YUGO/ZASTAVA

All models □ 1981 to 1990
903 cc □ 1116 cc □ 1298 cc □ 1301 cc

Haynes

Owners Workshop Manual

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Haynes®

THE BOOK

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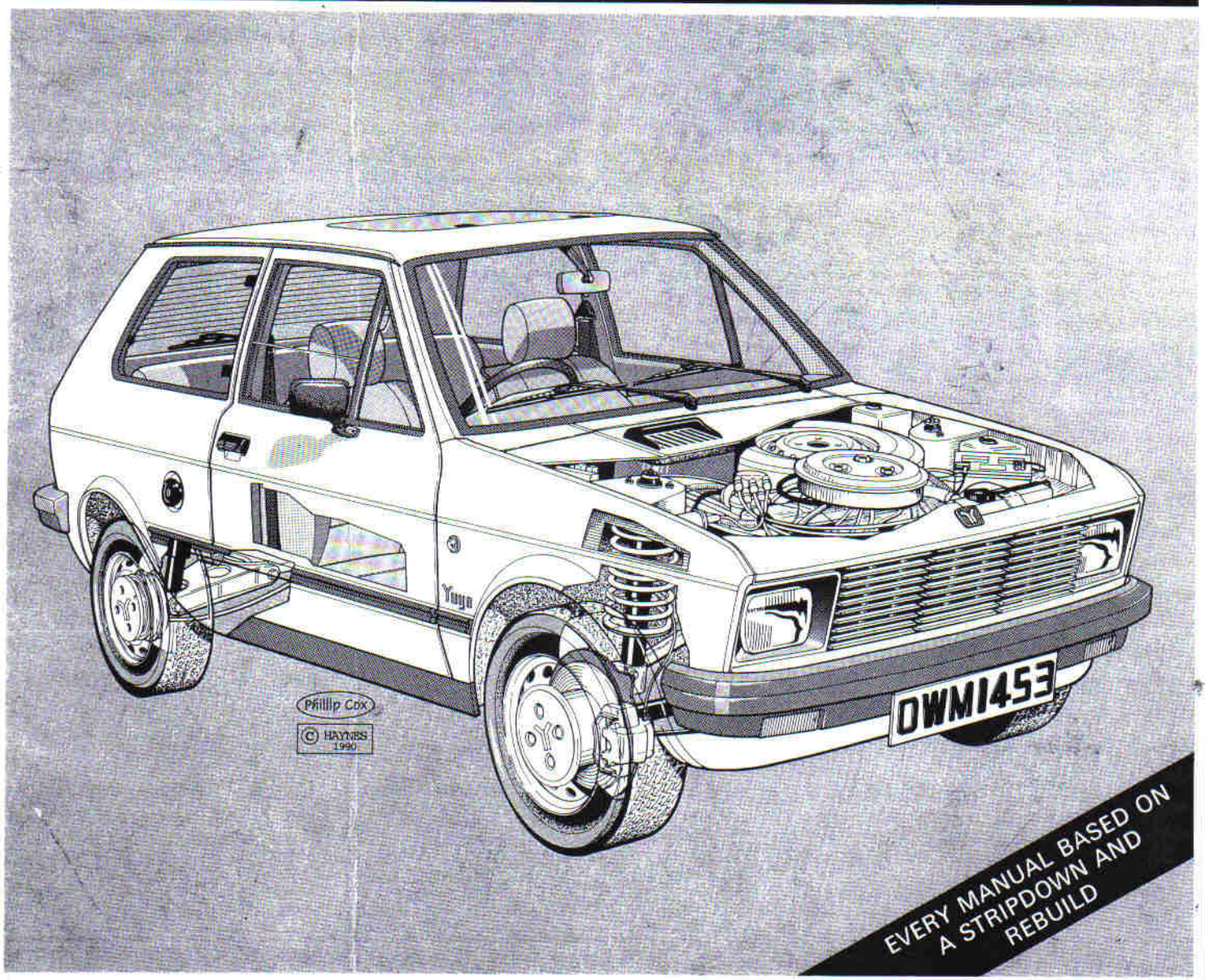

EVERY MANUAL BASED ON A STRIPDOWN AND REBUILD

Yugo/ Zastava Owners Workshop Manual

Colin Brown

Models covered
All Yugo and Zastava models
Saloon, Hatchback and Van
903 cc, 1116 cc, 1298 cc & 1301 cc

(1453-5T2)

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Haynes
THE BOOK

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A book in the Haynes Owners Workshop Manual Series

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Restoring and Preserving our Motoring Heritage

Few people can have had the luck to realise their dreams to quite the same extent and in such a remarkable fashion as John Haynes, Founder and Chairman of the Haynes Publishing Group.

Since 1965 his unique approach to workshop manual publishing has proved so successful that millions of Haynes Manuals are now sold every year throughout the world, covering literally thousands of different makes and models of cars, vans and motorcycles.

A continuing passion for cars and motoring led to the founding in 1985 of a Charitable Trust dedicated to the restoration and preservation of our motoring heritage. To inaugurate the new Museum, John Haynes donated virtually his entire private collection of 52 cars.

Now with an unrivalled international collection of over 210 veteran, vintage and classic cars and motorcycles, the Haynes Motor Museum in Somerset is well on the way to becoming one of the most interesting Motor Museums in the world.

A 70 seat video cinema, a cafe and an extensive motoring bookshop, together with a specially constructed one kilometre motor circuit, make a visit to the Haynes Motor Museum a truly unforgettable experience.

Every vehicle in the museum is preserved in as near as possible mint condition and each car is run every six months on the motor circuit.

Enjoy the picnic area set amongst the rolling Somerset hills. Peer through the William Morris workshop windows at cars being restored, and browse through the extensive displays of fascinating motoring memorabilia.

From the 1903 Oldsmobile through such classics as an MG Midget to the mighty 'E' Type Jaguar, Lamborghini, Ferrari Berlinetta Boxer, and Graham Hill's Lola Cosworth, there is something for everyone, young and old alike, at this Somerset Museum.

Haynes Motor Museum

Situated mid-way between London and Penzance, the Haynes Motor Museum is located just off the A303 at Sparkford, Somerset (home of the Haynes Manual) and is open to the public 7 days a week all year round, except Christmas Day and Boxing Day.

Contents

1988 Yugo 45A

1988 Yugo 513

About this manual

Its aim

The aim of this manual is to help you get the best value from your vehicle. It can do so in several ways. It can help you decide what work must be done (even should you choose to get it done by a garage), provide information on routine maintenance and servicing, and give a logical course of action and diagnosis when random faults occur. However, it is hoped that you will use the manual by tackling the work yourself. On simpler jobs it may even be quicker than booking the car into a garage and going there twice, to leave and collect it. Perhaps most important, a lot of money can be saved by avoiding the costs a garage must charge to cover its labour and overheads.

The manual has drawings and descriptions to show the function of the various components so that their layout can be understood. Then the tasks are described and photographed in a step-by-step sequence so that even a novice can do the work.

Its arrangement

The manual is divided into thirteen Chapters, each covering a logical sub-division of the vehicle. The Chapters are each divided into Sections, numbered with single figures, eg 5; and the Sections into paragraphs (or sub-sections), with decimal numbers following on from the Section they are in, eg. 5.1, 5.2, 5.3 etc.

It is freely illustrated, especially in those parts where there is a detailed sequence of operations to be carried out. There are two forms of illustration: figures and photographs. The figures are numbered in sequence with decimal numbers, according to their position in the Chapter – eg Fig. 6.4 is the fourth drawing/illustration in Chapter 6. Photographs carry the same number (either individually or in related groups) as the Section or sub-section to which they relate.

There is an alphabetical index at the back of the manual as well as a contents list at the front. Each Chapter is also preceded by its own individual contents list.

References to the 'left' or 'right' of the vehicle are in the sense of a person in the driver's seat facing forwards.

Unless otherwise stated, nuts and bolts are removed by turning anti-clockwise, and tightened by turning clockwise.

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

Whilst every care is taken to ensure that the information in this manual is correct, no liability can be accepted by the authors or publishers for loss, damage or injury caused by any errors in, or omissions from, the information given.

Project vehicles

The project vehicles used in the compilation of this manual and appearing in many of the photographic sequences were a Yugo 45A, Yugo 65A GLX and Yugo 513.

Introduction to the Yugo

Imported from Yugoslavia by Zastava (GB) Ltd since 1981, the Yugo range of vehicles has established its own niche in the UK market.

The first models imported were sold under the Zastava badge and consisted of 1100 cc and 1300 cc 3 and 5-door hatchbacks, based on the Fiat 128. Subsequently in 1983 these models became known as the Yugo 311, 313, 511 and 513, and a Van derivative was introduced. In 1984 4-door saloon models, also based on the Fiat 128 were introduced, known as the 411 and 413. In 1983 the Yugo 45 was introduced, a 3-door hatchback powered by a 903 cc engine and based on the Fiat 127. The 55 model followed, with the larger 1116 cc engine, and in 1986 these models were re-designated the 45A and 55A, with a Van derivative also available. The introduction of the 65A GLX with the 1300 cc engine brings the range up to date.

Throughout the manual, references to '3/4/5 series' refer to all 311, 313, 411, 413, 511 and 513 models (including early 1100 and 1300 models), unless otherwise specified. Similarly, references to '45/55/65 models' refer to all 45, 45A, 55, 55A and 65A models.

General dimensions, weights and capacities

Dimensions

Overall length:	
1100 models (1981-on)	3836 mm (151.1 in)
1300 models (1981-on)	3792 mm (149.4 in)
3 and 5 series models (1983-on)	3886 mm (153.0 in)
411 and 413 models (1984-on)	3815 mm (150.2 in)
45/55/65 models (1983-on)	3490 mm (137.4 in)
Overall width:	
1100 and 1300 models (1981-on)	1590 mm (62.6 in)
3/4/5 series models (1983-on)	1590 mm (62.6 in)
45/55/65 models (1983-on)	1542 mm (60.7 in)
Overall height:	
1100 and 1300 models (1981-on)	1372 mm (54.0 in)
3/4/5 models (1983-on)	1346 mm (53.0 in)
45/55/65 models (1983-on)	1390 mm (54.8 in)
Wheelbase:	
3/4/5 series models (1981-on)	2449 mm (96.4 in)
45/55/65 models (1983-on)	2150 mm (84.7 in)
Front track:	
3/4/5 series models (1981-on)	1304 mm (51.3 in)
45/55/65 models (1983-on)	1308 mm (51.5 in)
Rear track:	
3/4/5 series models (1981-on)	1320 mm (52.0 in)
45/55/65 models (1983-on)	1295 mm (51.0 in)
Turning circle:	
3/4/5 series models (1981-on)	10.28 m (33 ft 9 in)
45/55/65 models (1983-on)	9.5 m (31 ft 2 in)

Weights

Kerb weight:	
1100 models (1981-on)	835 kg (1837 lb)
1300 models (1981-on)	856 kg (1883 lb)
411 and 413 models (1984-on)	850 kg (1874 lb)
311 and 313 models (1983-on)	820 kg (1804 lb)
511 and 513 models (1983-on)	835 kg (1837 lb)
311 and 313 Van (1983-on)	800 kg (1760 lb)
45 and 55 models (1983-on)	726 kg (1600 lb)
45A and Van (1988-on)	750 kg (1650 lb)
55A and Van (1988-on)	790 kg (1738 lb)
65A (1988-on)	810 kg (1782 lb)
Maximum towing weights:	
Unbraked trailer:	
3/4/5 series models (1981-on)	400 kg (880 lb)
45 and 45A models (1983-on)	350 kg (770 lb)
55, 55A and 65A models (1983-on)	400 kg (880 lb)
Braked trailer:	
1100, 311, 411 and 511 models (1981-on)	685 kg (1507 lb)
1300, 313, 413 and 513 models (1981-on)	735 kg (1617 lb)
45 and 45A models (1983-on)	585 kg (1287 lb)
55 and 55A models (1983-on)	635 kg (1397 lb)
65A models (1988-on)	685 kg (1507 lb)

Capacities

Fuel tank:	
3/4/5 series models	38.0 litres (8.35 Imp gals)
45/55/65 models	30.0 litres (6.6 Imp gals)
Engine oil (with filter change):	
903 cc engine	4.0 litres (7.0 pints)
1116 cc, 1298 cc and 1301 cc engines	4.5 litres (7.9 pints)
Transmission (all models)	3.15 litres (5.5 pints)
Cooling system:	
903 cc engine	5.0 litres (8.8 pints)
1116 cc, 1298 cc and 1301 cc engines	6.5 litres (11.4 pints)

Jacking and towing

Jacking

The jack supplied with the vehicle must be used only for wheel changing. It is not designed for general maintenance purposes, and work underneath a vehicle supported only on the vehicle jack must never be attempted.

For general repair and maintenance work, raise the vehicle using a trolley jack positioned under the front towing eye for raising the front of the vehicle, and under the centre of the rear leaf spring for raising the rear (photo).

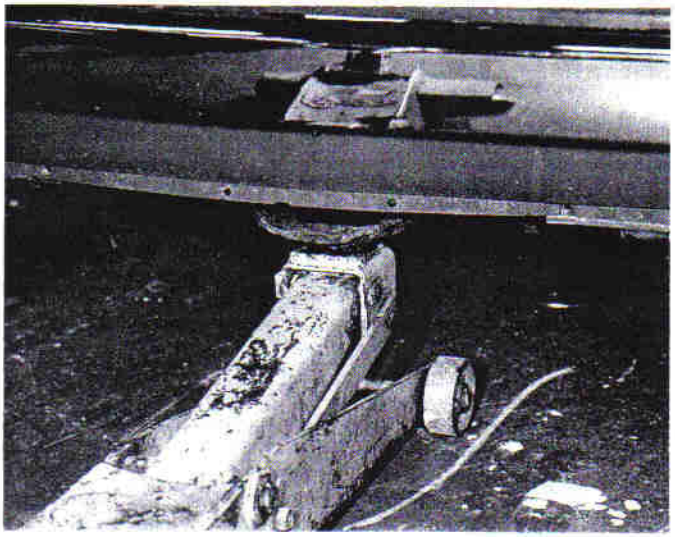
Once the desired height is reached, position axle stands under the chassis strong points and lower the vehicle onto the stands (photo).

If the wheels are to be removed during servicing, it is advantageous to loosen the wheel bolts before the vehicle is raised.

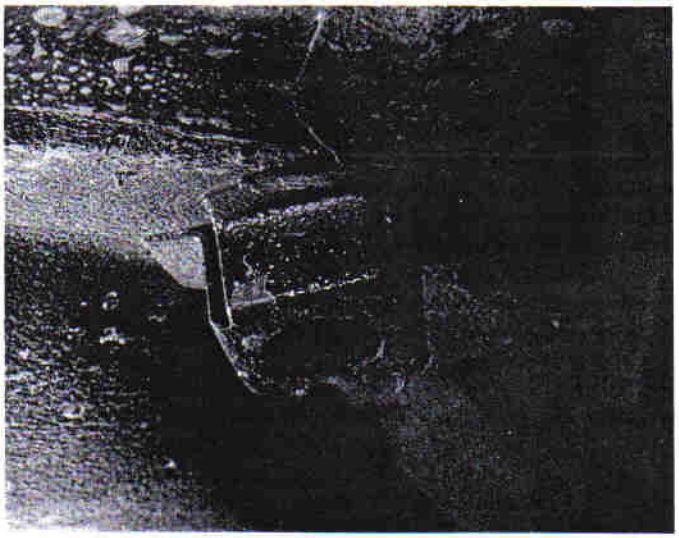
Towing

Towing eyes are provided at the front and rear of the vehicle (photos). The rear towing eye must only be used for the emergency towing of another vehicle and never for towing a trailer or caravan. Only a properly approved and fitted towing bracket must be used for this purpose.

