 This circuit comprises the float-type sender unit mounted in the base of the tank and the warning lamp(s) in the instrument panel.
2 Early 100 models were fitted with two warning lamps; an orange lamp which lit when approximately 7 litres were left in the tank and a red lamp which lit at 4 litres. All 75 models and 1986-on 100 models are fitted with a single orange lamp which lights at 5 litres. A different type of sender unit is fitted to these models so that a conventional fuel gauge can be fitted; a gauge is listed as an optional extra for all later models.
3 If any of the lamps fail to light, check the bulbs first, then the connections and wiring back to the sender unit. Open the tank filler cap and use a long piece of wire to check that the sender unit float arm is free to move smoothly throughout its full travel. If any fault is discovered, the sender unit must be renewed.
4 If the unit is merely inaccurate, there is little that the owner can do other than to drain the tank and pour in measured quantities of fuel until the lamp(s) go out; in this way the warning system may still prove to be of use.



15.1 Cold start device warning lamp is actuated by switch in throttle butterfly assembly

15 Cold start (choke) device indicator: general

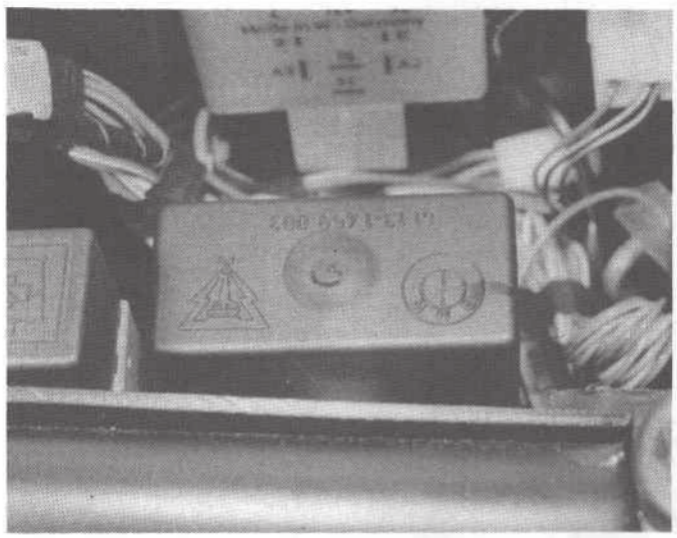
1 A plunger-type switch is screwed into the throttle body mounting bracket so that it illuminates a warning lamp in the instrument panel whenever the cold start lever (choke) is applied.
2 If the lamp fails to light, first check the bulb, then use a multimeter or similar to ensure that the switch is operating correctly. If not, check that the switch is securely mounted and fastened before renewing it.

16 Tail lamp bulb monitoring device: general

1 This component is mounted in the electrical component box underneath the rear of the fuel tank.
2 Its function is to illuminate a warning lamp set in the instrument panel if either of the bulbs in the rear lamp fails to light irrespective of whether this failure is caused by a defective bulb or a wiring fault.
3 When the ignition and the lights (UK models only) are switched on, the warning lamp should light and remain on until the brakes are applied; if it then goes out the rear lights are working properly. If the lamp stays on, there is a fault in one of the lights; on UK models if the warning lamp lights when the lights are switched off, the fault must be in the stop lamp circuit. The operation of the circuit can be checked quickly by removing one of the bulbs; the warning lamp should light.
4 If there is any doubt as to the correct operation of the system any faults can be eliminated as follows. Check the correct operation of the stop lamp bulb and the warning lamp bulb. Remove any corrosion that has built up in the bulbholders. By following the wiring diagram trace all the relevant wires, checking for continuity. Make sure all wiring connectors are free from corrosion and are fitted correctly. If the unit continues to malfunction it must be assumed that the fault lies within the unit, which is a sealed component and must be renewed.

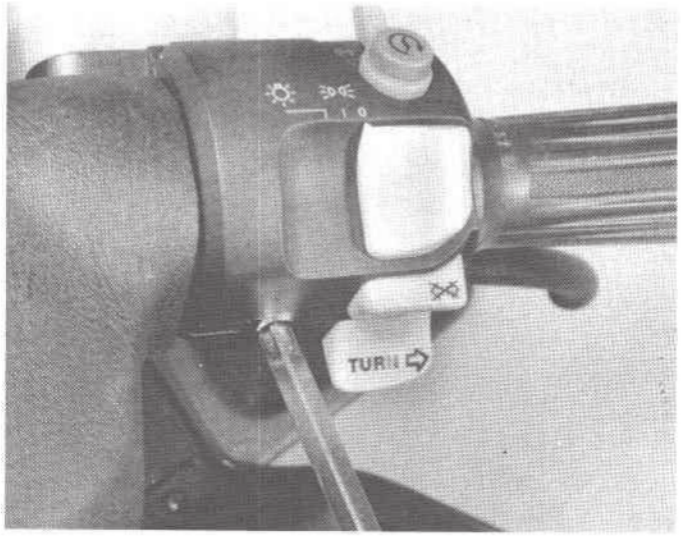
17 Switches: general

1 While the switches should give little trouble, they can be tested using a multimeter set to the resistance function or a battery and bulb test circuit. Using the information given in the wiring diagrams at the end of this Manual, check that full continuity exists in all switch positions and between the relevant pairs of wires. When clecking a particular circuit follow a logical sequence to eliminate the switch concerned.

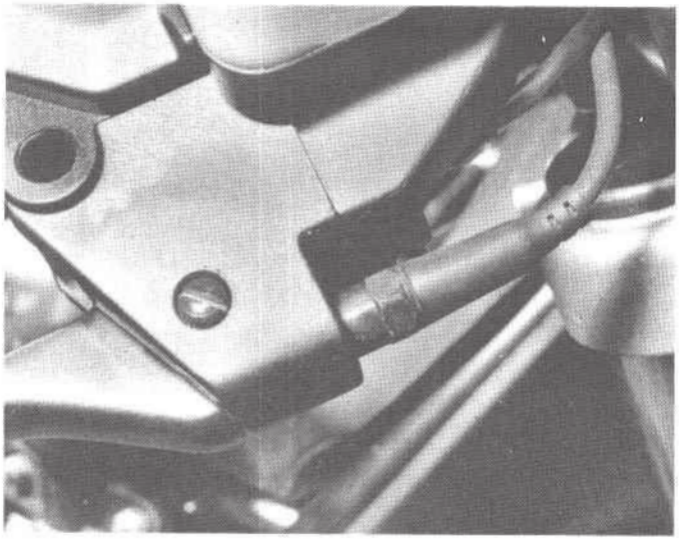


16.1 Tail lamp bulb monitor must be renewed if faulty

2 As a simple precaution always disconnect the battery (negative lead first) before removing any of the switches, to prevent the possibility of a short circuit. Most troubles are caused by dirty contacts, which can be cleaned, but in the event of the breakage of some internal part, it will be necessary to renew the complete switch.
3 Note that handlebar switches are secured by a single screw to the rear of the handlebar lever clamp or twistgrip assembly on all models.
4 When replacing the switch, ensure that it seats correctly in its housing. If necessary, chamfer the spigots of new switches slightly to achieve this.
5 On all models, note that if a switch is found to be faulty it can only be renewed. There is little to lose, therefore, by attempting to dismantle and repair it although whether this is successful or not depends entirely on the owner's skill and the nature of the fault.
6 Owners of early 100 models should note that their machines should have separate earth wires from the handlebar switch assemblies which must be reconnected always whenever the switches have been disturbed. If these wires are not reconnected, the switches may earth via the throttle control cable, causing the inner wire to heat up and melt the outer cable then causing a stiff throttle and the possible risk of loss of control.



17.1a Handlebar switches are retained by a single screw ...



17.1b ... while stop lamp switches are screwed into place

18 Relays: location and renewal

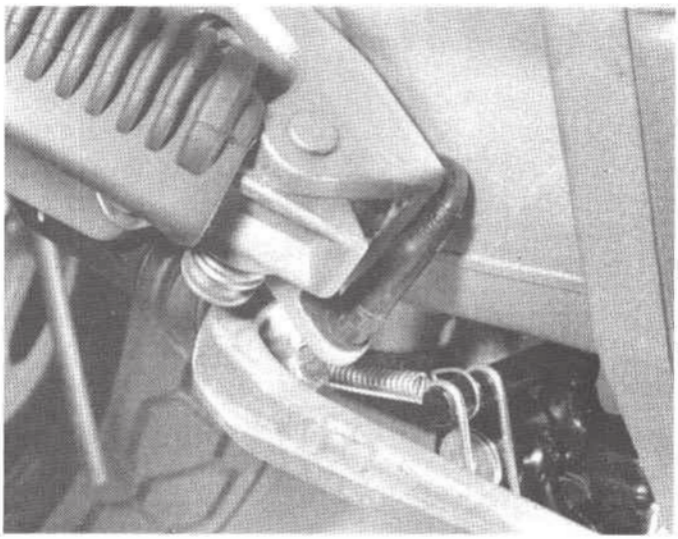
1 The various relays are mounted in the electrical components box under the fuel tank. In some cases (usually early models only) the wires have separate connectors, but usually the relays are pressed into a connecting lug.
2 If a relay which has individual wires leading to it is removed at any time, make a written note as each wire is removed, showing which colour wire should be connected to each terminal (the numbers are stamped into the relay itself). Use the colours of the wires shown in the diagrams at the back of this Manual to identify each relay.
3 If a relay is suspected of being faulty, it must be renewed; repairs are not possible.