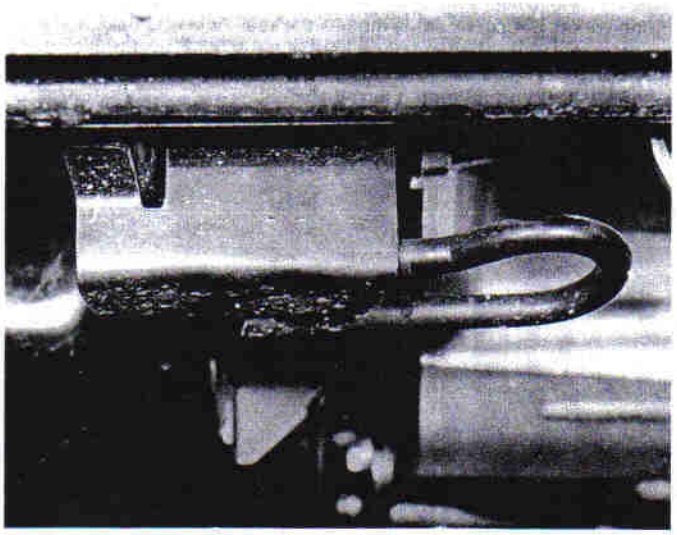
When being towed, ensure that the ignition switch is turned to unlock the steering wheel, and remember that on vehicles with a brake vacuum servo more effort will be required to operate the footbrake without the engine running.



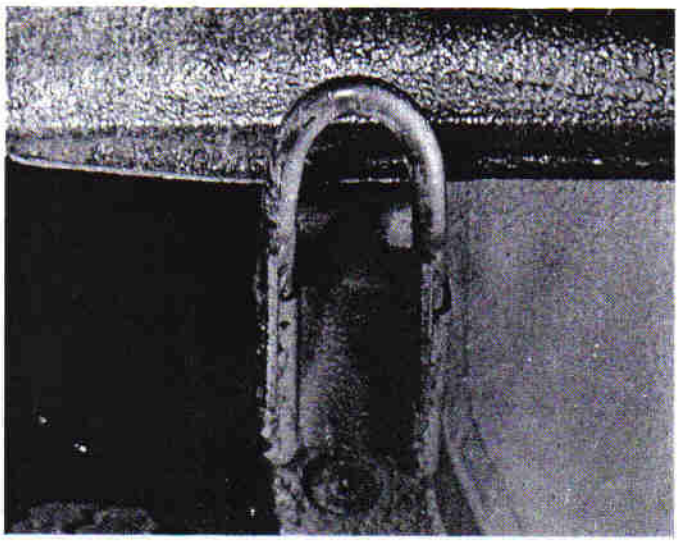
Trolley jack positioned under the front jacking point



Chassis strong point



Front towing eye



Rear towing eye

Wheel changing

With the vehicle on firm level ground, apply the handbrake and chock the wheel diagonally opposite that being removed.

Open the bonnet and on 45/55/65 models, lift out the spare wheel to gain access to the vehicle jack. On 3/4/5 series models unhook the jack from its stowage, then lift out the spare wheel after undoing the plastic clamp.

Take the wrench from the vehicle toolkit and loosen but do not remove the roadwheel bolts. This makes it easier to undo the bolts once the vehicle is raised off the ground.

Open out the jack and engage the jack head on the square section jacking point on the underside of the vehicle (photo).

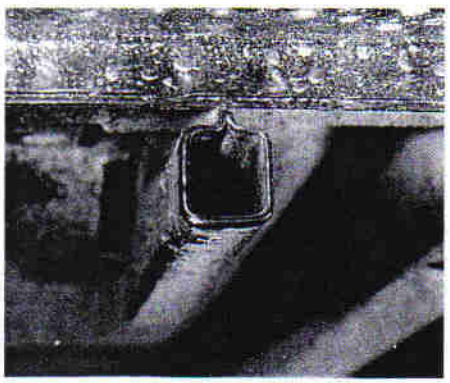
Raise the vehicle until the wheel is clear of the ground, remove the roadwheel bolts and lift off the wheel. On 45A and 55A models the wheel trim is located under the wheel bolts, but on 65A models the central motif must be prised out to gain access to the bolts.

Take the spare wheel and fit it to the hub, lining up the spigot on the hub with the hole in the wheel (photo). Fit the wheel bolts and, where applicable the wheel trim, and tighten the bolts as far as is possible with the wheel off the ground.

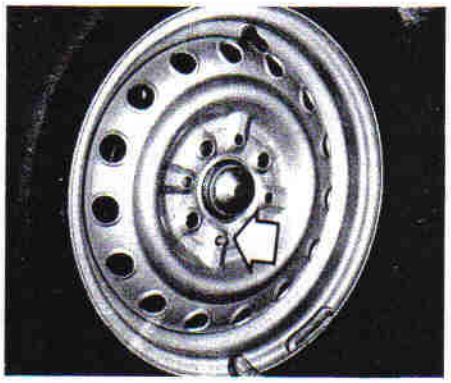
Lower the vehicle from the jack and tighten the bolts when the weight of the vehicle is on the ground. If the bolts cannot be torque loaded (roadside emergency), then torque load them as soon as possible.

Stow away the jack and wheel and remove the chocks from the opposite wheel.

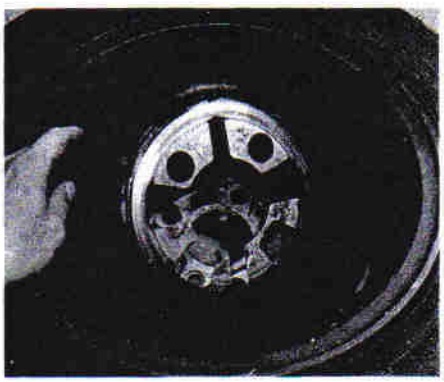
Note that some models have a dust excluding seal fitted to the inside of the wheel and this must be transferred to the spare when fitting (photo). Also, on some models the spare wheel is designed only for emergency use, particularly where alloy wheels are fitted and the spare is made of steel. Obviously the importance of repairing the original wheel and refitting it is self evident.



Jacking point on underside of vehicle



Locating the wheel (spigot arrowed)



Wheel dust excluding seal

Buying spare parts and vehicle identification numbers

Buying spare parts

Spare parts are available from many sources, for example: Yugo garages, other garages, accessory shops, and motor factors. Our advice regarding spare parts is as follows.

Officially appointed Yugo garages – This is the best source of parts which are peculiar to your car and otherwise not generally available (eg complete cylinder heads, internal gearbox components, badges, interior trim etc). It is also the only place at which you should buy parts if your vehicle is still under warranty – non-Yugo parts may invalidate the warranty. To be sure of obtaining the correct parts it will always be necessary to give the partsman your engine number, chassis number and number for spares, and if possible, to take the old part along for positive identification.

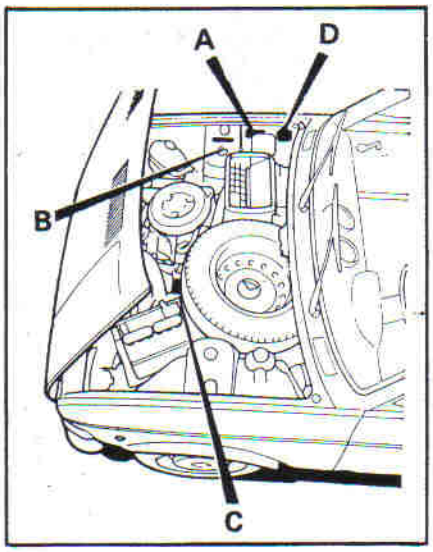
Other garages and accessory shops – These are often very good places to buy material and components needed for the maintenance of your car (eg oil filters, spark plugs, bulbs, drivebelts, oils and greases, touch-up paint, filler paste etc). They also sell accessories, usually have convenient opening hours, charge lower prices, and can often be found not far from home.

Motor factors – Good factors stock all of the more important components which wear out relatively quickly (eg clutch components, pistons, valves, exhaust systems, brake pipes/seals/shoes and pads etc). Motor factors will often provide new or reconditioned components on a part exchange basis – this can save a considerable amount of money.

Vehicle identification numbers

Modifications are a continuing and unpublicised process in vehicle manufacture quite apart from major model changes. Spare parts manuals and lists are compiled upon a numerical basis, the individual vehicle numbers being essential to correct identification of the component required.

The *chassis type and number plate* is located on the wing valance under the bonnet (photo). The *identification data plate* is located on the radiator top rail (photo) or on the wing valance. The *engine type and number* is stamped on the cylinder block. The *paintwork colour code* is given on a label stuck to the inner surface of the tailgate. (photo).



Location of vehicle identification plates

A Vehicle, bodywork and engine data (alternative location)
B Chassis type and number
C Engine type and number
D Type approval number

Paintwork colour code on tailgate label

Chassis number stamped on the inner wing

Identification data plate on radiator top rail

General repair procedures

Whenever servicing, repair or overhaul work is carried out on the car or its components, it is necessary to observe the following procedures and instructions. This will assist in carrying out the operation efficiently and to a professional standard of workmanship.

Joint mating faces and gaskets

Where a gasket is used between the mating faces of two components, ensure that it is renewed on reassembly, and fit it dry unless otherwise stated in the repair procedure. Make sure that the mating faces are clean and dry with all traces of old gasket removed. When cleaning a joint face, use a tool which is not likely to score or damage the face, and remove any burrs or nicks with an oilstone or fine file.

Make sure that tapped holes are cleaned with a pipe cleaner, and keep them free of jointing compound if this is being used unless specifically instructed otherwise.

Ensure that all orifices, channels or pipes are clear and blow through them, preferably using compressed air.

Oil seals

Whenever an oil seal is removed from its working location, either individually or as part of an assembly, it should be renewed.

The very fine sealing lip of the seal is easily damaged and will not seal if the surface it contacts is not completely clean and free from scratches, nicks or grooves. If the original sealing surface of the component cannot be restored, the component should be renewed.

Protect the lips of the seal from any surface which may damage them in the course of fitting. Use tape or a conical sleeve where possible. Lubricate the seal lips with oil before fitting and, on dual lipped seals, fill the space between the lips with grease.

Unless otherwise stated, oil seals must be fitted with their sealing lips toward the lubricant to be sealed.

Use a tubular drift or block of wood of the appropriate size to install the seal and, if the seal housing is shouldered, drive the seal down to the shoulder. If the seal housing is unshouldered, the seal should be fitted with its face flush with the housing top face.

Screw threads and fastenings

Always ensure that a blind tapped hole is completely free from oil, grease, water or other fluid before installing the bolt or stud. Failure to do this could cause the housing to crack due to the hydraulic action of the bolt or stud as it is screwed in.

When tightening a castellated nut to accept a split pin, tighten the nut to the specified torque, where applicable, and then tighten further to the next split pin hole. Never slacken the nut to align a split pin hole unless stated in the repair procedure.

When checking or retightening a nut or bolt to a specified torque setting, slacken the nut or bolt by a quarter of a turn, and then retighten to the specified setting.

Locknuts, locktabs and washers

Any fastening which will rotate against a component or housing in the course of tightening should always have a washer between it and the relevant component or housing.

Spring or split washers should always be renewed when they are used to lock a critical component such as a big-end bearing retaining nut or bolt.

Locktabs which are folded over to retain a nut or bolt should always be renewed.

Self-locking nuts can be reused in non-critical areas, providing resistance can be felt when the locking portion passes over the bolt or stud thread.

Split pins must always be replaced with new ones of the correct size for the hole.

Special tools

Some repair procedures in this manual entail the use of special tools such as a press, two or three-legged pullers, spring compressors etc. Wherever possible, suitable readily available alternatives to the manufacturer's special tools are described, and are shown in use. In some instances, where no alternative is possible, it has been necessary to resort to the use of a manufacturer's tool and this has been done for reasons of safety as well as the efficient completion of the repair operation. Unless you are highly skilled and have a thorough understanding of the procedure described, never attempt to bypass the use of any special tool when the procedure described specifies its use. Not only is there a very great risk of personal injury, but expensive damage could be caused to the components involved.

Tools and working facilities

Introduction

A selection of good tools is a fundamental requirement for anyone contemplating the maintenance and repair of a motor vehicle. For the owner who does not possess any, their purchase will prove a considerable expense, offsetting some of the savings made by doing-it-yourself. However, provided that the tools purchased meet the relevant national safety standards and are of good quality, they wil 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 *Special.* The newcomer to practical mechanics should start off with the *Maintenance and minor repair* tool kit and confine himself to the simpler jobs around the vehicle. Then, as his confidence and experience grow, he can undertake more difficult tasks, buying extra tools as, and when, they are needed. In this way, a *Maintenance and minor repair* tool kit can be built-up into a *Repair and overhaul* tool kit over a considerable period of time without any major cash outlays. The experienced do-it-yourselfer will have a tool kit good enough for most repair and overhaul procedures and will add tools from the *Special* category when he feels the expense is justified by the amount of use to which these tools will be put.

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.

Maintenance and minor repair tool kit

The tools given in this list should be considered as a minimum requirement if routine maintenance, servicing and minor repair operations are to be undertaken. We recommend the purchase of combination spanners (ring one end, open-ended the other); although more expensive than open-ended ones, they do give the advantages of both types of spanner.

Combination spanners - 10, 11, 12, 13, 14 & 17 mm
Adjustable spanner - 9 inch
Engine sump/gearbox drain plug key
Spark plug spanner (with rubber insert)
Spark plug gap adjustment tool
Set of feeler gauges
Brake adjuster spanner
Brake bleed nipple spanner
Screwdriver - 4 in long x 1/4 in dia (flat blade)
Screwdriver - 4 in long x 1/4 in dia (cross blade)
Combination pliers - 6 inch
Hacksaw (junior)
Tyre pump
Tyre pressure gauge
Grease gun
Oil can
Fine emery cloth (1 sheet)
Wire brush (small)
Funnel (medium size)

Repair and overhaul tool kit

These tools are virtually essential for anyone undertaking any major repairs to a motor vehicle, and are additional to those given in the *Maintenance and minor repair* list. Included in this list is a comprehensive set of sockets. Although these are expensive they will be found invaluable as they are so versatile - particularly if various drives are included in the set. We recommend the 1/2 in square-drive type, as this can be used with most proprietary torque wrenches. If you cannot afford a socket set, even bought piecemeal, then inexpensive tubular box spanners are a useful alternative.

The tools in this list will occasionally need to be supplemented by tools from the *Special* list.

Sockets (or box spanners) to cover range in previous list
Reversible ratchet drive (for use with sockets)
Extension piece, 10 inch (for use with sockets)
Universal joint (for use with sockets)
Torque wrench (for use with sockets)
'Mole' wrench - 8 inch
Ball pein hammer
Soft-faced hammer, plastic or rubber
Screwdriver - 6 in long x 5/16 in dia (flat blade)
Screwdriver - 2 in long x 5/16 in square (flat blade)
Screwdriver - 1 1/2 in long x 1/4 in dia (cross blade)
Screwdriver - 3 in long x 1/8 in dia (electricians)
Pliers - electricians side cutters
Pliers - needle nosed
Pliers - circlip (internal and external)
Cold chisel - 1/2 inch
Scriber
Scraper
Centre punch
Pin punch
Hacksaw
Valve grinding tool
Steel rule/straight-edge
Allen keys (inc. splined/Torx type if necessary)
Selection of files
Wire brush (large)
Axle-stands
Jack (strong trolley or hydraulic type)

Special tools

The tools in this list are those which are not used regularly, are expensive to buy, or which need to be used in accordance with their manufacturers' instructions. Unless relatively difficult mechanical jobs are undertaken frequently, it will not be economic to buy many of these tools. Where this is the case, you could consider clubbing together with friends (or joining a motorists' club) to make a joint purchase, or borrowing the tools against a deposit from a local garage or tool hire specialist.

The following list contains only those tools and instruments freely available to the public, and not those special tools produced by the vehicle manufacturer specifically for its dealer network. You will find occasional references to these manufacturers' special tools in the text of this manual. Generally, an alternative method of doing the job without the vehicle manufacturers' special tool is given. However, sometimes, there is no alternative to using them. Where this is the case and the relevant tool cannot be bought or borrowed, you will have to entrust the work to a franchised garage.

Valve spring compressor (where applicable)
Piston ring compressor
Balljoint separator
Universal hub/bearing puller
Impact screwdriver
Micrometer and/or vernier gauge
Dial gauge
Stroboscopic timing light
Dwell angle meter/tachometer
Universal electrical multi-meter
Cylinder compression gauge
Lifting tackle
Trolley jack
Light with extension lead

Buying tools

For practically all tools, a tool factor is the best source since he will have a very comprehensive range compared with the average garage or accessory shop. Having said that, accessory shops often offer excellent quality tools at discount prices, so it pays to shop around.

There are plenty of good tools around at reasonable prices, but always aim to purchase items which meet the relevant national safety standards. If in doubt, ask the proprietor or manager of the shop for advice before making a purchase.

Care and maintenance of tools

Having purchased a reasonable tool kit, it is necessary to keep the tools in a clean serviceable condition. After use, always wipe off any dirt, grease and metal particles using a clean, dry cloth, before putting the tools away. Never leave them lying around after they have been used. A simple tool rack on the garage or workshop wall, for items such as screwdrivers and pliers is a good idea. Store all normal wrenches and sockets in a metal box. Any measuring instruments, gauges, meters, etc, must be carefully stored where they cannot be damaged or become rusty.

Take a little care when tools are used. Hammer heads inevitably become marked and screwdrivers lose the keen edge on their blades from time to time. A little timely attention with emery cloth or a file will soon restore items like this to a good serviceable finish.

Working facilities

Not to be forgotten when discussing tools, is the workshop itself. If anything more than routine maintenance is to be carried out, some form of suitable working area becomes essential.

It is appreciated that many an owner mechanic is forced by circumstances to remove an engine or similar item, without the benefit of a garage or workshop. Having done this, any repairs should always be done under the cover of a roof.

Wherever possible, any dismantling should be done on a clean, flat workbench or table at a suitable working height.

Any workbench needs a vice: one with a jaw opening of 4 in (100 mm) is suitable for most jobs. As mentioned previously, some clean dry storage space is also required for tools, as well as for lubricants, cleaning fluids, touch-up paints and so on, which become necessary.

Another item which may be required, and which has a much more general usage, is an electric drill with a chuck capacity of at least 5/16 in (8 mm). This, together with a good range of twist drills, is virtually essential for fitting accessories such as mirrors and reversing lights.

Last, but not least, always keep a supply of old newspapers and clean, lint-free rags available, and try to keep any working area as clean as possible.

Spanner jaw gap comparison table

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 in BSF
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	5/8 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

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	0.401	= Inches of water (inH_2O)	X	2.491	=	Millibar (mbar)
Millimetres of mercury (mmHg)	X	0.535	= Inches of water (inH_2O)	X	1.868	=	Millimetres of mercury (mmHg)
Inches of water (inH_2O)	X	0.036	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X	27.68	=	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*

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 rely on a single jack when working underneath the vehicle. Always use reliable additional means of support, such as axle stands, securely placed under a part of the vehicle that you know will not give way.

DON'T attempt to loosen or tighten high-torque nuts (e.g. wheel hub nuts) while the vehicle is on a jack; it may be pulled off.

DON'T start the engine without first ascertaining that the transmission is in neutral (or 'Park' where applicable) and the parking brake applied.

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 catalytic converter without first ascertaining that it is sufficiently cool to avoid burning you.

DON'T allow brake fluid or antifreeze to contact vehicle paintwork.

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* below).

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.

DO wear eye protection when using power tools such as drill, sander, bench grinder etc, and when working under the vehicle.

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

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

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, brake bands, clutch linings, torque converters, gaskets, etc – contain asbestos. *Extreme care must be taken to avoid inhalation of dust from such products since it is hazardous to health.* If in doubt, assume that they *do* contain asbestos.

Fire

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

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

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

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

Fumes

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

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

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

If you are fortunate enough to have the use of an inspection pit, never drain or pour petrol, and never run the engine, while the vehicle is standing over it; the fumes, being heavier than air, will concentrate in the pit with possibly lethal results.

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.

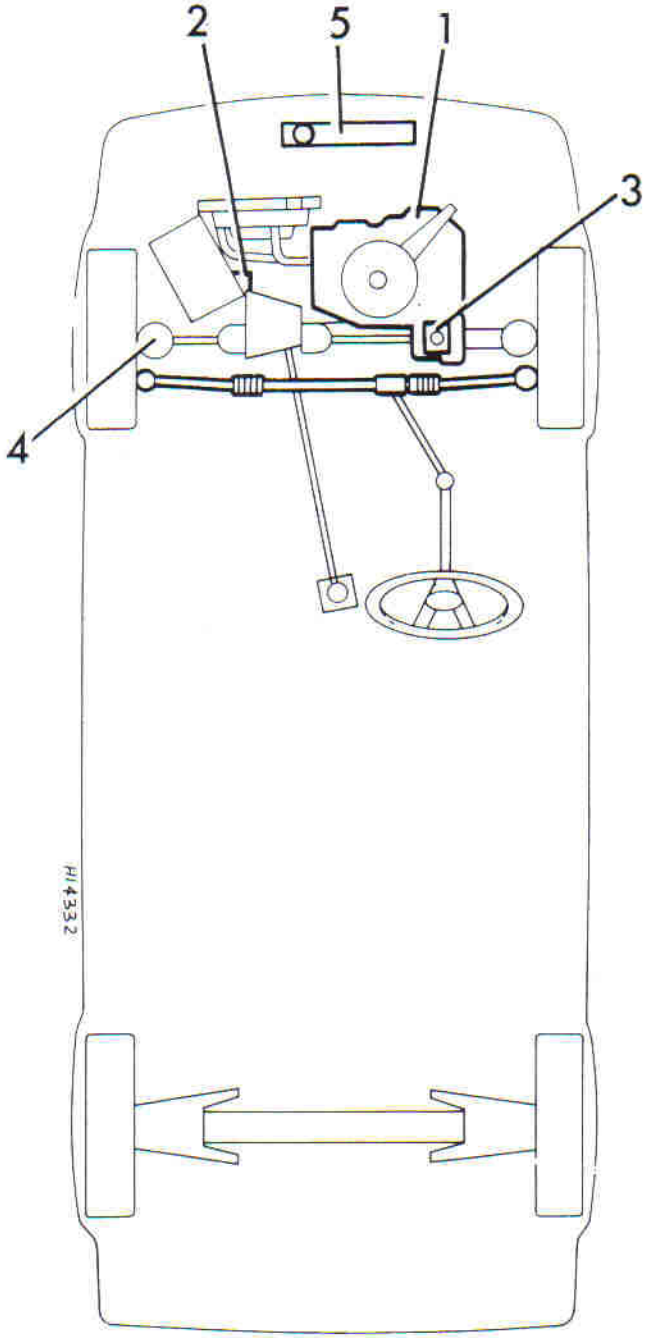
When jump starting a car using a booster battery, for negative earth (ground) vehicles, connect the jump leads in the following sequence: First connect one jump lead between the positive (+) terminals of the two batteries. Then connect the other jump lead first to the negative (–) terminal of the booster battery, and then to a good earthing (ground) point on the vehicle to be started, at least 18 in (45 cm) from the battery if possible. Ensure that hands and jump leads are clear of any moving parts, and that the two vehicles do not touch. Disconnect the leads in the reverse order.

Mains electricity and electrical equipment

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

Ignition HT voltage

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



Recommended lubricants and fluids

Component or system	Lubricant type/specification	Duckhams recommendation
1 **Engine**	Multigrade engine oil, viscosity SAE 15W/40	Duckhams Hypergrade
2 **Transmission**	Esso gear oil number AL 2801 (ZC 90 or ST 90)*	No direct equivalent
3 **Braking system**	Hydraulic fluid to DOT 3	Duckhams Universal Brake and Clutch Fluid
4 **Driveshaft CV joints**	Lithium based molybdenum disulphide grease	Duckhams LBM 10
5 **Cooling system**	Water/ethylene glycol based antifreeze mixture	Duckhams Universal Antifreeze and Summer Coolant

* **Note:** *This oil is the* **only** *type suitable for use in the transmission. No other type of oil should be used.*

Routine maintenance

Maintenance is essential for ensuring safety and desirable for the purpose of getting the best in terms of performance and economy from the car. Over the years the need for periodic lubrication has been greatly reduced if not totally eliminated. This has unfortunately tended to lead some owners to think that because no such action is required the items either no longer exist or will last forever. This is certainly not the case; it is essential to carry out regular visual examinations as comprehensively as possible in order to spot any possible defects at an early stage before they develop into major and expensive repairs.

Weekly, before a long journey or every 400 km (250 miles)

Check engine oil level (Chapter 1, Section 3)
Check brake reservoir fluid level (Chapter 8, Section 3)
Check tyre pressures (Chapter 7)
Check operation of all lights and horn (Chapter 12)
Top up washer fluid reservoirs, adding a screen wash additive such as Turtle Wax High Tech Screen Wash. Check operation of washers and wipers (Chapter 12, Section 34)
Check coolant level (Chapter 2, Section 4)
Check battery electrolyte level (Chapter 12, Section 3)

Every 6000 miles (10 000 km) or at six monthly intervals, whichever comes first

Renew the engine oil and oil filter (Chapter 1, Section 3)
Check and top up as necessary the oil level in the transmission unit (Chapter 6, Section 2)
Check all steering components for security, wear and leaks (Chapter 9)
Check all suspension components for security, wear and leaks (Chapter 10)
Inspect the driveshafts for damage, paying particular attention to the rubber boots (Chapter 7, Sections 4 and 5)
Check the condition of the exhaust system (Chapter 3, Section 22)
Inspect the braking system for leaks and security of components (Chapter 8, Section 13)
Check the operation of the handbrake (Chapter 8, Section 20)
Check the brake pads and discs for wear (Chapter 8, Sections 4 and 7)
Check all tyres for abnormal wear, cuts, bulges and correct pressure (Chapter 7, Section 8)
Check the engine and transmission unit for leaks and security.
Check and adjust, as necessary, the valve clearances on 903 cc OHV engines (Chapter 1, Section 5)
Check and if necessary adjust the spark plug gaps. Renew the plugs if necessary (Chapter 4, Section 14)
Check the contact breaker gap (where applicable). Renew the points if necessary (Chapter 4, Section 6)
Check and if necessary adjust the alternator drivebelt. Renew as necessary (Chapter 12, Section 7)
Check and if necessary adjust the clutch cable free play (Chapter 5, Section 3)
Check and top up the following as necessary:
Brake hydraulic fluid (Chapter 8, Section 3)
Cooling system (Chapter 2, Section 4)
Battery (Chapter 12, Section 3)
Check and if necessary adjust the dwell angle (contact breaker ignition) (Chapter 4, Section 13)
Check ignition timing (Chapter 4, Section 12)
Check and if necessary adjust engine idle speed and CO content (Chapter 3, Section 11 or 15, or Chapter 13, as applicable)
Carry out a visual inspection of the underside and bodywork panels, clear out sill drain holes and renew underseal/paintwork as necessary (Chapter 11)
Check the tightness of the wheel bolts (Chapter 7)
Lubricate all locks, hinges and latches (Chapter 11)
Check the operation and condition of seat belts (Chapter 11, Section 34)
Check all electrical equipment for correct function (Chapter 12)

Every 12 000 miles (20 000 km) or at 12 monthly intervals, whichever comes first, in addition to the 6000 mile service

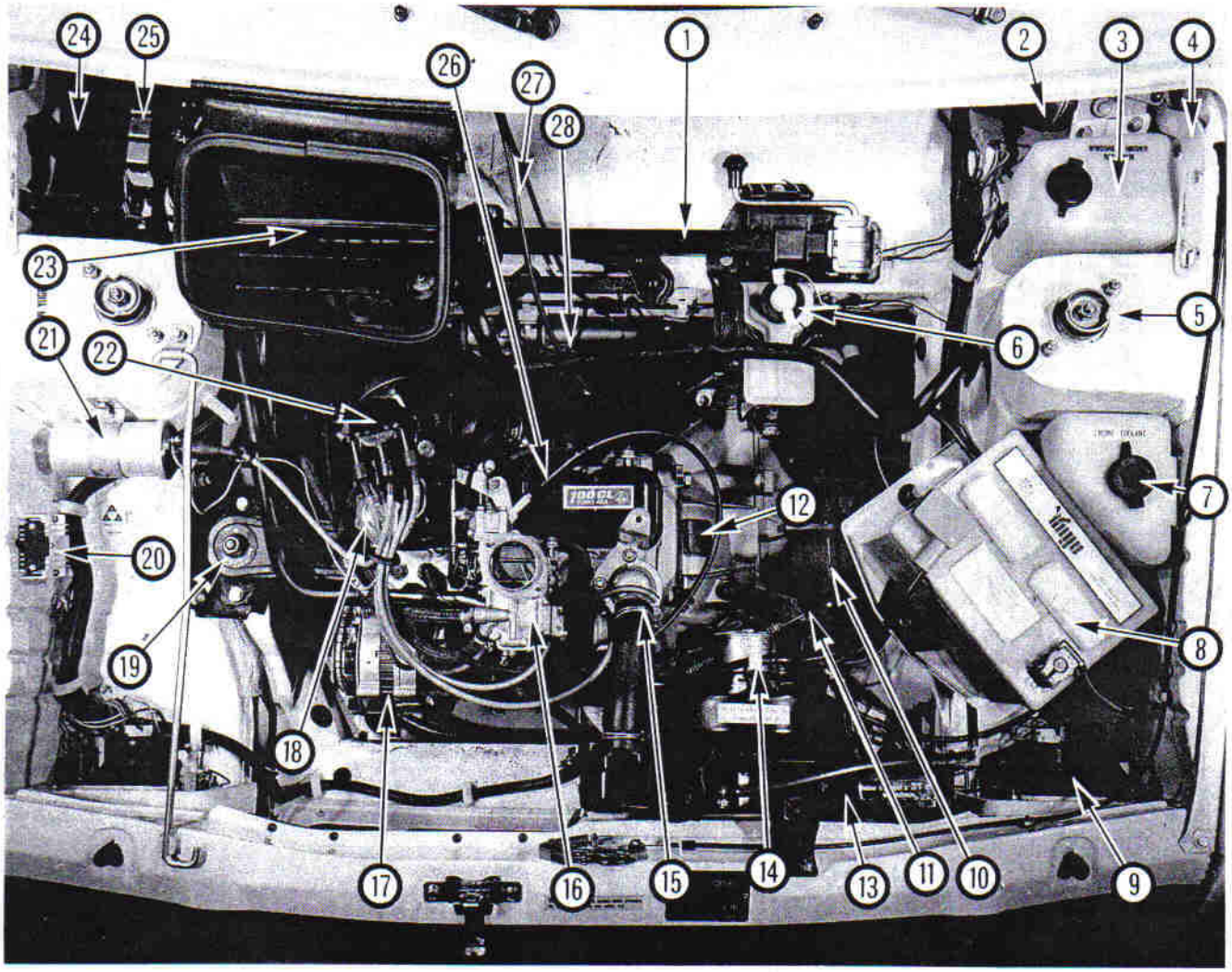
Renew the transmission oil (Chapter 6, Section 2)
Inspect the rear brake shoes and drums for wear (Chapter 8, Sections 5 and 9)
Check and if necessary adjust front wheel alignment, castor and camber (Chapter 9, Section 10 and Chapter 10, Section 12)
Check and if necessary adjust valve clearances on OHC engines (Chapter 1, Section 26)
Check the tightness of the inlet and exhaust manifold nuts/bolts (Chapter 3, Section 22)
Check the timing belt for wear on OHC engines (Chapter 1, Section 28)
Renew the contact breaker points (where applicable) (Chapter 4, Section 7)
Renew the air cleaner element (Chapter 3, Section 3)
Check and clean out the PCV system (Chapter 3, Section 21)
Check charging rate
Check headlight beam alignment (Chapter 12, Section 13)

Every 24 000 miles (40 000 km) or at 24 monthly intervals, whichever comes first, in addition to the 12 000 mile service

Renew the hydraulic fluid in the complete braking system (Chapter 8, Sections 3 and 14)
Check and adjust rear wheel alignment and camber (Chapter 10, Section 12)
Renew the coolant in the cooling system (Chapter 2, Section 4)