19 Turn signal relay: location and testing

1 The turn signal relay is the larger unit mounted by two bolts in the electrical components box under the rear of the fuel tank.
2 If the turn signal lamps cease to function correctly, there may be any one of several possible faults responsible which should be checked before the relay is suspected. First check that the lamps are correctly mounted and that all the earth connections are clean and tight. Check that the bulbs are of the correct wattage and that corrosion has not developed on the bulbs or in their holders. Any such corrosion must be thoroughly cleaned off to ensure proper bulb contact. Also check that the turn signal switches are functioning correctly and that the wiring is in good order. Finally ensure that the battery is fully charged.
3 Faults in any one or more of the above items will produce symptoms for which the turn signal relay may be blamed unfairly. If the fault persists even after the preliminary checks have been made, the relay must be at fault. Unfortunately the only practical method of testing the relay is to substitute a known good one. if the fault is then cured, the relay is proven faulty and must be renewed.
4 Note that the relay has a self-cancelling circuit which is connected to the speedometer so that the turn signals cancel automatically after a distance of 210 metres (689 feet) has been traversed or a period of 10 seconds at above 31 mph (50 kmh) has elapsed. If this circuit fails, the relay unit must be renewed.

20 Horn: location and adjustment

1 A single or twin horn arrangement is fitted according to the model. Each horn is mounted on a resilient steel bracket; on all 100 models the horns are either inside the headlamp surround or in the fairing (as appropriate). Refer to Chapter 7 for information on removal and

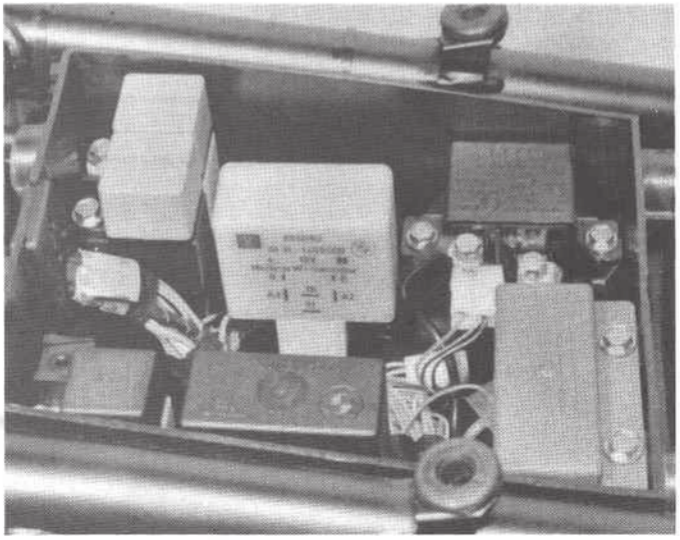


17.1c Regular lubrication will help preserve switches

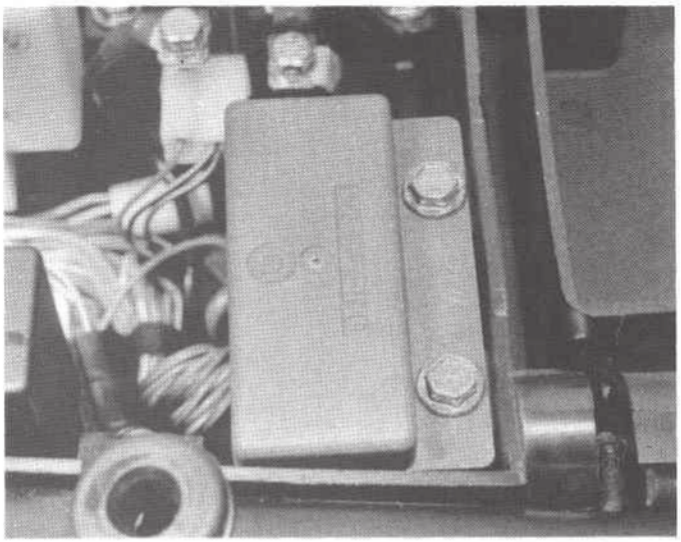
refitting. On most 75 models the horns are mounted in similar locations but in some cases a single horn is mounted on the frame front downtubes. If a horn fails to operate, or works feebly, it can be adjusted by slackening the locknut and turning the adjuster screw in or out by a small amount until the best sound is obtained.

2 If the horn fails to work at all, first check that power is reaching it by disconnecting the wires. Substitute a 12 volt bulb, switch on the ignition and press the horn button. If the bulb lights, the circuit is proved good and the horn is at fault; if the bulb does not light, there is a fault in the circuit which must be found and rectified. Check the relay first.

3 To test the horn itself, connect a fully-charged 12 volt battery directly to the horn. If it does not sound, a gentle tap on the outside may free the internal contacts. If this fails, the horn must be renewed as repairs are not possible, but there is little to be lost by attempting to dismantle the horn and repair it; Fiamm horns for example can be dismantled and their contacts can be cleaned quite easily.



18.1 Relays are mounted in electrical components box, under rear of fuel tank



19.1 Remove mounting bolts to release turn signal relay

21 Radio: general – K100RT, K100LT

These models are sold usually with either a complete radio installation included or at least the fitting kit comprising the aerial, wiring, waterproof loudspeakers and the necessary suppressors. Since a number of different units can be found, specific instructions cannot be given in this Manual Owners should refer for information to the selling dealer or to agents of the radio manufacturer. A full wiring diagram showing all modified or additional components should be included with the fitting kit when purchased.

22 Bulbs: renewal

Headlamp and parking lamp

1 **Note:** The headlamp bulb fitted to all models is the standard H4 pattern which is connected to the wiring loom by a three-pin plug and which is located in the headlamp reflector by the three protruding tangs. These tangs are offset so that the bulb will fit correctly only one way. Never touch the glass envelope of these bulbs; any dirt or greasy or acidic deposits will etch the glass and shorten the bulb's life. If the glass is touched inadvertently it should be wiped clean with a soft cloth soaked with a solvent such as methylated spirit. Ensure that the bulb is clean and dry before switching on the light.

2 On K75 models the rim and reflector unit must be removed from the headlamp shell to reach the bulb. check carefully around the rim and remove any retaining screws, then gently unclip the rim from the shell and withdraw it. Withdraw the connector plug, peel back the rubber cover and unclip the bulb from the back of the reflector. To remove the parking lamp bulb withdraw the bulb holder from the back of the reflector then press the bulb into the holder and turn it anticlockwise to release it. Refitting is the reverse of the removal procedure ensuring that the headlamp rim is securely fastened.

3 On K75 C, K75 T and K100 models withdraw the windscreen and the headlamp surround or handlebar fairing as appropriate. Refer to Chapter 7. Remove its two mounting bolts and lift forwards the headlamp unit, disengaging the adjuster screw from its bracket. Turn the parking lamp bulb holder anticlockwise to release it from the reflector, then press the bulb into the holder and turn it anticlockwise to release it from the holder. To remove the headlamp bulb unplug the connector, peel off the rubber cover and rotate the locking ring anticlockwise to release the bulb.

4 Reassembly is the reverse of the removal procedure, but when refitting the headlamp unit be careful to engage the adjuster screw nut in its bracket and to align the triangular marks on the headlamp unit brackets with those of the rear cover mounting brackets so that the unit is correctly aligned in the vertical plane before its mounting bolts are tightened.

5 On K75 S models reach forward inside the fairing to pull the parking lamp bulb holder out of the reflector right-hand side; the bulb is a standard bayonet fitting in its holder and is removed as described in paragraph 3 above. To remove the headlamp bulb unplug the connector, peel back the rubber cover and release the retaining wire clip to release the bulb. Refitting is the reverse of the removal procedure.

6 On K100 RS models refer to the relevant Section of Chapter 7 and remove the fairing kneepads and the small panels above them; it may also be necessary to release the horizontal centre panel from its mountings under the instruments to gain access to the headlamp unit. Bulb removal and refitting is as described in paragraph 3 above.

7 On K100 RT and K100 LT models no dismantling is necessary; it is possible to reach forwards inside the fairing to remove the bulbs as described in paragraph 3 above.

Headlamp – beam alignment

8 On all models the headlamp beam alignment should be set with the rider, and pillion passenger if one is regularly carried, seated normally; the machine should be standing on its wheels with the tyre pressures and rear suspension correctly set for the load carried. On K100 RS, K100 RT and K100 LT models set the vertical aim three-position lever to its top position so that the headlamp beam is at maximum height; this then gives two additional settings to compensate for increased loads.

9 The headlamp beam should be adjusted vertically (and horizontally, where possible) to comply with local legislation.

10 On K75 models only, vertical adjustment is possible, by slackening the headlamp mounting bolts and tilting the unit. On K75 C, K75 T and K100 models a knurled plastic adjusting screw is fitted to the bottom left-hand corner of the headlamp unit to provide vertical adjustment. On K75 S models two knurled plastic adjusting screws are fitted; that in the bottom left-hand corner of the headlamp unit adjusts vertical

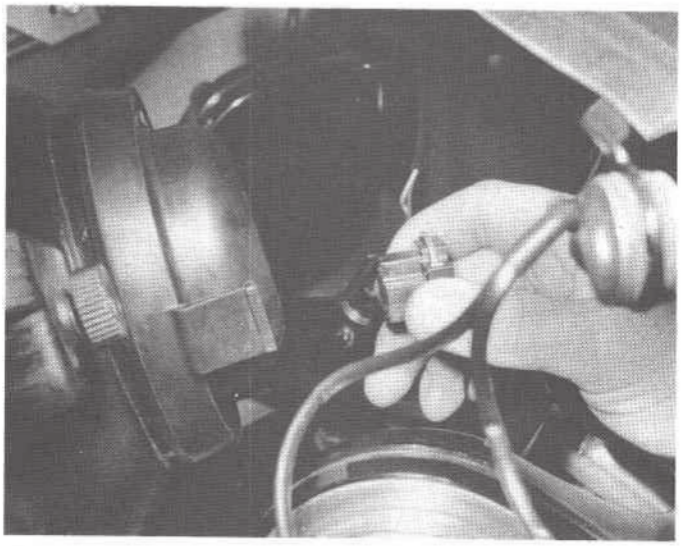
aim, while that in the top right-hand corner adjusts horizontal aim. On K100 RS, K100 RT and K100 LT models vertical aim is adjusted by a knurled plastic screw in the centre of the three-position lever, on the right-hand side of the unit and horizontal aim is adjusted by a knurled plastic screw in the top left-hand corner of the unit. Except for K100 RS models, where it may prove necessary to remove the fairing knee pads and other panels (see above), the adjusters are easily reached by hand from behind the headlamp assembly.

11 UK lighting regulations stipulate that the lighting system must be arranged so that the light does not dazzle a person standing in the same horizontal plane as the vehicle, at a distance greater than 25 feet from the lamp, whose eye level is not less than 3 feet 6 inches above that plane. It is easy to approximate this setting by placing the machine 25 feet away from a wall, on a level road, and setting the beam height so that it is concentrated at the same height as the distance from the centre of the headlamp to the ground. In addition, the headlamp must be capable of being dipped.

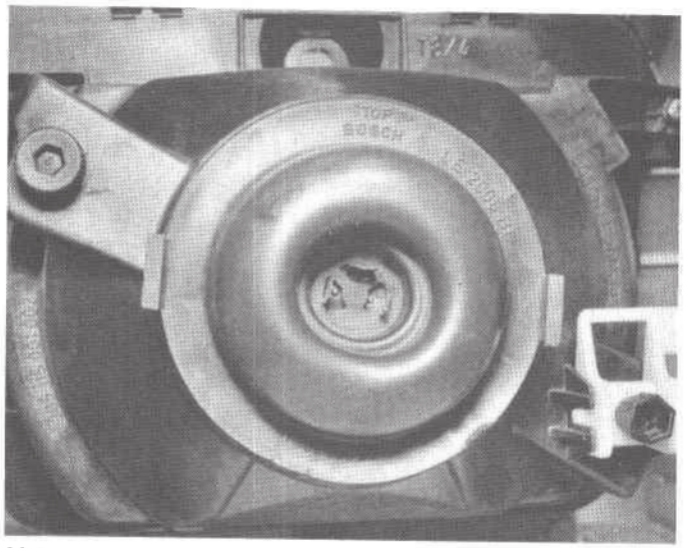
Stop and tail lamp

12 Unlock and raise the seat, then remove the tail storage compartment cover and unscrew the two knurled plastic nuts or screws inside the compartment rear wall which retain the rear lamp unit.

13 Withdraw the unit and remove either bulb by pressing inwards the bulb holder plastic clip and pulling it out of the unit. Both bulbs are a standard bayonet fitting and are removed by pressing them into the holder and turning them anticlockwise to release them. Refitting is the reverse of the removal procedure.



22.1a Unplug connector to disconnect headlamp bulb wiring



22.6a Headlamp bulb renewal, K100 RS – remove rubber cover ...

Turn signal lamps

14 With the exception of the front turn signal assemblies incorporated in fairings as described below, the turn signal lamps are retained by a single screw which passes through the back of each unit's body and into the lens assembly. Remove the retaining screw, withdraw the lens assembly then remove the bulb holder and bulb exactly as described in paragraph 13 above; the bulb holders are identical to those used in the rear lamp assembly. Do not overtighten the screw on refitting.

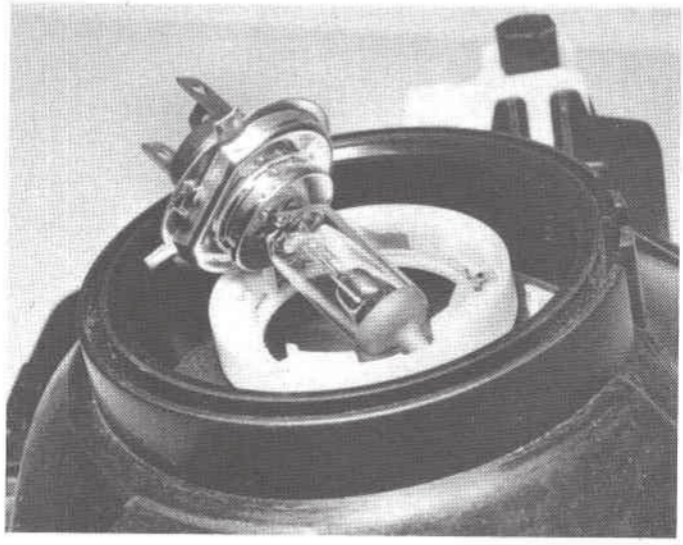
15 On K75 S front turn signal lamps remove the single screw which retains the assembly to the fairing, withdraw the assembly and turn the bulb holder anticlockwise to release it. The bulb is a standard bayonet fitting and is removed as described in paragraph 13 above. Do not overtighten the screw or the lens will crack.

16 On K100 RS front turn signal lamps remove the single screw which retains the lens and withdraw the lens. Remove the bulb as described in paragraph 13 above. On reassembly take care not to overtighten the retaining screw or the lens will be cracked.

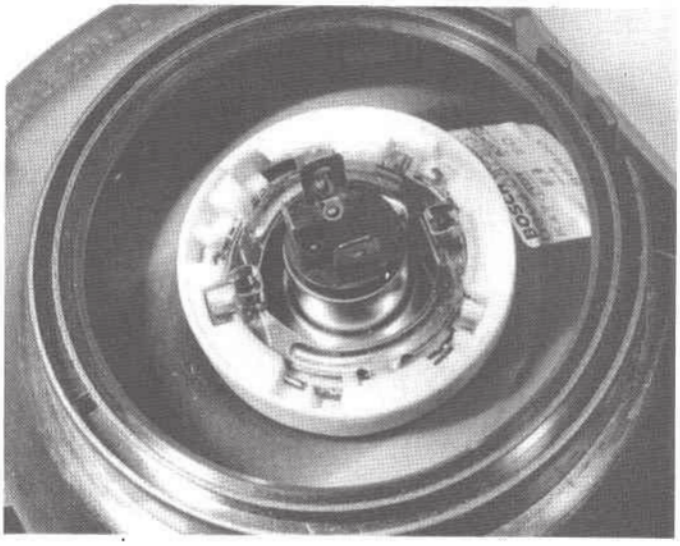
17 On K100 RT and K100 LT front turn signal lamps, position the front forks as necessary to permit access, then reach forward inside the fairing until the bulb holder can be twisted anticlockwise to release it and pulled out. The bulb is the standard bayonet type which is removed and refitted as described in paragraph 13 above.