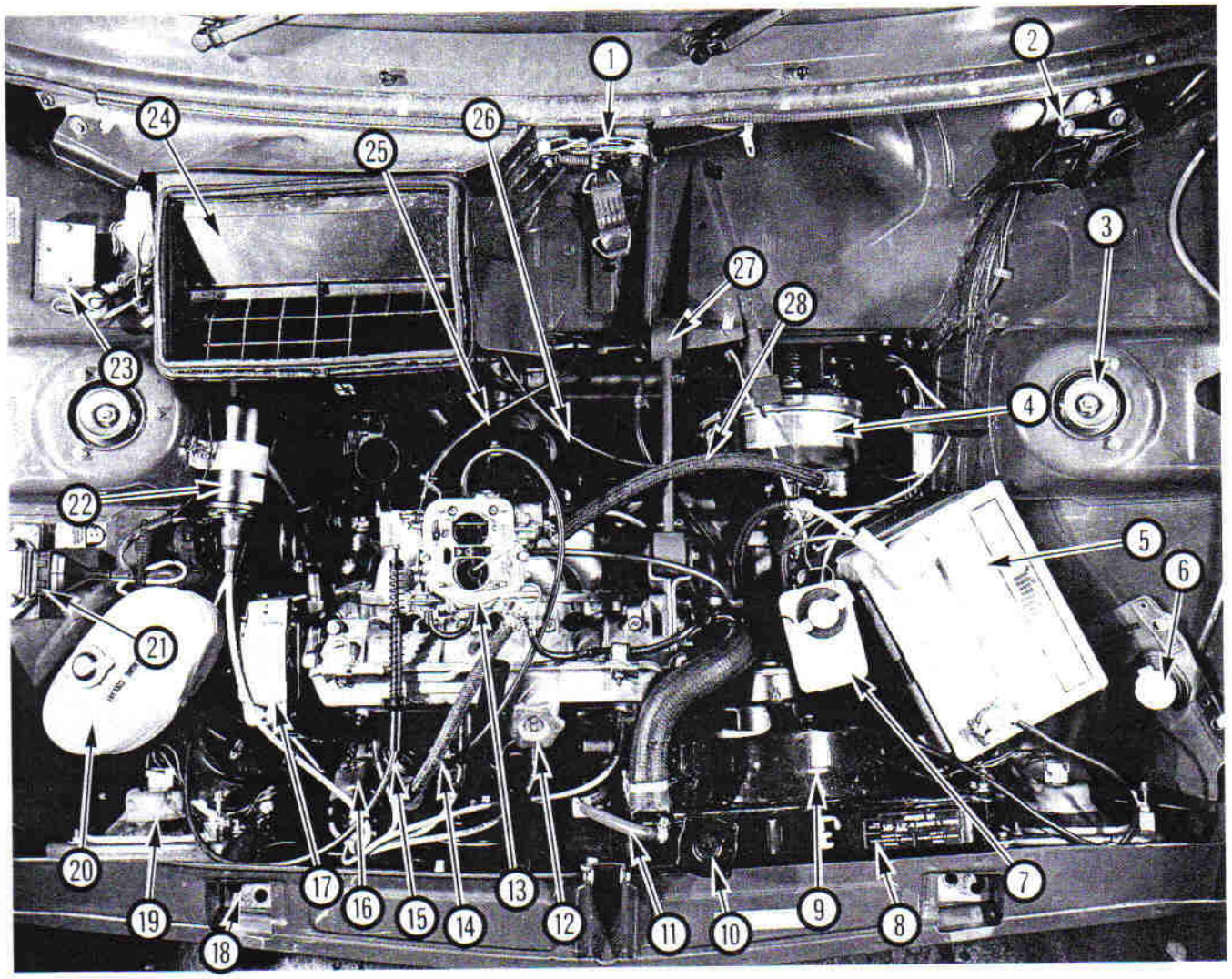
Every 36 000 miles (60 000 km) or at 36 monthly intervals, whichever comes first

Renew the timing belt (OHC engines) (Chapter 1, Section 28)



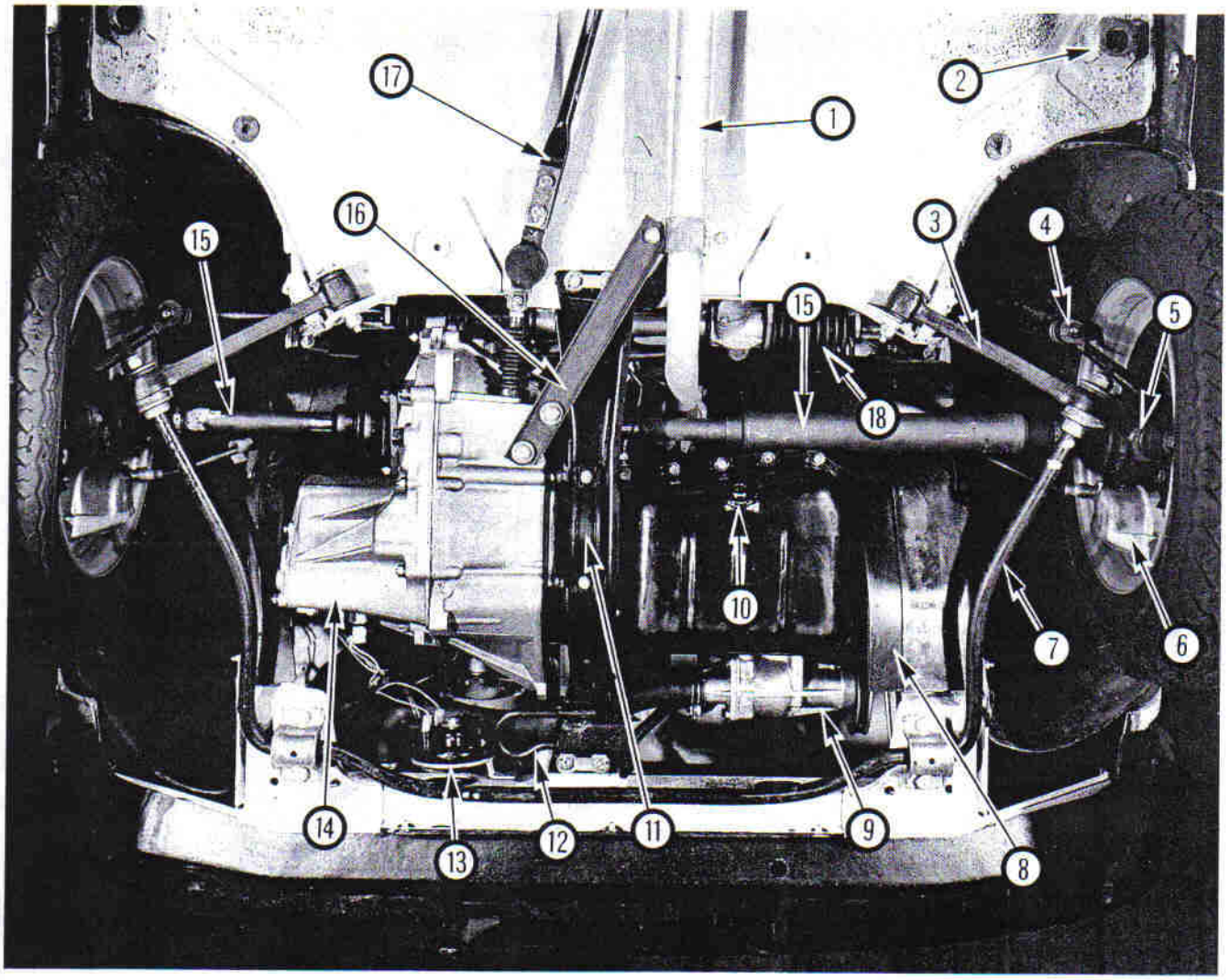
Engine compartment on a 1988 Yugo 45A model (air cleaner housing removed)

1 *Wheel jack*
2 *Windscreen wiper motor*
3 *Windscreen washer reservoir*
4 *Bonnet hinge*
5 *Suspension strut top mounting*
6 *Brake hydraulic fluid reservoir*
7 *Coolant expansion tank*
8 *Battery*
9 *Headlight unit*
10 *Clutch cable*
11 *Clutch release arm*
12 *Flywheel timing mark cover*
13 *Radiator*
14 *Radiator cooling fan*
15 *Thermostat housing and top radiator hose*
16 *Carburettor*
17 *Alternator*
18 *Engine oil filler cap*
19 *Right-hand engine mounting*
20 *Dim-dip system control unit*
21 *Coil*
22 *Distributor*
23 *Heater air inlet duct*
24 *Fuse box*
25 *Relays*
26 *Accelerator cable*
27 *Speedometer cable*
28 *Choke cable*



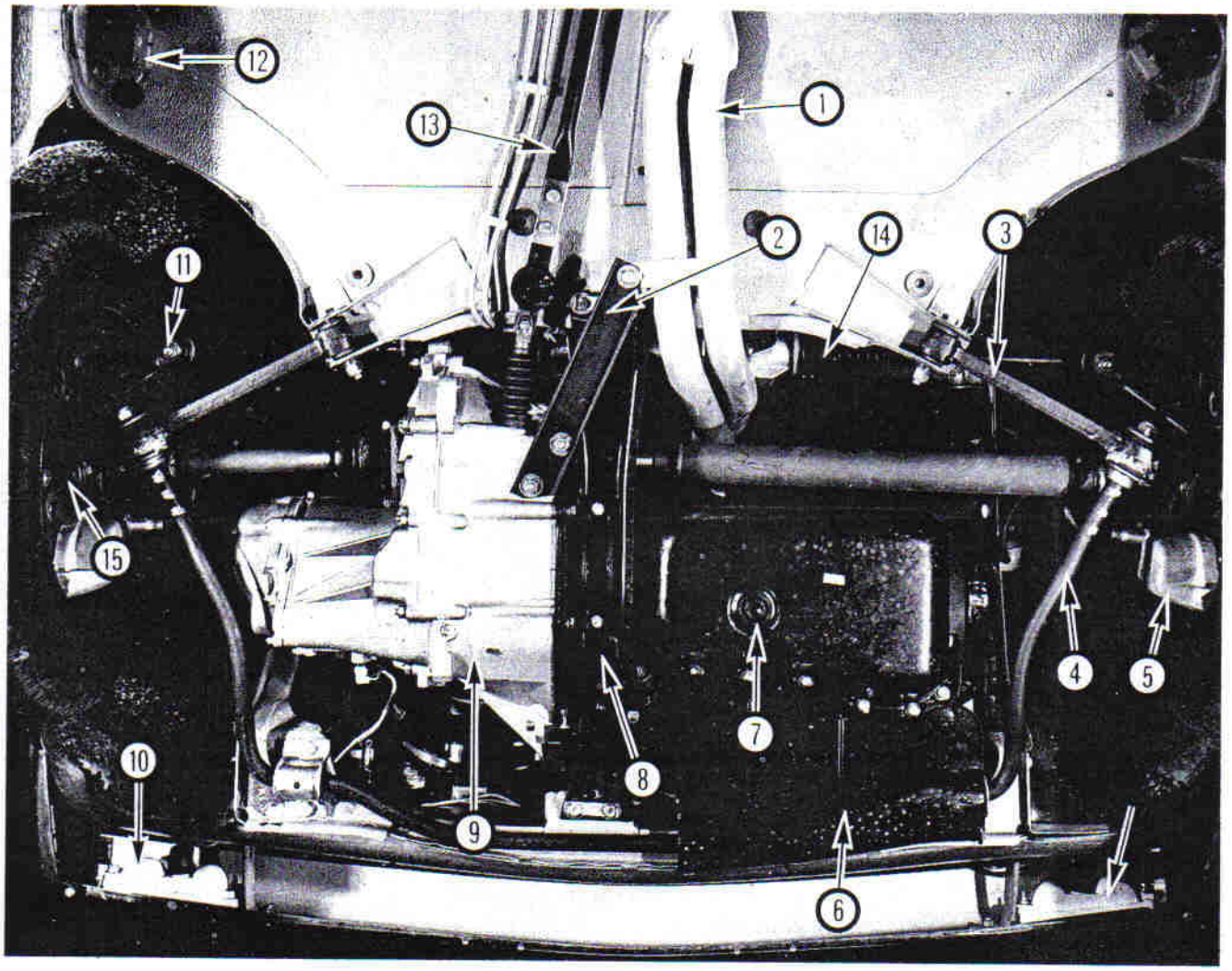
Engine compartment on a 1988 Yugo 513 (air cleaner housing, spare wheel and bonnet removed)

1 *Bonnet lock*
2 *Windscreen wiper motor*
3 *Suspension strut top mounting*
4 *Brake servo vacuum unit*
5 *Battery*
6 *Windscreen wash reservoir*
7 *Brake hydraulic fluid reservoir*
8 *Radiator*
9 *Radiator cooling fan*
10 *Radiator filler cap*
11 *Radiator coolant expansion hose*
12 *Engine oil filler cap*
13 *Carburettor*
14 *Fuel hose from fuel pump to carburettor*
15 *Accelerator cable*
16 *Distributor*
17 *Timing belt cover*
18 *Bonnet hinge location*
19 *Headlight*
20 *Coolant expansion tank*
21 *Electronic ignition control unit*
22 *Coil*
23 *Dim-dip lighting control unit*
24 *Heater fresh air inlet duct*
25 *Choke cable*
26 *Speedometer cable*
27 *Engine torsion bar*
28 *Brake servo vacuum hose*



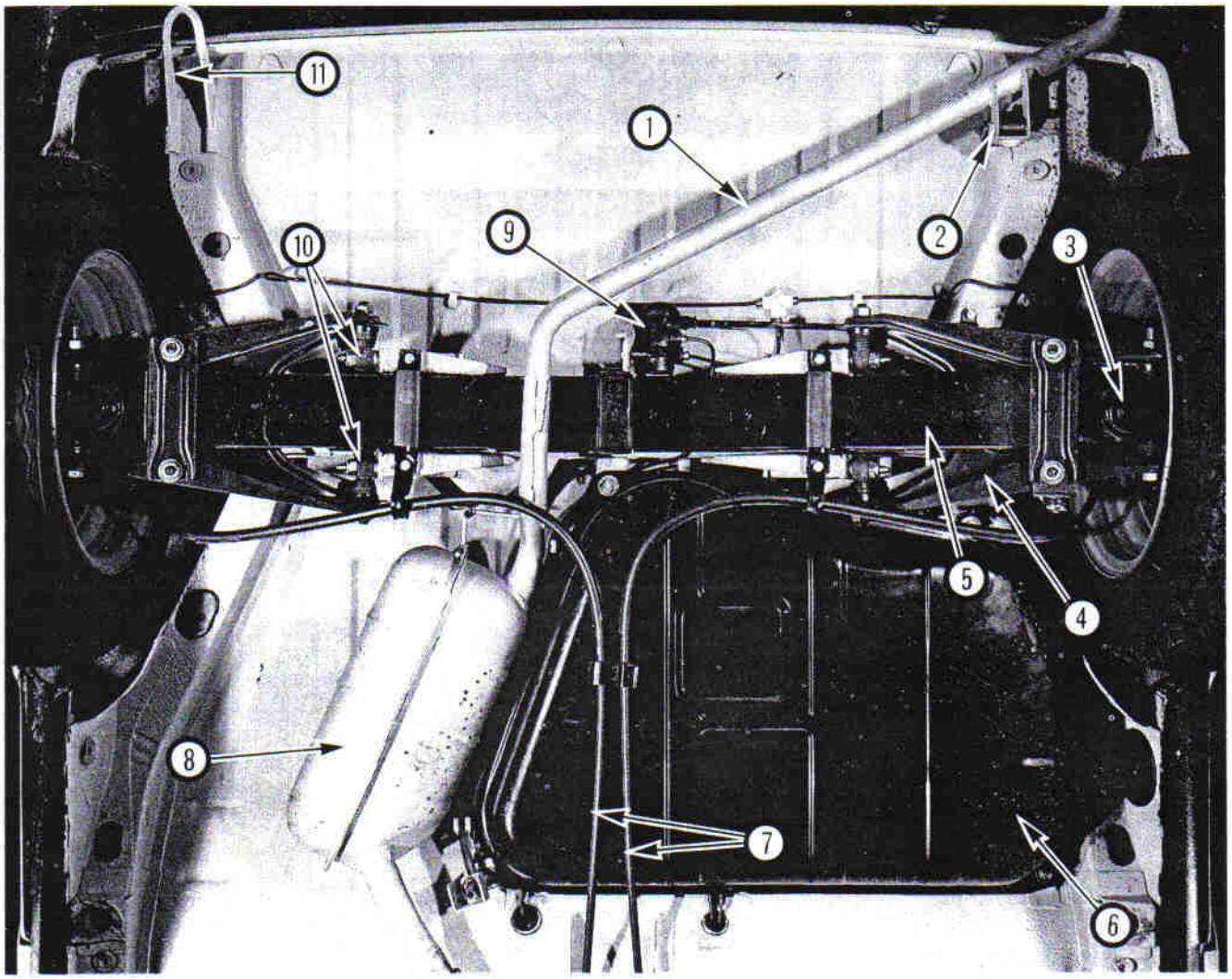
Front underbody view of a 1988 Yugo 45A model (splash panels removed)