Instrument panel bulbs

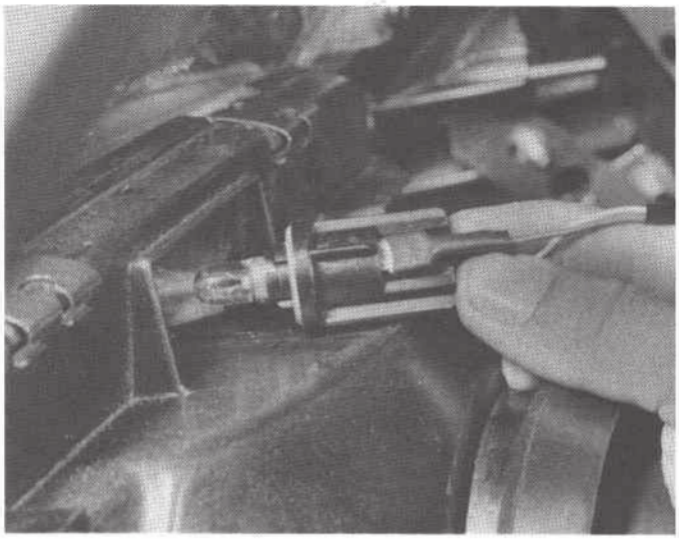
18 Refer to the relevant Section of Chapter 7 for details of removing the instrument panel from the machine and dismantling it far enough to reach the bulbs.



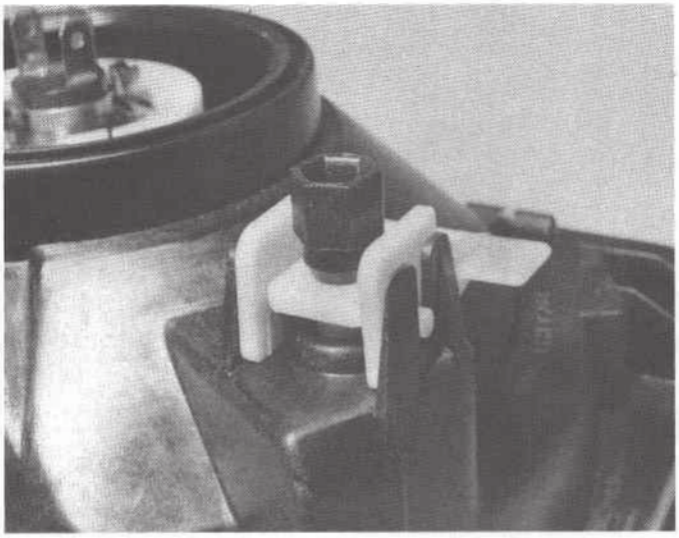
22.1b Bulb is located by offset tangs – never touch glass envelope



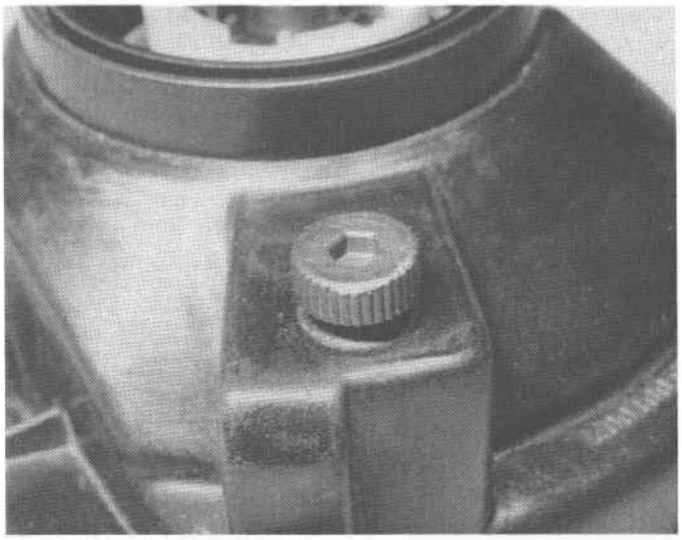
22.6b ... and disengage locking ring to release headlamp bulb



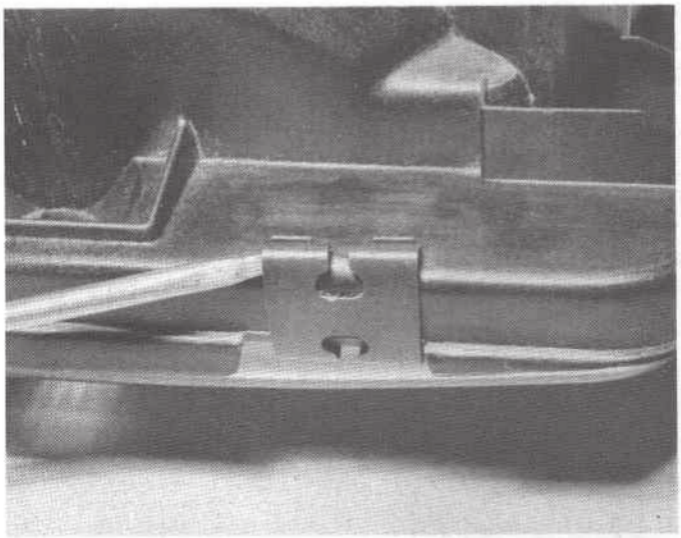
22.6c Parking lamp bulb is a bayonet fit in bulb holder



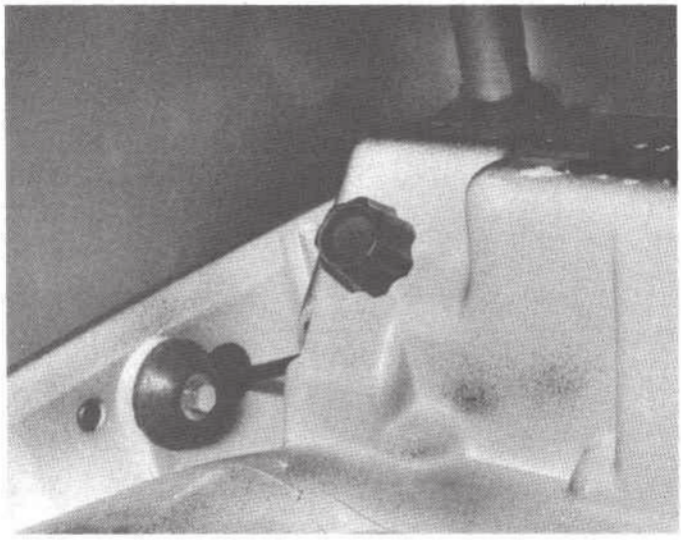
22.8 Headlamp beam adjustment, K100 RS – knurled screw provides basic vertical setting, white lever provides alteration to suit loads



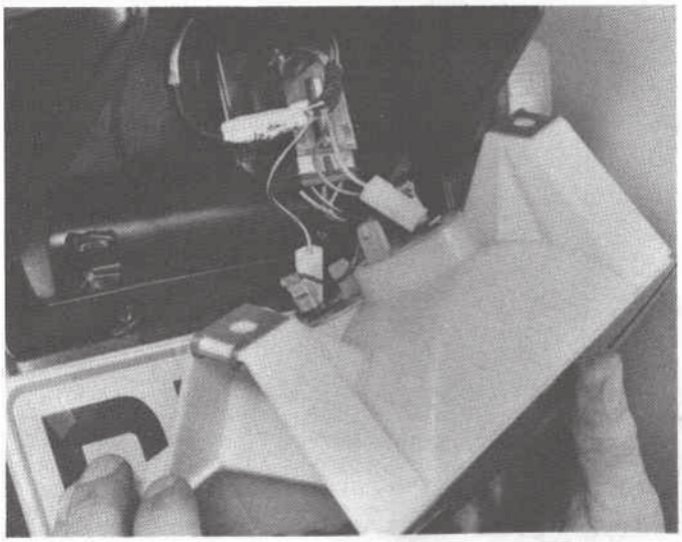
22.10a Single knurled screw provides horizontal adjustment



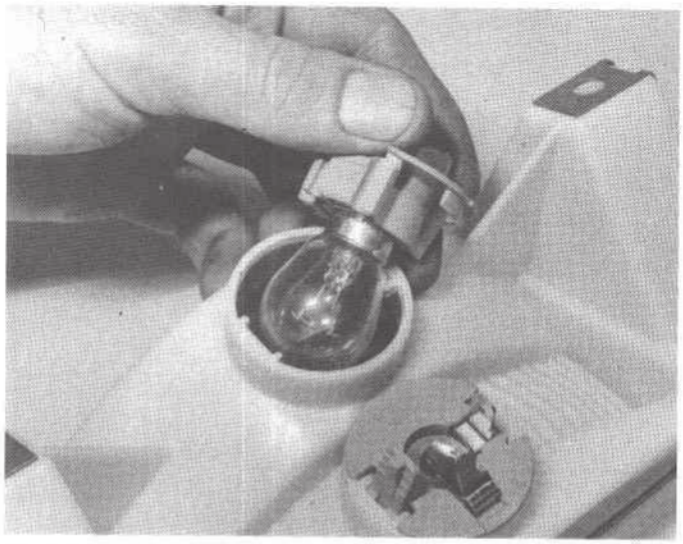
22.10b Ensure clips are secure which fasten headlamp assembly



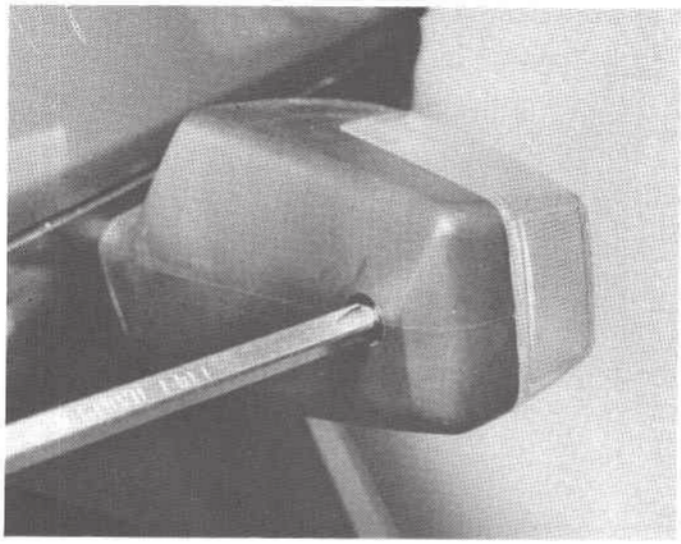
22.12a Remove plastic nuts or screws inside tail compartment ...



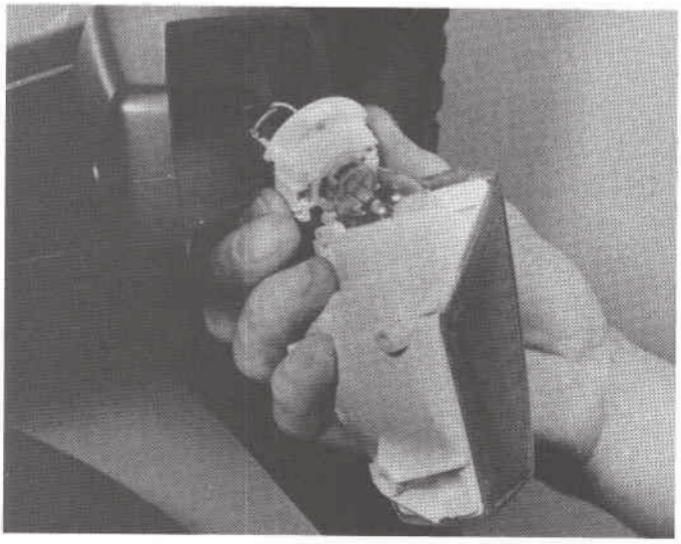
22.12b ... to release tail lamp assembly



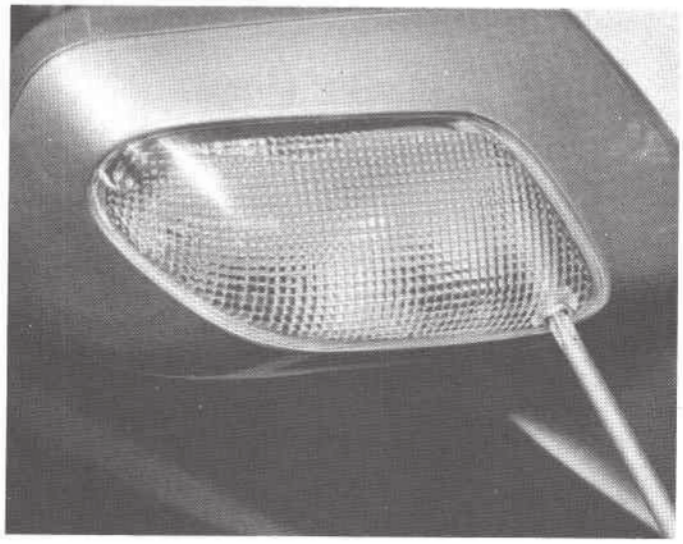
22.13 Disengage bulb holder plastic clip as shown to remove bulb assemblies



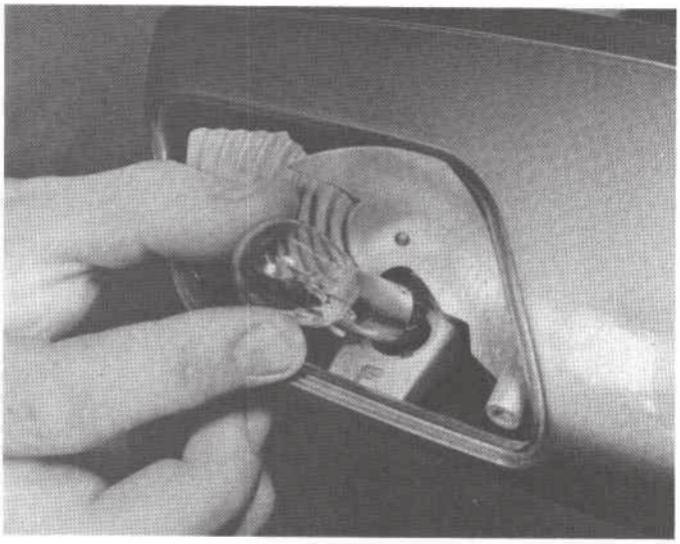
22.14a Except for fairing mounted lamp, remove single retaining screw ...



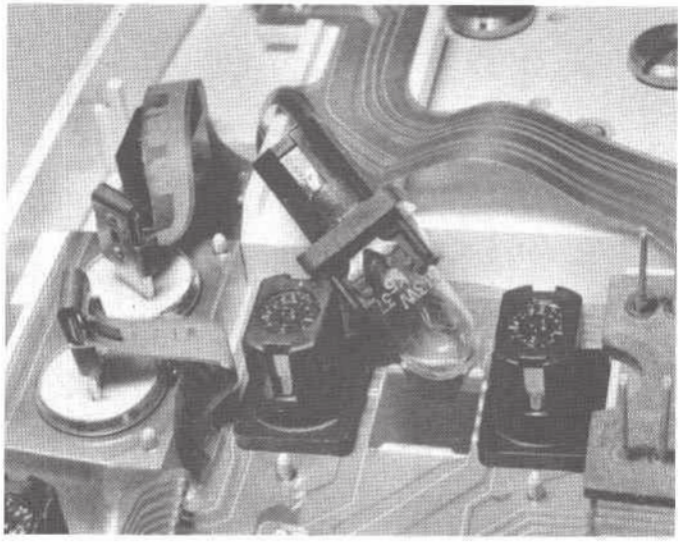
22.14b ... to release lens assembly and expose bulb holder