1 *Exhaust pipe*
2 *Chassis strong point*
3 *Track control arm*
4 *Steering tie-rod balljoint*
5 *Control arm-to-hub carrier balljoint*
6 *Brake caliper*
7 *Anti-roll bar*
8 *Engine side splash panel*
9 *Water pump*
10 *Engine oil drain plug*
11 *Engine crossmember and centre mounting*
12 *Front towing eye*
13 *Horn*
14 *Transmission unit*
15 *Driveshaft*
16 *Exhaust mounting bracket*
17 *Gearchange linkage*
18 *Steering rack*



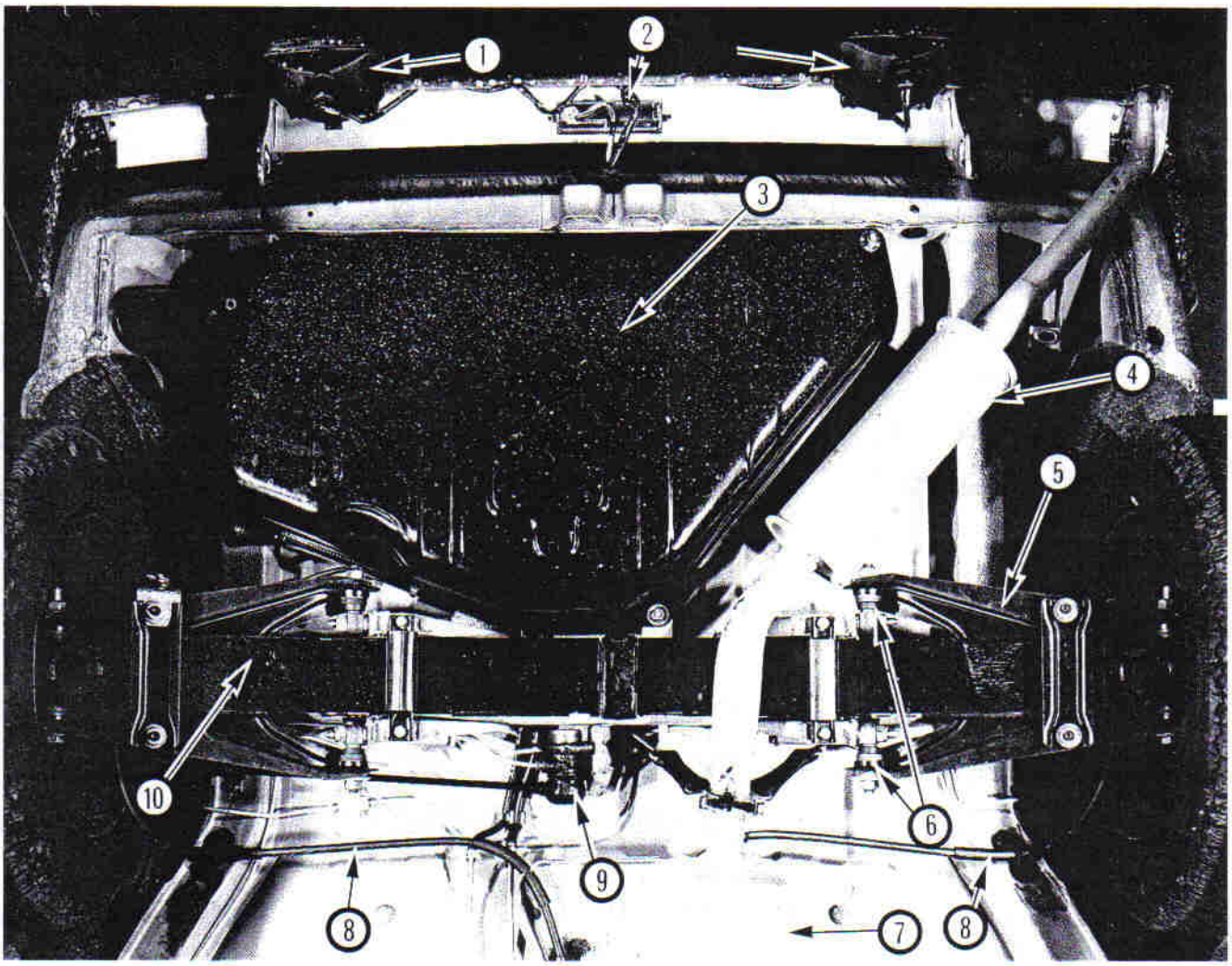
Front underbody view of a 1988 Yugo 513 model

1 *Exhaust*
2 *Exhaust bracket*
3 *Track control arm*
4 *Anti-roll bar*
5 *Brake caliper*
6 *Engine splash panel*
7 *Engine oil drain plug*
8 *Engine crossmember and centre mounting*
9 *Transmission unit*
10 *Front sidelight unit*
11 *Steering tie-rod balljoint*
12 *Chassis point*
13 *Gearchange linkage*
14 *Steering rack*
15 *Control arm-to-hub carrier balljoint*



Rear underbody view of a 1988 Yugo 45 model

1 *Exhaust pipe*
2 *Exhaust flexible mounting*
3 *Rear shock absorber lower mounting*
4 *Control arm*
5 *Rear suspension leaf spring*
6 *Fuel tank*
7 *Handbrake cables*
8 *Rear silencer*
9 *Brake pressure regulator valve*
10 *Control arm pivots*
11 *Rear towing eye*



Rear underbody view of a 1988 Yugo 513 model

1 *Rear foglight*
2 *Numberplate light*
3 *Fuel tank*
4 *Rear silencer*
5 *Control arm*
6 *Control arm pivots and adjustment shims*
7 *Intermediate silencer*
8 *Handbrake cable*
9 *Brake pressure regulator valve*
10 *Rear suspension leaf spring*

Fault diagnosis

Introduction

The vehicle owner who does his or her own maintenance according to the recommended schedules should not have to use this section of the manual very often. Modern component reliability is such that, provided those items subject to wear or deterioration are inspected or renewed at the specified intervals, sudden failure is comparatively rare. Faults do not usually just happen as a result of sudden failure, but develop over a period of time. Major mechanical failures in particular are usually preceded by characteristic symptoms over hundreds or even thousands of miles. Those components which do occasionally fail without warning are often small and easily carried in the vehicle.

With any fault finding, the first step is to decide where to begin investigations. Sometimes this is obvious, but on other occasions a little detective work will be necessary. The owner who makes half a dozen haphazard adjustments or replacements may be successful in curing a fault (or its symptoms), but he will be none the wiser if the fault recurs and he may well have spent more time and money than was necessary. A calm and logical approach will be found to be more satisfactory in the long run. Always take into account any warning signs or abnormalities that may have been noticed in the period preceding the fault – power loss, high or low gauge readings, unusual noises or smells, etc – and remember that failure of components such as fuses or spark plugs may only be pointers to some underlying fault.

The pages which follow here are intended to help in cases of failure to start or breakdown on the road. There is also a Fault Diagnosis Section at the end of each Chapter which should be consulted if the preliminary checks prove unfruitful. Whatever the fault, certain basic principles apply. These are as follows:

Verify the fault. This is simply a matter of being sure that you know what the symptoms are before starting work. This is particularly important if you are investigating a fault for someone else who may not have described it very accurately.

Don't overlook the obvious. For example, if the vehicle won't start, is there petrol in the tank? (Don't take anyone else's word on this particular point, and don't trust the fuel gauge either!) If an electrical fault is indicated, look for loose or broken wires before digging out the test gear.

Cure the disease, not the symptom. Substituting a flat battery with a fully charged one will get you off the hard shoulder, but if the underlying cause is not attended to, the new battery will go the same way. Similarly, changing oil-fouled spark plugs for a new set will get you moving again, but remember that the reason for the fouling (if it wasn't simply an incorrect grade of plug) will have to be established and corrected.

Don't take anything for granted. Particularly, don't forget that a 'new' component may itself be defective (especially if it's been rattling round in the boot for months), and don't leave components out of a fault diagnosis sequence just because they are new or recently fitted. When you do finally diagnose a difficult fault, you'll probably realise that all the evidence was there from the start.

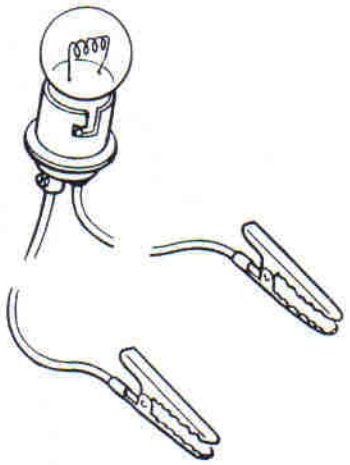
Electrical faults

Electrical faults can be more puzzling than straightforward mechanical failures, but they are no less susceptible to logical analysis if the basic principles of operation are understood. Vehicle electrical wiring exists in extremely unfavourable conditions – heat, vibration and chemical attack – and the first things to look for are loose or corroded connections and broken or chafed wires, especially where the wires pass through holes in the bodywork or are subject to vibration.

All metal-bodied vehicles in current production have one pole of the battery 'earthed', ie connected to the vehicle bodywork, and in nearly all modern vehicles it is the negative (–) terminal. The various electrical components – motors, bulb holders etc – are also connected to earth, either by means of a lead or directly by their mountings. Electric current flows through the component and then back to the battery via the bodywork. If the component mounting is loose or corroded, or if a good path back to the battery is not available, the circuit will be incomplete and malfunction will result. The engine and/or gearbox are also earthed by means of flexible metal straps to the body or subframe; if these straps are loose or missing, starter motor, generator and ignition trouble may result.

Assuming the earth return to be satisfactory, electrical faults will be due either to component malfunction or to defects in the current supply. Individual components are dealt with in Chapter 12. If supply wires are broken or cracked internally this results in an open-circuit, and the easiest way to check for this is to bypass the suspect wire temporarily with a length of wire having a crocodile clip or suitable connector at each end. Alternatively, a 12V test lamp can be used to verify the presence of supply voltage at various points along the wire and the break can be thus isolated.

If a bare portion of a live wire touches the bodywork or other earthed metal part, the electricity will take the low-resistance path thus formed back to the battery: this is known as a short-circuit. Hopefully a short-circuit will blow a fuse, but otherwise it may cause burning of the insulation (and possibly further short-circuits) or even a fire. This is why it is inadvisable to bypass persistently blowing fuses with silver foil or wire.



A simple test lamp is useful for tracing electrical faults

Spares and tool kit

Most vehicles are supplied only with sufficient tools for wheel changing; the *Maintenance and minor repair* tool kit detailed in *Tools and working facilities*, with the addition of a hammer, is probably sufficient for those repairs that most motorists would consider attempting at the roadside. In addition a few items which can be fitted without too much trouble in the event of a breakdown should be carried. Experience and available space will modify the list below, but the following may save having to call on professional assistance:

Spark plugs, clean and correctly gapped
HT lead and plug cap – long enough to reach the plug furthest from the distributor
Distributor rotor, condenser and contact breaker points (if applicable)
Drivebelt(s) – emergency type may suffice
Spare fuses
Set of principal light bulbs
Tin of radiator sealer and hose bandage
Exhaust bandage
Roll of insulating tape
Length of soft iron wire
Length of electrical flex
Torch or inspection lamp (can double as test lamp)
Battery jump leads
Tow-rope
Ignition water dispersant aerosol
Litre of engine oil
Sealed can of hydraulic fluid
Emergency windscreen
'Worm drive' clips

If spare fuel is carried, a can designed for the purpose should be used to minimise risks of leakage and collision damage. A first aid kit and a warning triangle, whilst not at present compulsory in the UK, are obviously sensible items to carry in addition to the above.

When touring abroad it may be advisable to carry additional spares which, even if you cannot fit them yourself, could save having to wait while parts are obtained. The items below may be worth considering:

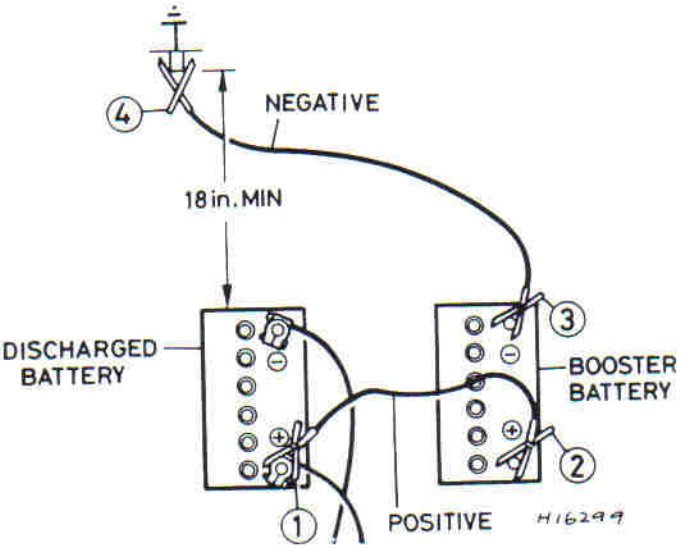
Clutch and throttle cables
Cylinder head gasket
Alternator brushes
Fuel pump repair kit
Tyre valve core

One of the motoring organisations will be able to advise on availability of fuel etc in foreign countries.

Engine will not start

Engine fails to turn when starter operated

Flat battery (recharge, use jump leads, or push start)
Battery terminals loose or corroded
Battery earth to body defective
Engine earth strap loose or broken
Starter motor (or solenoid) wiring loose or broken
Automatic transmission selector in wrong position, or inhibitor switch faulty
Ignition/starter switch faulty
Major mechanical failure (seizure)
Starter or solenoid internal fault (see Chapter 12)



Jump start leads connections for negative earth vehicles – connect leads in order shown

Carrying a few spares can save you a long walk!