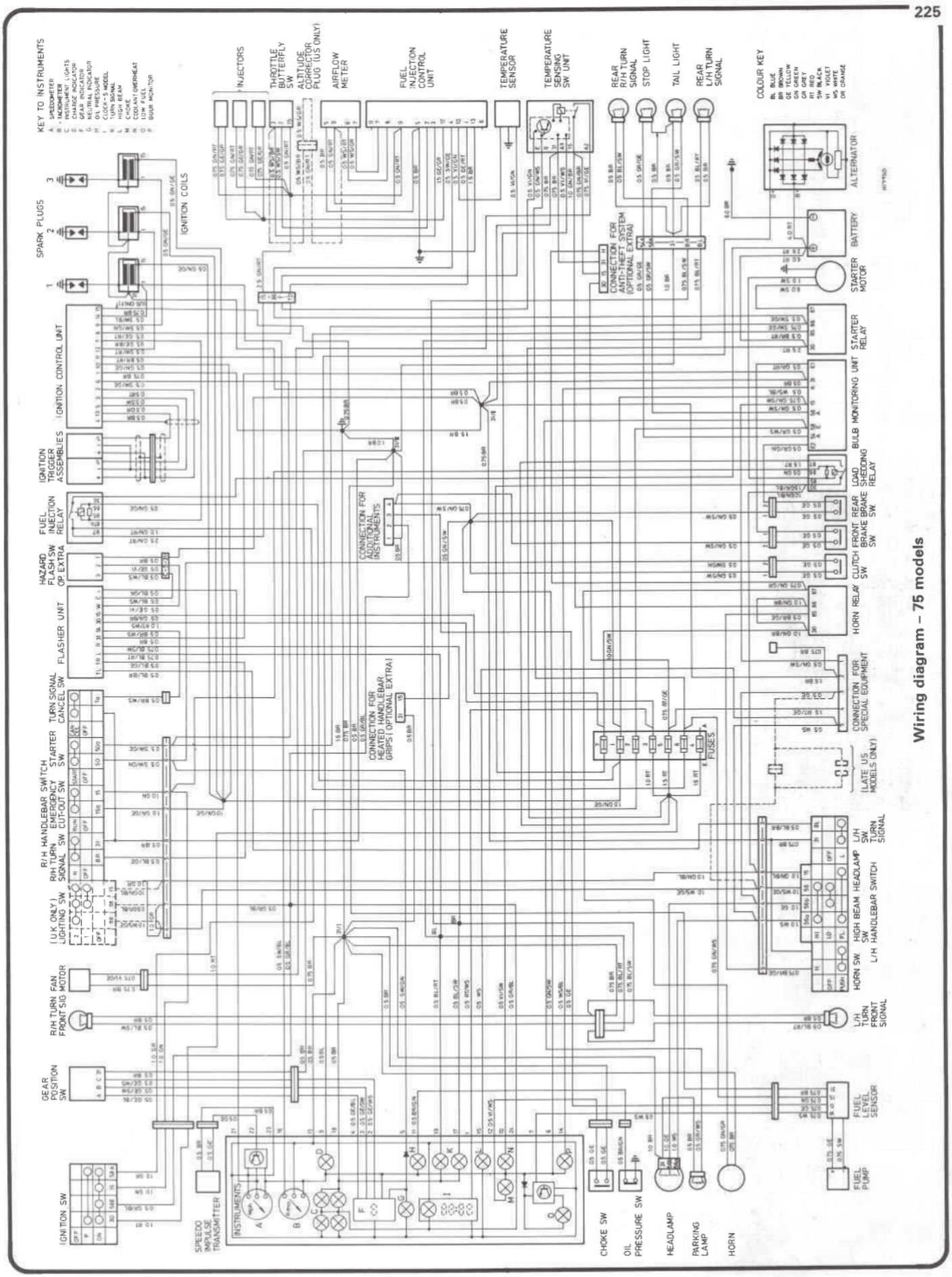
22.16a K100 RS – remove single lens retaining screw from front lamp assembly



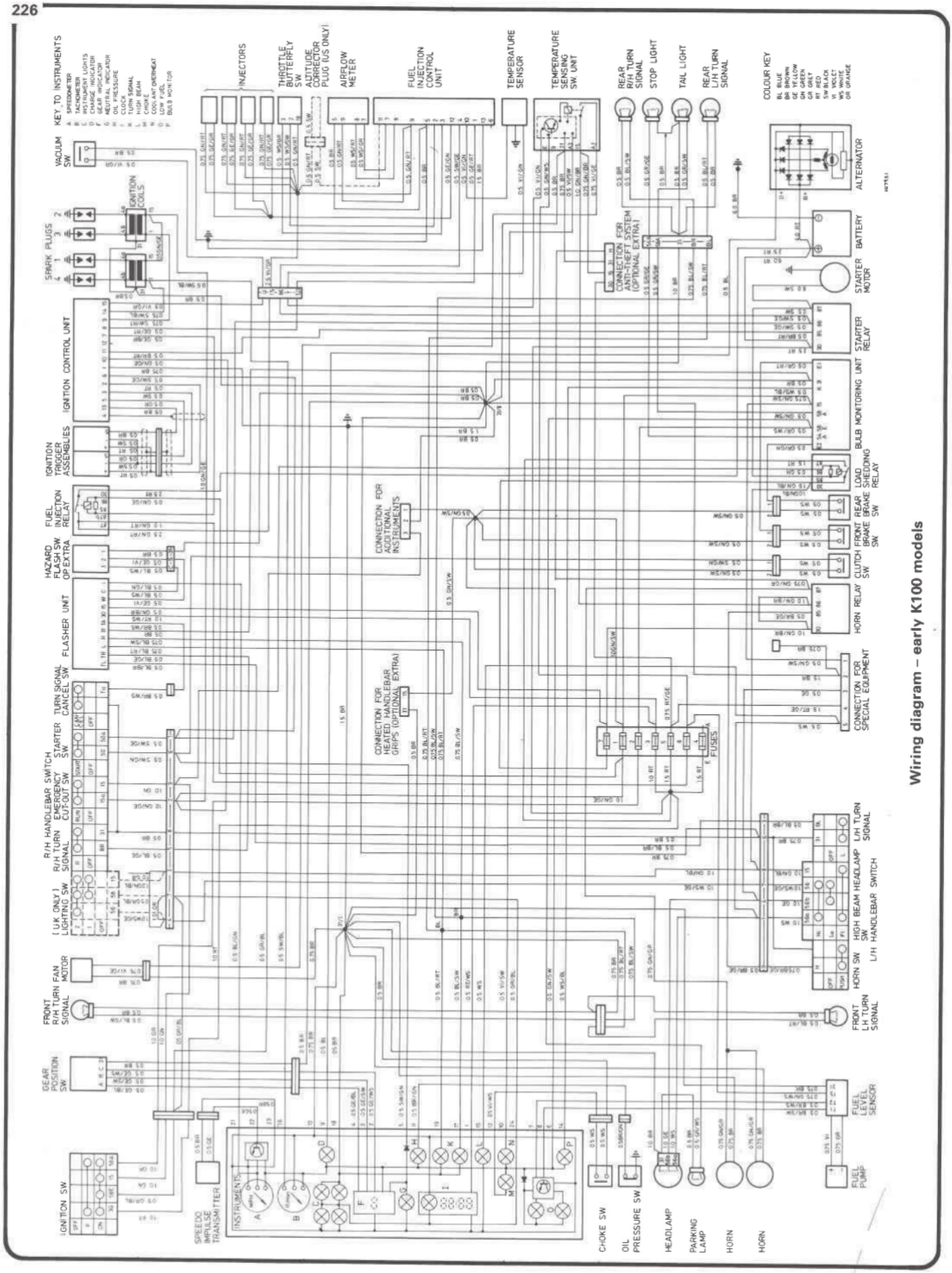
22.16b Bulbs are of bayonet type – press in and twist anticlockwise to release



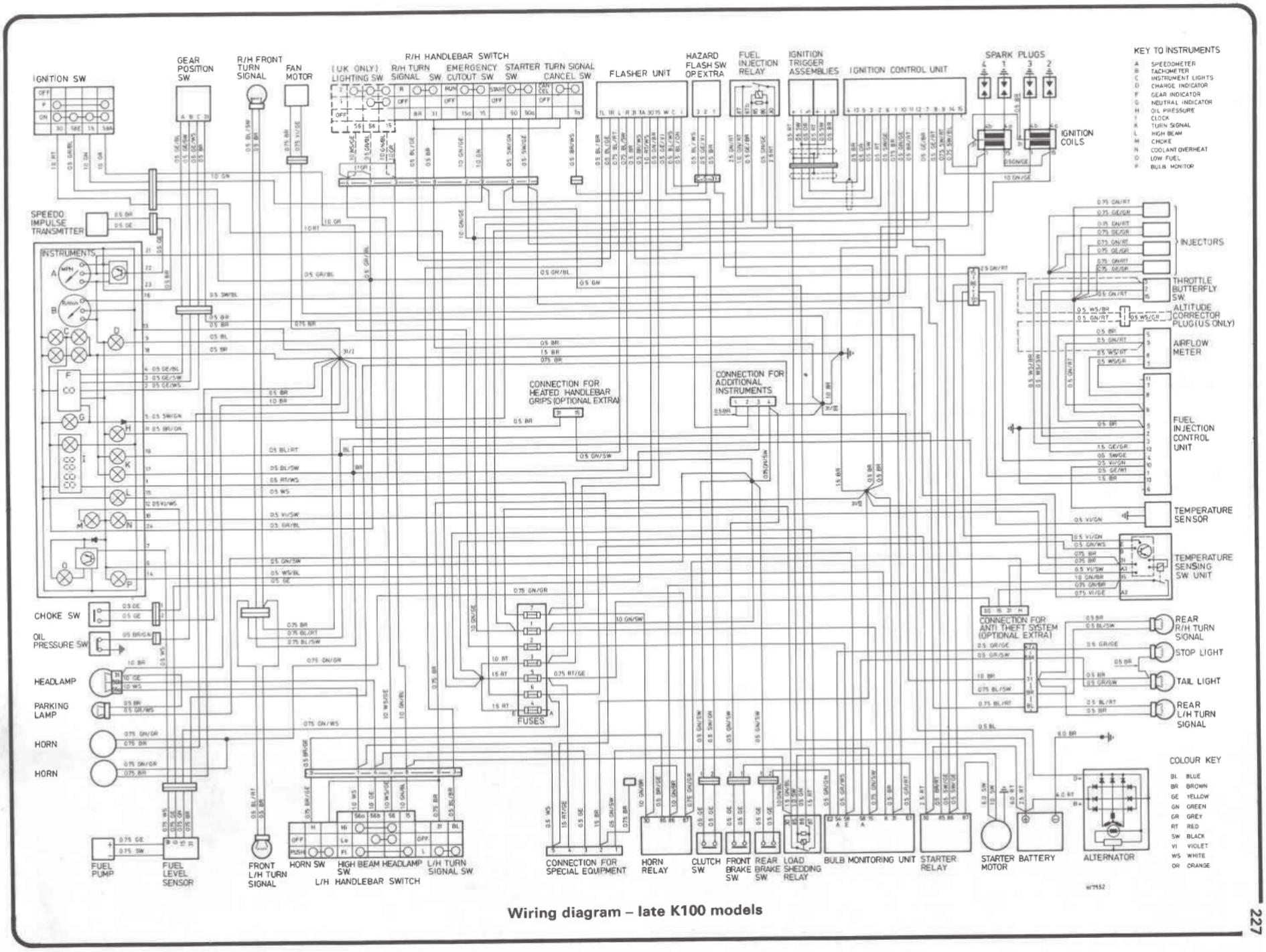
22.18 Instrument panel bulbs are capless type – do not damage wire tails on refitting



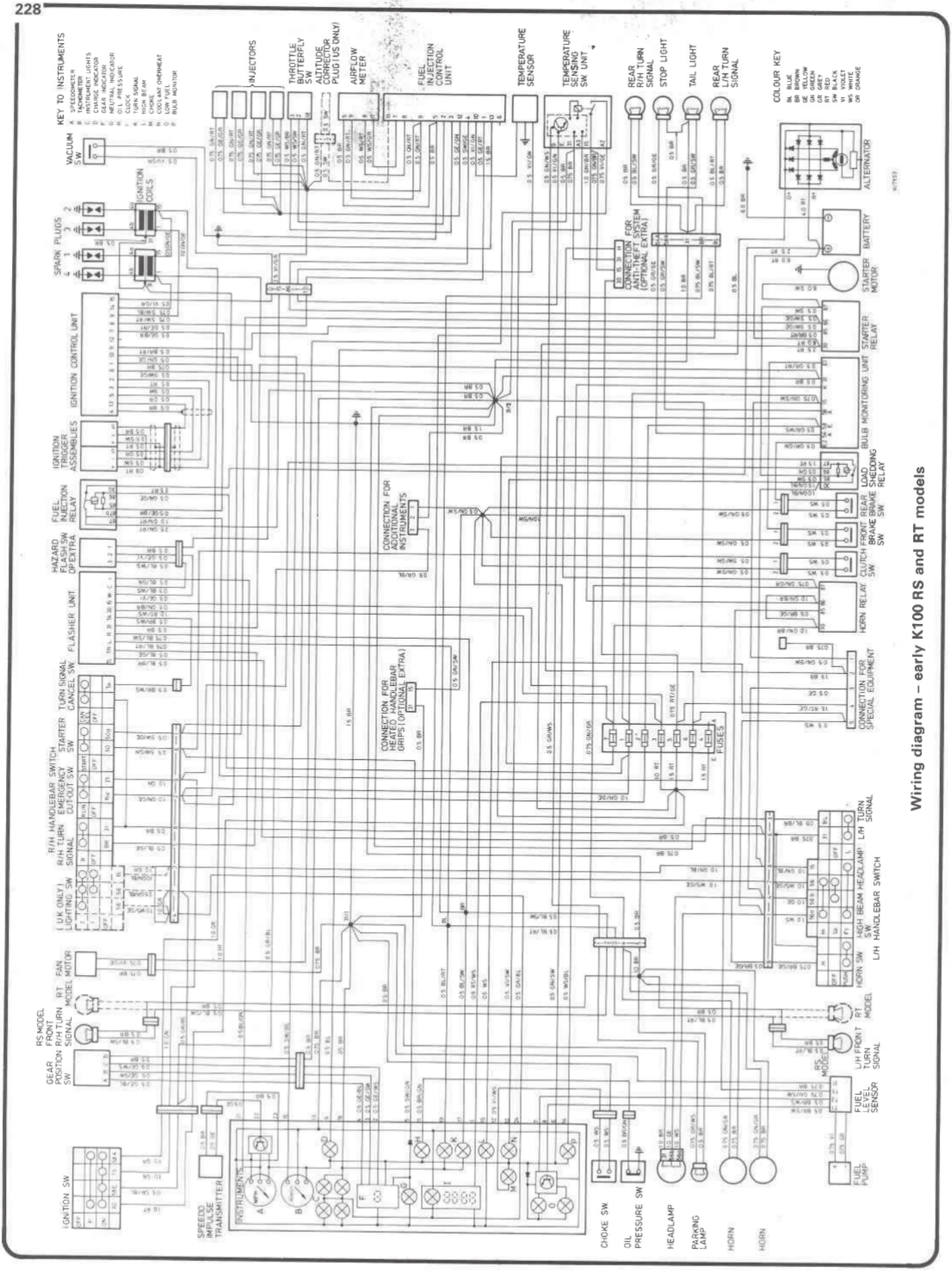
Wiring diagram – 75 models



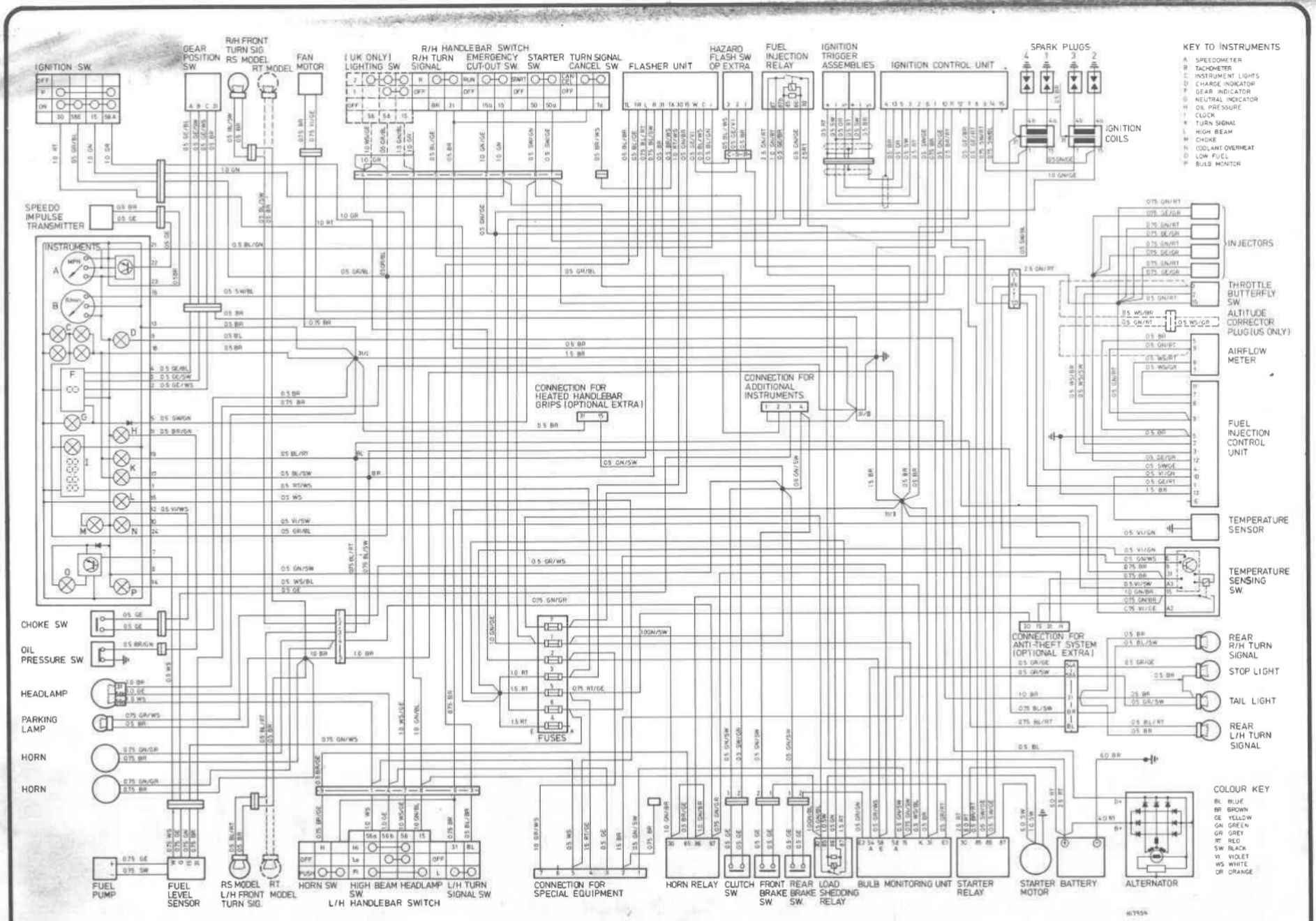
Wiring diagram – early K100 models



Wiring diagram – late K100 models



Wiring diagram – early K100 RS and RT models



Wiring diagram – late K100 RS and RT models

English/American terminology

Because this book has been written in England, British English component names, phrases and spellings have been used throughout. American English usage is quite often different and whereas normally no confusion should occur, a list of equivalent terminology is given below.