Starter motor turns engine slowly
- Partially discharged battery (recharge, use jump leads, or push start)
- Battery terminals loose or corroded
- Battery earth to body defective
- Engine earth strap loose
- Starter motor (or solenoid) wiring loose
- Starter motor internal fault (see Chapter 12)

Starter motor spins without turning engine
- Flat battery
- Starter motor pinion sticking on sleeve
- Flywheel gear teeth damaged or worn
- Starter motor mounting bolts loose

Engine turns normally but fails to start
- Damp or dirty HT leads and distributor cap – crank engine and check for spark, or try a moisture dispersant such as Holts Wet Start
- Dirty or incorrectly gapped distributor points (if applicable)
- No fuel in tank (check for delivery at carburettor)
- Excessive choke (hot engine) or insufficient choke (cold engine)
- Fouled or incorrectly gapped spark plugs (remove, clean and regap)
- Other ignition system fault (see Chapter 4)
- Other fuel system fault (see Chapter 3)
- Poor compression (see Chapter 1)
- Major mechanical failure (eg camshaft drive)

Engine fires but will not run
- Insufficient choke (cold engine)
- Air leaks at carburettor or inlet manifold
- Fuel starvation (see Chapter 3)
- Ballast resistor defective, or other ignition fault (see Chapter 4)

Engine cuts out and will not restart

Engine cuts out suddenly – ignition fault
- Loose or disconnected LT wires
- Wet HT leads or distributor cap (after traversing water splash)
- Coil or condenser failure (check for spark)
- Other ignition fault (see Chapter 4)

Engine misfires before cutting out – fuel fault
- Fuel tank empty
- Fuel pump defective or filter blocked (check for delivery)
- Fuel tank filler vent blocked (suction will be evident on releasing cap)
- Carburettor needle valve sticking
- Carburettor jets blocked (fuel contaminated)
- Other fuel system fault (see Chapter 4)

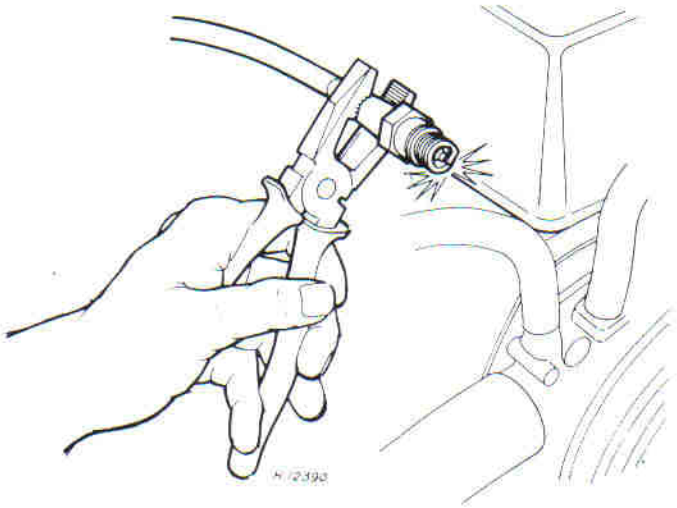
Engine cuts out – other causes
- Serious overheating
- Major mechanical failure (eg camshaft drive)

Engine overheats

Ignition (no-charge) warning light illuminated
- Slack or broken drivebelt – retension or renew (Chapter 12)

Ignition warning light not illuminated
- Coolant loss due to internal or external leakage (see Chapter 2)
- Thermostat defective
- Low oil level
- Brakes binding
- Radiator clogged externally or internally
- Electric cooling fan not operating correctly
- Engine waterways clogged
- Ignition timing incorrect or automatic advance malfunctioning
- Mixture too weak

Note: *Do not add cold water to an overheated engine or damage may result*



Crank engine and check for spark. Note use of insulated tool

Low engine oil pressure

Gauge reads low or warning light illuminated with engine running
- Oil level low or incorrect grade
- Defective gauge or sender unit
- Wire to sender unit earthed
- Engine overheating
- Oil filter clogged or bypass valve defective
- Oil pressure relief valve defective
- Oil pick-up strainer clogged
- Oil pump worn or mountings loose
- Worn main or big-end bearings

Note: *Low oil pressure in a high-mileage engine at tickover is not necessarily a cause for concern. Sudden pressure loss at speed is far more significant. In any event, check the gauge or warning light sender before condemning the engine.*

Engine noises

Pre-ignition (pinking) on acceleration
- Incorrect grade of fuel
- Ignition timing incorrect
- Distributor faulty or worn
- Worn or maladjusted carburettor
- Excessive carbon build-up in engine

Whistling or wheezing noises
- Leaking vacuum hose
- Leaking carburettor or manifold gasket
- Blowing head gasket

Tapping or rattling
- Incorrect valve clearances
- Worn valve gear
- Worn timing chain or belt
- Broken piston ring (ticking noise)

Knocking or thumping
- Unintentional mechanical contact (eg fan blades)
- Worn drivebelt
- Peripheral component fault (generator, water pump etc)
- Worn big-end bearings (regular heavy knocking, perhaps less under load)
- Worn main bearings (rumbling and knocking, perhaps worsening under load)
- Piston slap (most noticeable when cold)

Chapter 1 Engine

Contents

Specifications

903 cc OHV engine

General

Type	Four cylinder in-line, liquid cooled, overhead valve. Transversely mounted with transmission at front of vehicle
Designation	100GL 064
Bore	65.0 mm (2.56 in)
Stroke	68.0 mm (2.68 in)
Displacement	903 cc (55.0 cu in)
Compression ratio	9.0 to 1
Maximum power (DIN)	33.1 kW (45 bhp) at 5800 rpm
Maximum torque (DIN)	62.8 Nm (46.3 lbf ft) at 3300 rpm
Compression pressure	9.3 to 10.5 bar (135 to 150 lbf/in²)
Maximum difference between cylinders	0.69 bar (10.0 lbf/in²)
Firing order	1-3-4-2 (No 1 cylinder at timing gear end)

Cylinder block

Material	Cast iron
Cylinder bore diameter:	
Class A	65.000 to 65.010 mm
Class C	65.020 to 65.030 mm
Class E	65.040 to 65.050 mm
Diameter of camshaft bearing bores in crankcase:	
Timing gear end:	
Grade B	50.505 to 50.515 mm
Grade C	50.515 to 50.525 mm
Grade D	50.705 to 50.715 mm
Grade E	50.715 to 50.725 mm
Centre	46.420 to 46.450 mm
Flywheel end	35.921 to 35.951 mm
Maximum cylinder bore taper	0.015 mm
Maximum cylinder bore ovality	0.015 mm

Pistons and piston rings

Piston diameter (Kolbenschmit):	
Grade A	64.971 to 64.989 mm
Grade B	64.981 to 64.999 mm
Grade C	64.991 to 65.009 mm
Grade D	65.001 to 65.019 mm
Grade E	65.011 to 65.029 mm
Piston diameter (Fiat):	
Grade A	64.940 to 64.950 mm
Grade C	64.960 to 64.970 mm
Grade E	64.980 to 64.990 mm
Oversize pistons (both types)	0.2, 0.4 and 0.6 mm
Piston clearance in cylinder bore:	
Kolbenschmit	0.011 to 0.039 mm
Fiat	0.050 to 0.070 mm
Piston ring groove width:	
Kolbenschmit:	
Top	1.790 to 1.810 mm
Second	2.030 to 2.050 mm
Bottom	3.967 to 3.987 mm
Fiat:	
Top	1.785 to 1.805 mm
Second	2.015 to 2.035 mm
Bottom	3.957 to 3.977 mm
Piston ring clearance in groove:	
Kolbenschmit:	
Top	0.050 to 0.082 mm
Second	0.040 to 0.072 mm
Bottom	0.030 to 0.062 mm
Fiat:	
Top	0.045 to 0.077 mm
Second	0.025 to 0.057 mm
Bottom	0.020 to 0.052 mm
Piston ring end gap:	
Kolbenschmit (all rings)	0.20 to 0.35 mm (0.009 to 0.013 in)
Fiat (all rings)	0.20 to 0.35 mm (0.009 to 0.013 in)
Oversize piston rings	0.1, 0.2, 0.4 and 0.6 mm (0.004, 0.008, 0.016 and 0.024 in)

Crankshaft

Main journal diameter	50.785 to 50.805 mm
Standard main bearing shell thickness	1.832 to 1.837 mm
Main bearing shell undersizes	0.254, 0.508, 0.762 and 1.016 mm
Crankshaft endfloat	0.06 to 0.26 mm (0.002 to 0.010 in)
Crankpin diameter	39.985 to 40.005 mm
Standard big-end shell thickness	1.807 to 1.813 mm
Big-end shell undersizes	0.254, 0.508, 0.762 and 1.016 mm

Camshaft

Diameter of camshaft journals:	
Timing end	37.975 to 38.000 mm
Centre	43.348 to 43.373 mm
Flywheel end	30.975 to 31.000 mm
Bearing reamed diameters:	
Timing gear end*	38.025 to 38.050 mm
Centre	43.404 to 43.424 mm
Flywheel end	31.026 to 31.046 mm
**Supplied reamed to size*	
Timing gear end bearing outside diameter:	
Grade B	50.485 to 50.500 mm
Grade C	50.495 to 50.510 mm
Grade D	50.685 to 50.700 mm
Grade E	50.695 to 50.710 mm
Cam lift	5.6 mm
Outside diameter of cam follower	13.982 to 14.000 mm
Cam follower oversizes	0.05 to 0.010 mm
Cam follower running clearance	0.010 to 0.046 mm

Cylinder head and valves

Material (cylinder head)	Light alloy
Maximum distortion	0.05 mm
Valve guide bore in head	12.950 to 12.977 mm
Valve guide outside diameter	13.010 to 13.030 mm
Valve guide oversizes	0.5, 0.10, 0.25 mm
Inside diameter of valve guide (reamed)	7.022 to 7.040 mm
Guide fit in head (interference)	0.033 to 0.080 mm
Valve stem diameter	6.982 to 7.000 mm

Maximum clearance (valve stem to guide)	0.022 to 0.058 mm
Valve seat angle	44°55' to 45°05'
Valve face angle	45°25' to 43°35'
Valve head diameter:	
Inlet	29.0 mm
Exhaust	26.0 mm
Contact band (valve to seat)	1.3 to 1.5 mm
Valve clearances (cold):	
Inlet	0.15 mm (0.006 in)
Exhaust	0.20 mm (0.008 in)
For timing check	0.60 mm (0.024 in)
Valve timing:	
Inlet valve:	
Opens	17°BTDC
Closes	43°ABDC
Exhaust valve:	
Opens	57°BBDC
Closes	3°ATDC

Rocker Gear

Rocker shaft diameter	14.978 to 14.990 mm
Rocker arm bush inside diameter	15.010 to 15.030 mm
Pedestal shaft journal inside diameter	15.010 to 15.028 mm

Lubrication system

Oil pump type	Gear, driven by camshaft
Oil pressure (at normal operating temperature and average roadspeed)	3.0 to 4.0 bar (43.5 to 58.0 lbf/in²)
Clearances:	
Gear endfloat	0.020 to 0.105 mm
Gear tooth tip-to-body	0.05 to 0.14 mm
Gear backlash	0.08 mm
Oil filter	Champion C106
Oil capacity	4.0 litres (7.0 pints)
Lubricant type/specification	Multigrade engine oil, viscosity SAE 15W/40 (Duckhams Hypergrade)

Torque wrench settings

	Nm	lbf ft
Cylinder head bolts:		
Stage 1	30	22
Stage 2	59	43.5
Camshaft sprocket bolts	49	36
Crankshaft pulley nut	98	72
Main bearing cap bolts	69	51
Big-end bearing cap bolts	41	30
Flywheel bolts	49	36
Rocker pedestal nuts	39	29
Valve cover nuts	8	5.9
Crankshaft rear oil seal bolts	8	5.9

1116 cc, 1298 cc and 1301 cc OHC engines

General

Type	Four cylinder in-line liquid cooled single overhead camshaft, transversely mounted with transmission at front of vehicle.
Designation:	
1116 cc	126A 064
1298 cc and 1301 cc	128A 6064
1116 cc engine:	
Bore	80.0 mm (3.15 in)
Stroke	55.5 mm (2.19 in)
Displacement	1116 cc (68.08 cu in)
Compression ratio	9.2 to 1
Maximum power (DIN)	40.4 kW (55 bhp) at 6000 rpm
Maximum torque (DIN)	77.4 Nm (57 lbf ft) at 3000 rpm
Compression pressure	10.35 to 11.73 bar (150 to 170 lbf/in²)
Maximum difference between cylinders	0.96 bar (14 lbf/in²)
Firing order	1-3-4-2
1298 cc engine (where different from 1116 cc engine):	
Bore	86.4 mm (3.40 in)
Stroke	55.375 mm (2.182 in)
Displacement	1298 cc (79.18 cu in)
Compression ratio	9.1 to 1
Maximum power (DIN)	47.7 kW (65 bhp) at 5800 rpm
Maximum torque (DIN)	98.1 Nm (72.3 lbf ft) at 3500 rpm
1301 cc engine (where different from 1298 cc engine):	
Stroke	55.5 mm (2.187 in)
Displacement	1301 cc (79.39 cu in)

Cylinder block

Material	Cast-iron
Bore diameter:	
1116 cc	80.000 to 80.050 mm
1298 cc and 1301 cc	86.400 to 86.450 mm
Maximum cylinder bore taper	0.015 mm
Maximum cylinder bore ovality	0.015 mm

Pistons and piston rings (Fiat)

Piston diameter – 1116 cc:	
Grade A	79.940 to 79.950 mm
Grade C	79.960 to 79.970 mm
Grade E	79.980 to 79.990 mm
Piston diameter: 1298 cc and 1301 cc:	
Grade A	86.320 to 86.330 mm
Grade C	86.340 to 86.350 mm
Grade E	86.360 to 86.370 mm
Oversize pistons	0.2, 0.4 and 0.6 mm
Piston clearance in cylinder bore:	
1116 cc	0.050 to 0.070 mm
1298 cc and 1301 cc	0.070 to 0.090 mm
Piston ring groove width – 1116 cc:	
Top	1.535 to 1.555 mm
Second	2.015 to 2.035 mm
Bottom	3.957 to 3.977 mm
Piston ring groove width – 1298 cc and 1301 cc:	
Top	1.535 to 1.555 mm
Second	2.030 to 2.050 mm
Bottom	3.967 to 3.987 mm
Piston ring groove clearance – 1116 cc:	
Top	0.045 to 0.077 mm
Second	0.025 to 0.057 mm
Bottom	0.020 to 0.052 mm
Piston ring groove clearance – 1298 cc and 1301 cc:	
Top	0.045 to 0.077 mm
Second	0.040 to 0.072 mm
Bottom	0.030 to 0.062 mm
Piston ring end gap – 1116 cc:	
Top	0.30 to 0.40 mm
Second	0.20 to 0.35 mm
Bottom	0.20 to 0.35 mm
Piston ring end gap – 1298 cc and 1301 cc:	
Top	0.30 to 0.45 mm
Second	0.30 to 0.45 mm
Bottom	0.25 to 0.40 mm
Oversize piston rings	0.2, 0.4, 0.6 mm (0.008, 0.016, 0.023 in)

Pistons and piston rings (Kolbenschmit)

Piston diameter – 1116 cc:	
Grade A	79.963 to 79.976 mm
Grade B	79.973 to 79.986 mm
Grade C	79.983 to 79.996 mm
Grade D	79.993 to 80.006 mm
Grade E	80.003 to 80.016 mm
Piston diameter – 1298 cc and 1301 cc:	
Grade A	86.351 to 86.369 mm
Grade B	86.361 to 86.379 mm
Grade C	86.371 to 86.389 mm
Grade D	86.381 to 86.399 mm
Grade E	86.391 to 86.409 mm
Oversize pistons	0.2, 0.4 and 0.6 mm
Piston clearance in cylinder bore:	
1116 cc	0.024 to 0.047 mm
1298 cc and 1301 cc	0.031 to 0.059 mm
Piston ring groove width – 1116 cc:	
Top	1.535 to 1.555 mm
Second	2.015 to 2.035 mm
Bottom	3.957 to 3.977 mm
Piston ring groove width – 1298 cc and 1301 cc:	
Top	1.535 to 1.555 mm
Second	2.030 to 2.050 mm
Bottom	3.967 to 3.987 mm
Piston ring groove clearance – 1116 cc:	
Top	0.045 to 0.077 mm
Second	0.025 to 0.057 mm
Bottom	0.020 to 0.052 mm

Piston ring groove clearance – 1298 cc and 1301 cc:	
Top	0.045 to 0.077 mm
Second	0.040 to 0.072 mm
Bottom	0.030 to 0.620 mm
Piston ring end gap – 1116 cc:	
Top	0.300 to 0.400 mm
Second	0.200 to 0.350 mm
Bottom	0.200 to 0.350 mm
Piston ring end gap – 1298 cc and 1301 cc:	
Top	0.300 to 0.450 mm
Second	0.300 to 0.450 mm
Bottom	0.250 to 0.400 mm
Oversize piston rings	0.2, 0.4 and 0.6 mm

Crankshaft

Journal diameter	50.785 to 50.805 mm
Standard main bearing shell thickness	1.825 to 1.831 mm
Main bearing undersizes	0.254, 0.508, 0.762 and 1.016 mm
Crankshaft endfloat	0.0265 to 0.0550 mm
Crankpin diameter	45.498 to 45.518 mm
Standard big-end shell bearing thickness	1.531 to 1.538 mm
Big-end shell undersizes	0.254, 0.508, 0.762 and 1.016 mm