English	American	English	American
Air filter	Air cleaner	Mudguard	Fender
Alignment (headlamp)	Aim	Number plate	License plate
Allen screw/key	Socket screw/wrench	Output or layshaft	Countershaft
Anticlockwise	Counterclockwise	Panniers	Side cases
Bottom/top gear	Low/high gear	Paraffin	Kerosene
Bottom/top yoke	Bottom/top triple clamp	Petrol	Gasoline
Bush	Bushing	Petrol/fuel tank	Gas tank
Carburettor	Carburetor	Pinking	Pinging
Catch	Latch	Rear suspension unit	Rear shock absorber
Circlip	Snap ring	Rocker cover	Valve cover
Clutch drum	Clutch housing	Selector	Shifter
Dip switch	Dimmer switch	Self-locking pliers	Vise-grips
Disulphide	Disulfide	Side or parking lamp	Parking or auxiliary light
Dynamo	DC generator	Side or prop stand	Kick stand
Earth	Ground	Silencer	Muffler
End float	End play	Spanner	Wrench
Engineer's blue	Machinist's dye	Split pin	Cotter pin
Exhaust pipe	Header	Stanchion	Tube
Fault diagnosis	Trouble shooting	Sulphuric	Sulfuric
Float chamber	Float bowl	Sump	Oil pan
Footrest	Footpeg	Swinging arm	Swingarm
Fuel/petrol tap	Petcock	Tab washer	Lock washer
Gaiter	Boot	Top box	Trunk
Gearbox	Transmission	Two/four stroke	Two/four cycle
Gearchange	Shift	Tyre	Tire
Gudgeon pin	Wrist/piston pin	Valve collar	Valve retainer
Indicator	Turn signal	Valve collets	Valve cotters
Inlet	Intake	Vice	Vise
Input shaft or mainshaft	Mainshaft	Wheel spindle	Axle
Kickstart	Kickstarter	White spirit	Stoddard solvent
Lower leg	Slider	Windscreen	Windshield

Conversion factors

Length (distance)							
Inches (in)	X	25.4	= Millimetres (mm)	X	0.0394	=	Inches (in)
Feet (ft)	X	0.305	= Metres (m)	X	3.281	=	Feet (ft)
Miles	X	1.609	= Kilometres (km)	X	0.621	=	Miles
Volume (capacity)							
Cubic inches (cu in; in^3)	X	16.387	= Cubic centimetres (cc; cm^3)	X	0.061	=	Cubic inches (cu in; in^3)
Imperial pints (Imp pt)	X	0.568	= Litres (l)	X	1.76	=	Imperial pints (Imp pt)
Imperial quarts (Imp qt)	X	1.137	= Litres (l)	X	0.88	=	Imperial quarts (Imp qt)
Imperial quarts (Imp qt)	X	1.201	= US quarts (US qt)	X	0.833	=	Imperial quarts (Imp qt)
US quarts (US qt)	X	0.946	= Litres (l)	X	1.057	=	US quarts (US qt)
Imperial gallons (Imp gal)	X	4.546	= Litres (l)	X	0.22	=	Imperial gallons (Imp gal)
Imperial gallons (Imp gal)	X	1.201	= US gallons (US gal)	X	0.833	=	Imperial gallons (Imp gal)
US gallons (US gal)	X	3.785	= Litres (l)	X	0.264	=	US gallons (US gal)
Mass (weight)							
Ounces (oz)	X	28.35	= Grams (g)	X	0.035	=	Ounces (oz)
Pounds (lb)	X	0.454	= Kilograms (kg)	X	2.205	=	Pounds (lb)
Force							
Ounces-force (ozf; oz)	X	0.278	= Newtons (N)	X	3.6	=	Ounces-force (ozf; oz)
Pounds-force (lbf; lb)	X	4.448	= Newtons (N)	X	0.225	=	Pounds-force (lbf; lb)
Newtons (N)	X	0.1	= Kilograms-force (kgf; kg)	X	9.81	=	Newtons (N)
Pressure							
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X	0.070	= Kilograms-force per square centimetre (kgf/cm^2; kg/cm^2)	X	14.223	=	Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X	0.068	= Atmospheres (atm)	X	14.696	=	Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X	0.069	= Bars	X	14.5	=	Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X	6.895	= Kilopascals (kPa)	X	0.145	=	Pounds-force per square inch (psi; lbf/in^2; lb/in^2)
Kilopascals (kPa)	X	0.01	= Kilograms-force per square centimetre (kgf/cm^2; kg/cm^2)	X	98.1	=	Kilopascals (kPa)
Millibar (mbar)	X	100	= Pascals (Pa)	X	0.01	=	Millibar (mbar)
Millibar (mbar)	X	0.0145	= Pounds-force per square inch (psi; lbf/in^2, lb/in^2)	X	68.947	=	Millibar (mbar)
Millibar (mbar)	X	0.75	= Millimetres of mercury (mmHg)	X	1.333	=	Millibar (mbar)
Millibar (mbar)	X	1.40	= Inches of water (inH_2O)	X	0.714	=	Millibar (mbar)
Millimetres of mercury (mmHg)	X	1.868	= Inches of water (inH_2O)	X	0.535	=	Millimetres of mercury (mmHg)
Inches of water (inH_2O)	X	27.68	= Pounds-force per square inch (psi, lbf/in^2, lb/in^2)	X	0.036	=	Inches of water (inH_2O)
Torque (moment of force)							
Pounds-force inches (lbf in; lb in)	X	1.152	= Kilograms-force centimetre (kgf cm; kg cm)	X	0.868	=	Pounds-force inches (lbf in; lb in)
Pounds-force inches (lbf in; lb in)	X	0.113	= Newton metres (Nm)	X	8.85	=	Pounds-force inches (lbf in; lb in)
Pounds-force inches (lbf in; lb in)	X	0.083	= Pounds-force feet (lbf ft; lb ft)	X	12	=	Pounds-force inches (lbf in; lb in)
Pounds-force feet (lbf ft; lb ft)	X	0.138	= Kilograms-force metres (kgf m; kg m)	X	7.233	=	Pounds-force feet (lbf ft; lb ft)
Pounds-force feet (lbf ft; lb ft)	X	1.356	= Newton metres (Nm)	X	0.738	=	Pounds-force feet (lbf ft; lb ft)
Newton metres (Nm)	X	0.102	= Kilograms-force metres (kgf m; kg m)	X	9.804	=	Newton metres (Nm)
Power							
Horsepower (hp)	X	745.7	= Watts (W)	X	0.0013	=	Horsepower (hp)
Velocity (speed)							
Miles per hour (miles/hr; mph)	X	1.609	= Kilometres per hour (km/hr; kph)	X	0.621	=	Miles per hour (miles/hr; mph)
*Fuel consumption**							
Miles per gallon, Imperial (mpg)	X	0.354	= Kilometres per litre (km/l)	X	2.825	=	Miles per gallon, Imperial (mpg)
Miles per gallon, US (mpg)	X	0.425	= Kilometres per litre (km/l)	X	2.352	=	Miles per gallon, US (mpg)

Temperature

Degrees Fahrenheit = (°C x 1.8) + 32

Degrees Celsius (Degrees Centigrade; °C) = (°F - 32) x 0.56

**It is common practice to convert from miles per gallon (mpg) to litres/100 kilometres (l/100km), where mpg (Imperial) x l/100 km = 282 and mpg (US) x l/100 km = 235*

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