Camshaft

Number of bearings	5
Diameter of camshaft journals:	
No. 1 (timing end)	29.944 to 29.960 mm
No. 2	47.935 to 47.950 mm
No. 3	48.135 to 48.150 mm
No. 4	48.335 to 48.350 mm
No. 5	48.535 to 48.550 mm
Cam lift	8.8 mm
Camshaft bearing diameters in carrier:	
No. 1	29.990 to 30.014 mm
No. 2	47.980 to 48.005 mm
No. 3	48.180 to 48.205 mm
No. 4	48.380 to 48.405 mm
No. 5	48.580 to 48.605 mm
Outside diameter of cam follower	36.975 to 36.995 mm
Cam follower running clearance	0.005 to 0.050 mm

Cylinder head and valves

Head material	Light alloy
Maximum distortion	0.05 mm
Valve guide bore in head	13.950 to 13.977 mm
Valve guide outside diameter	14.040 to 14.058 mm
Valve guide oversizes	0.05, 0.10 and 0.25 mm
Inside diameter of valve guide (reamed)	8.022 to 8.040 mm
Valve guide fit in cylinder head (interference)	0.063 to 0.108 mm
Valve stem diameter	7.974 to 7.992 mm
Maximum clearance (valve stem to guide)	0.030 to 0.066 mm
Valve face angle	45° 25' to 45° 35'
Valve seat angle	44° 55' to 45° 05'
Valve head diameter:	
Inlet	36.00 mm
Exhaust	31.15 mm
Contact band (valve to seat)	2.0 mm
Valve clearances:	
Inlet	0.40 mm (0.016 in)
Exhaust	0.50 mm (0.020 in)
For timing check	Inlet: 0.60 mm (0.024 in), Exhaust: 0.65 mm (0.026 in)

Valve timing:	**1116 cc and 1298 cc**	**1301 cc**
Inlet valve:		
Opens	12° BTDC	20° BTDC
Closes	52° ABDC	44° ABDC
Exhaust valve:		
Opens	52° BBDC	60° BBDC
Closes	12° ATDC	4° ATDC

Auxiliary shaft

Bearing internal diameter (reamed):	
No 1 (timing belt end)	35.664 to 35.684 mm
No 2	32.000 to 32.020 mm
Shaft journal diameter:	
No 1 (timing belt end)	35.593 to 35.618 mm
No 2	31.940 to 31.960 mm

Lubrication system

Oil pump type	Gear driven from auxiliary shaft
Tooth tip-to-body clearance	0.110 to 0.180 mm (0.0043 to 0.0071 in)
Gear endfloat	0.020 to 0.105 mm (0.0008 to 0.0041 in)
Oil pressure at normal operating temperature and average road/engine speed	3.43 to 4.9 bar (50 to 71 lbf/in²)
Backlash between gears	0.15 mm
Oil filter	Champion C106
Oil capacity	4.5 litres (7.9 pints)
Lubricant type/specification	Multigrade engine oil, viscosity SAE 15W/40 (Duckhams Hypergrade)

Torque wrench settings

	Nm	lbf ft
Cylinder head bolts (10 mm diameter):		
Stage 1	20	15
Stage 2	40	30
Stage 3	Turn through 90°	Turn through 90°
Stage 4	Turn through 90°	Turn through 90°
Cylinder head bolts (12 mm diameter):		
Stage 1	39	29
Stage 2	93	69
Camshaft carrier to cylinder head	20	15
Main bearing cap bolts	80	59
Big-end cap nuts	51	38
Flywheel mounting bolts	83	61
Camshaft sprocket bolt	83	61
Timing belt tensioner bolt	44	32
Auxiliary shaft sprocket bolt	83	61
Oil pressure switch	32	24
Crankshaft pulley nut	137	99
Alternator bracket bolts	49	36

PART 1 GENERAL

1 General description

The Yugo 45 and 45A models are powered by the 903 cc OHV engine, all other models have either the 1116 cc, 1298 cc or 1301 cc OHC engine.

903 cc (OHV) engine

This is of four cylinder overhead valve type with a light alloy cylinder head and a cast-iron block and crankcase.

A three bearing crankshaft is used and the chain-driven camshaft runs in three steel backed white metal bearings.

The light alloy pistons are fitted with two compression and one oil control ring. The gudgeon pin is an interference fit in the small end of the connecting rod.

Lubrication is provided by an oil pump within the sump pan and both the pump and the distributor are driven from a gear on the camshaft. Pressurised oil passes through a cartridge type oil filter. An oil pressure relief valve is incorporated in the oil pump. The engine oil is independent of the transmission lubricant.

1116 cc, 1298 cc and 1301 cc (OHC) engines

These engines are of single overhead camshaft type, the camshaft being driven by a toothed belt.

The three OHC engines all use the same basic cylinder block, the 1298 cc and 1301 cc engines being derived from the 1116 cc engine. A capacity of 1301 cc is obtained by increasing the bore of the 1116 cc engine, and a capacity of 1298 cc is obtained by a small reduction in the stroke of the 1301 cc engine.

The cylinder head is of light alloy while the cylinder block and crankcase are of cast-iron construction.

A five bearing crankshaft is used and the camshaft runs in a similar number of bearings, but as these are in-line bored directly in the camshaft carrier, no repair is possible.

The pistons are of light alloy with two compression and one oil control ring.

An auxiliary shaft, driven by the timing belt is used to drive the distributor, oil pump and fuel pump.

The oil pump is located within the sump pan and incorporates a pressure relief valve.

Pressurised oil passes through a cartridge type oil filter.

The crankshaft main bearings are supplied with oil under pressure from drillings in the crankcase from the main oil gallery whilst the connecting rod big-end bearings are lubricated from the main bearings by oil forced through the crankshaft oilways. The camshaft bearings are fed from a drilling from the main oil gallery. The cams and tappets are lubricated by oil mist from outlets in the camshaft bearings.

The cylinder walls, pistons and gudgeon pins are lubricated by oil splashed up by the crankshaft webs. An oil pressure warning light is fitted to indicate when the pressure is too low.

All engines

The engine is mounted transversely with the transmission at the front of the car.

The engine oil is independent of the transmission lubricant.

2 Routine maintenance

At the intervals specified in the *'Routine maintenance'* Section at the beginning of this manual carry out the following:

Check the engine oil level and top up if necessary (Section 3)
Renew the engine oil and oil filter (Section 3)
Visually inspect the engine for signs of leakage (oil, water etc)
On OHC engines, check the condition of the timing belt
On OHC engines, renew the timing belt
On all engines, check if necessary and adjust valve clearances

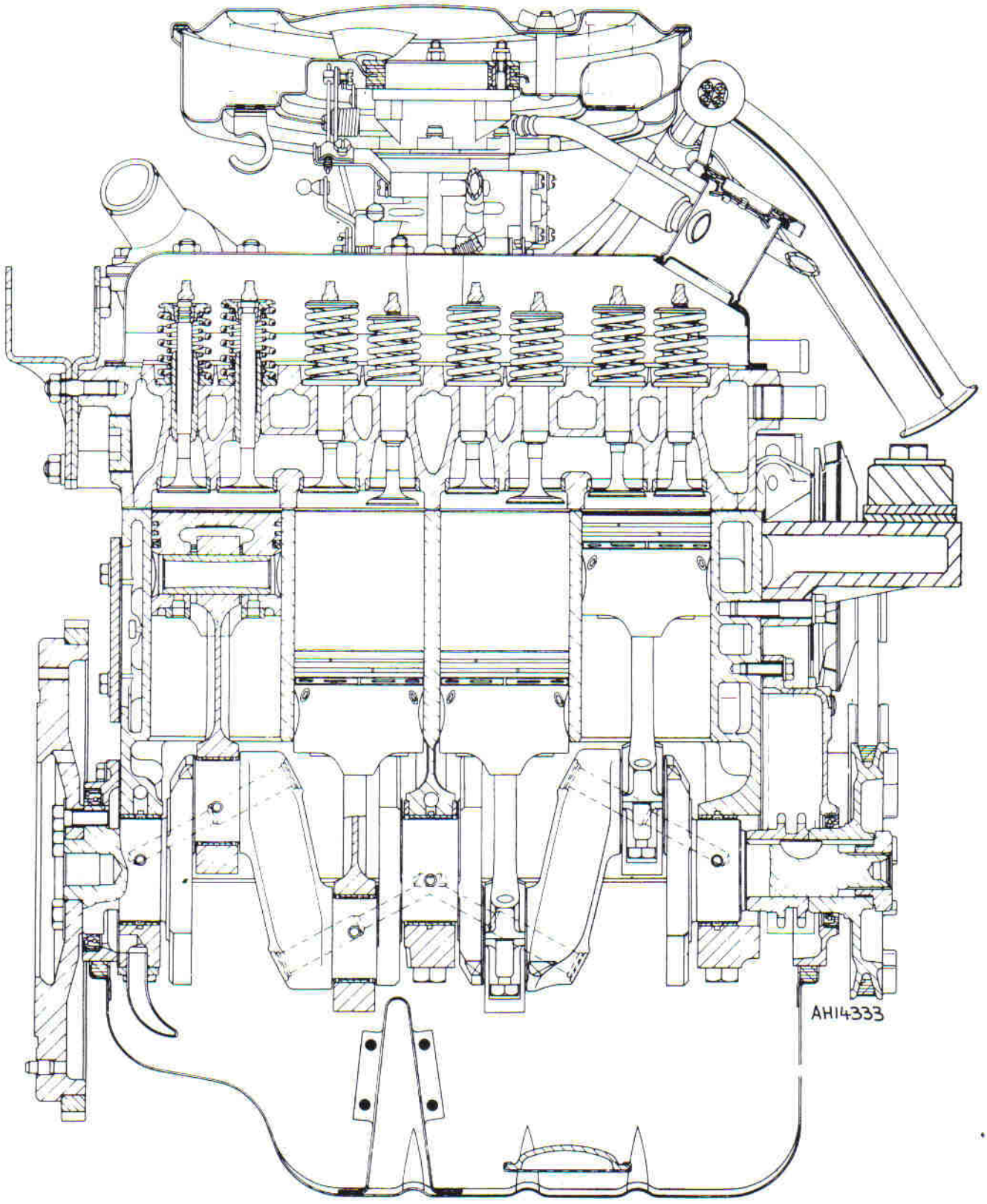


Fig. 1.1 Longitudinal section of 903 cc OHV engine (Sec 1)

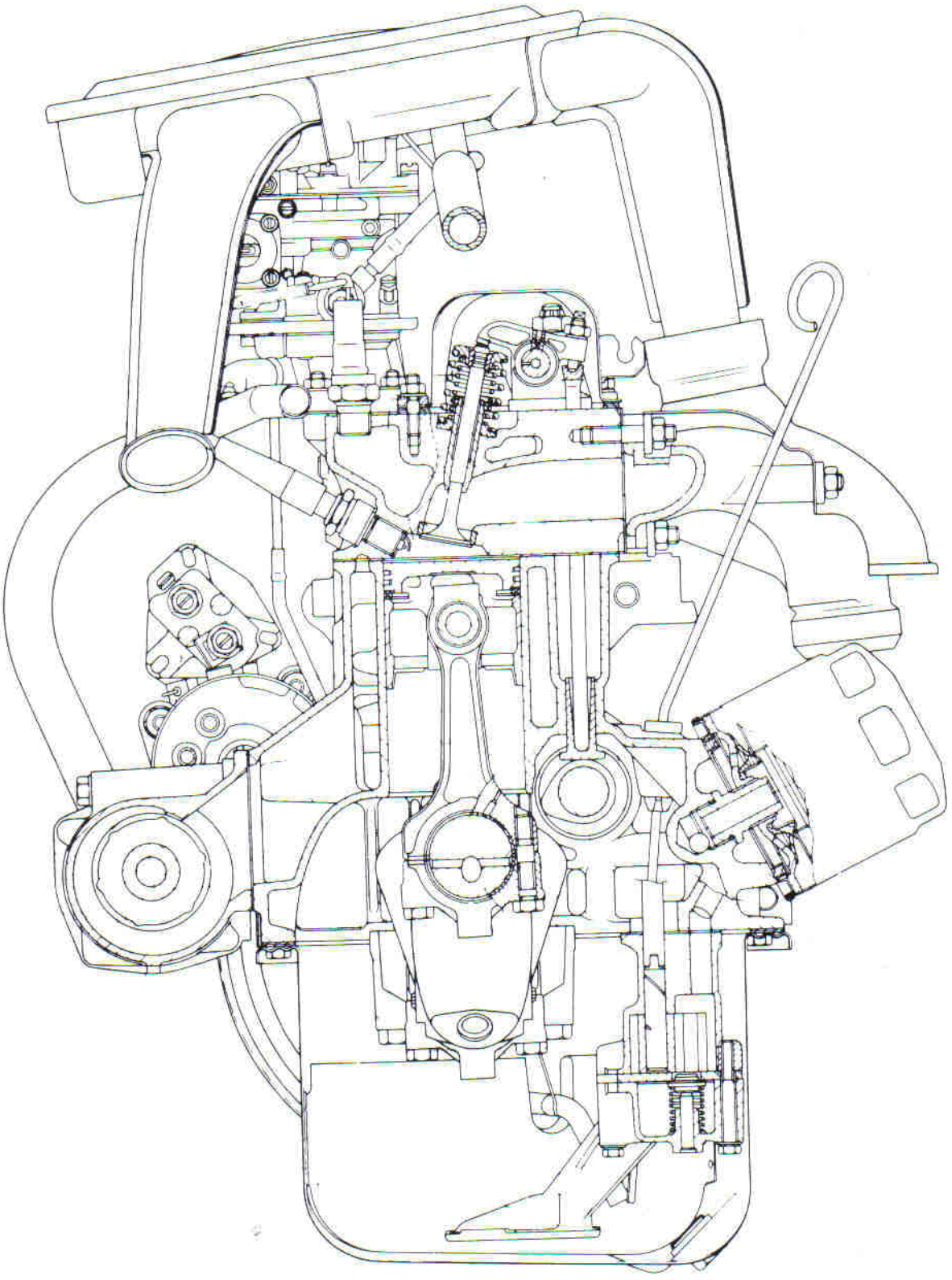


Fig. 1.2 Cross-section of 903 cc OHV engine (Sec 1)

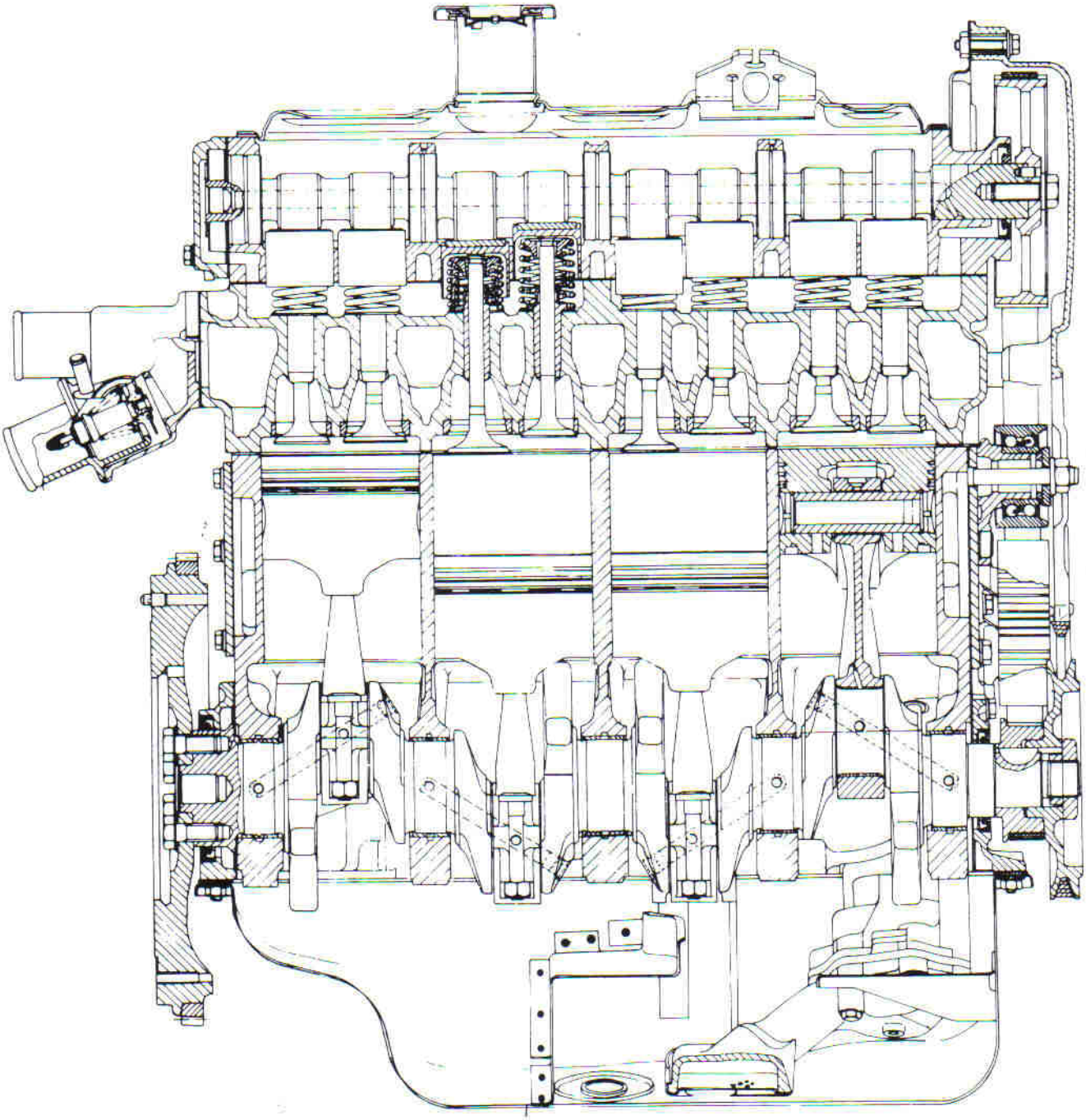


Fig. 1.3 Longitudinal section of 1116 cc, 1298 cc and 1301 cc OHC engines (Sec 1)

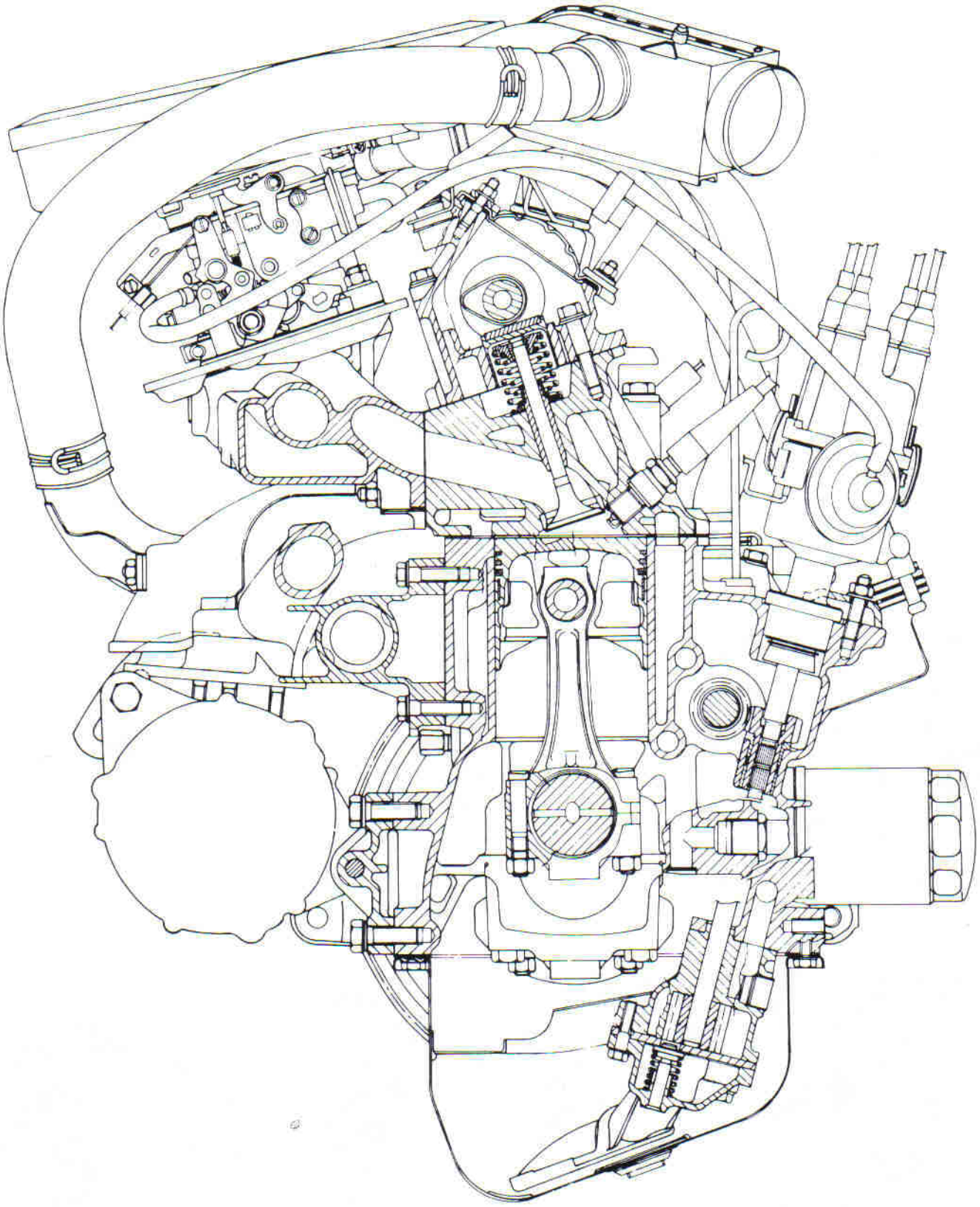


Fig. 1.4 Cross-section of 1116 cc, 1298 cc and 1301 cc OHC engines (Sec 1)

3 Engine oil and filter

1 The engine oil level should be checked at the weekly service (see *Routine maintenance)*. Preferably check the level cold, first thing in the morning or if the engine has been running, allow at least ten minutes to elapse after switching off to permit the oil to drain.
2 Withdraw the dipstick, wipe it clean on non-fluffy material, re-insert it and then withdraw it for the second time (photo).
3 The oil level should be between the MIN and MAX marks. If not, top up with specified oil to the MAX mark. Pour the oil slowly through the filler orifice on the rocker cover. To raise the oil level from MIN to MAX will require approximately 1.1 litres (2.0 pints) (photos).
4 At the intervals specified in *'Routine maintenance'* the oil and filter should be renewed.
5 Have the engine at normal operating temperature and remove the oil filler cap.
6 Place a suitable container under the sump pan. Unscrew and remove the oil drain plug and allow the oil to drain (photo).
7 While the oil is draining, unscrew and discard the oil filter. To unscrew the filter, a filter or chain wrench will normally be required. If such a tool is not available, drive a long screwdriver through the oil filter casing and use it as a lever to unscrew the filter cartridge.
8 Smear the rubber sealing ring of the new oil filter with oil and screw it into position using hand pressure only (photo).
9 Refit the drain plug and refill the engine with the correct quantity and grade of oil.
10 Start the engine. It will take two or three seconds for the oil warning lamp to go out. This is normal and is due to the time taken for the new filter to fill with oil.
11 Switch off, check for leaks and check the oil level, topping-up if necessary.

4 Major operations possible without removing engine from car

The following work can be carried out without the need to remove the engine from the car.

903 cc engine

Valve clearances – checking and adjusting
Timing chain and sprockets – removal and refitting
Cylinder head – removal and refitting
Sump pan – removal and refitting
Pistons/connecting rods – removal and refitting
Oil pump – removal and refitting
Engine mountings – renewal

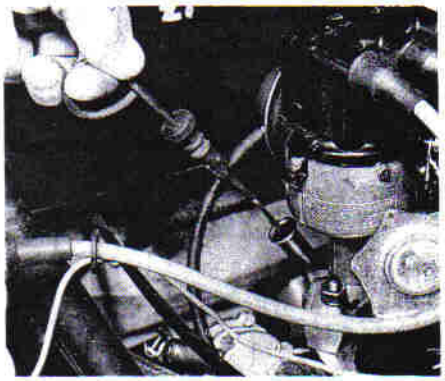
1116 cc, 1298 cc and 1301 cc engines

Valve clearances – checking and adjusting
Camshaft and camshaft carrier – removal and refitting
Timing belt – removal and refitting
Cylinder head – removal and refitting
Sump pan – removal and refitting
Oil pump – removal and refitting
Pistons/connecting rods – removal and refitting
Engine mountings – renewal

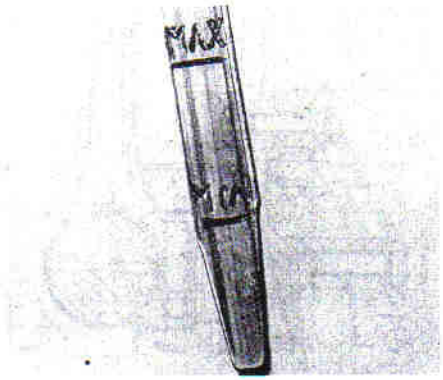
PART 2 903 CC (OHV) ENGINE

5 Valve clearances – adjustment

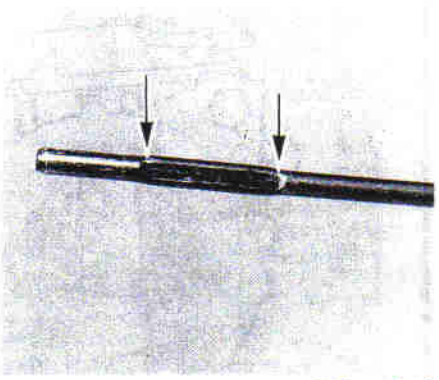
1 Adjust the valves when the engine is cold.



3.2 Withdrawing oil dipstick on 903 cc OHV engine

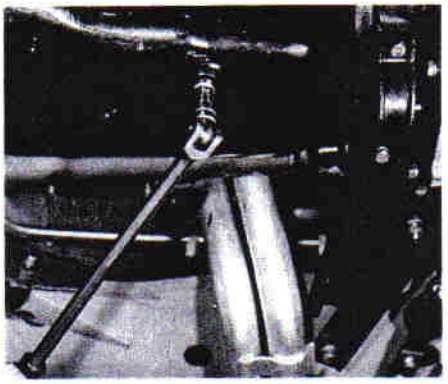


3.3A Level marks on dipstick – 903 cc OHV engine



3.3B Level marks on dipstick – 1298 cc OHC engine

3.3C Topping-up an OHC engine with oil



3.6 Unscrewing the oil drain plug on 1298 cc OHC engine

3.8 Fitting sealing ring to oil filter

2 Unbolt and remove the valve cover (photos).
3 It is important that the clearance is set when the cam follower of the valve being adjusted is on the heel of the cam (ie; opposite the peak). This can be done by carrying out the adjustments in the following order, which also avoids turning the crankshaft more than necessary.
4 Turn the crankshaft either using a spanner on the pulley nut or by raising a front roadwheel, engaging a gear (3rd or 4th) and turning the wheel in the forward direction of travel. It will be easier to turn the engine if the spark plugs are first removed.

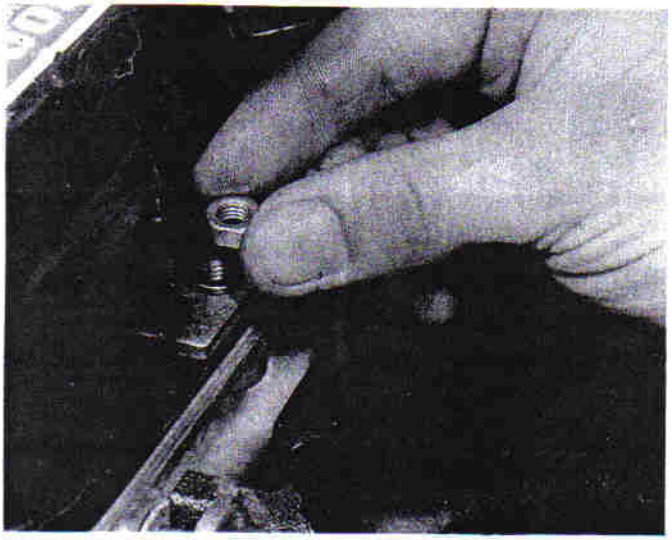
Valve fully open	Check and adjust
Valve No. 8 EX	Valve No. 1 EX
Valve No. 6 IN	Valve No. 3 IN
Valve No. 4 EX	Valve No. 5 EX
Valve No. 7 IN	Valve No. 2 IN
Valve No. 1 EX	Valve No. 8 EX
Valve No. 3 IN	Valve No. 6 IN
Valve No. 5 EX	Valve No. 4 EX
Valve No. 2 IN	Valve No. 7 IN

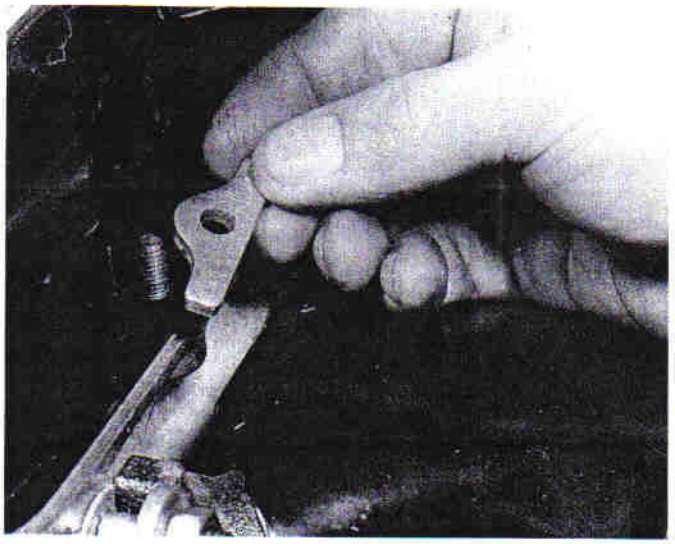
5 Count the valve from the timing cover end of the engine.
6 Remember, the inlet and exhaust valve clearances are different.
7 Insert the appropriate feeler gauge between the end of the valve stem and the rocker arm. It should be a stiff sliding fit (photo).
8 If the clearance is incorrect, release the rocker arm adjuster screw locknut using a ring spanner. Turn the adjuster screw using a small open-ended spanner, but tie something to it in case it is inadvertently dropped through one of the pushrod holes.
9 Once the clearance is correct, tighten the locknut without moving the position of the adjuster screw.
10 Repeat the operations on the remaining seven valves.
11 Re-check all the clearances. Make sure that the valve cover gasket is in good condition and fit the valve cover (photo).

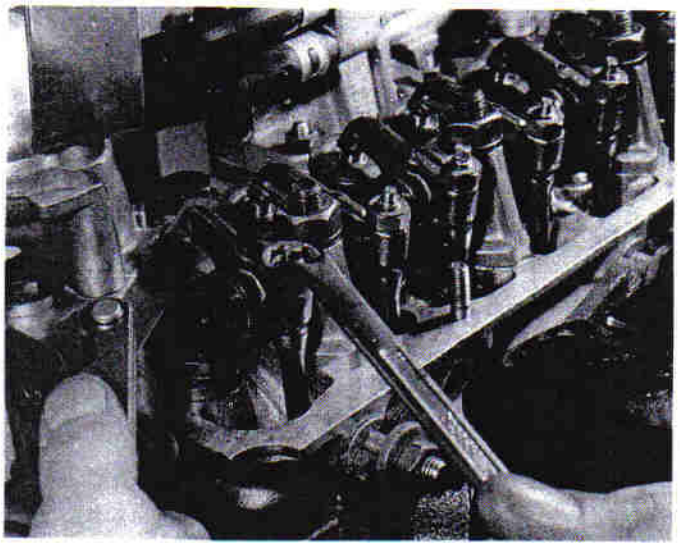
6 Timing chain and sprockets – removal and refitting

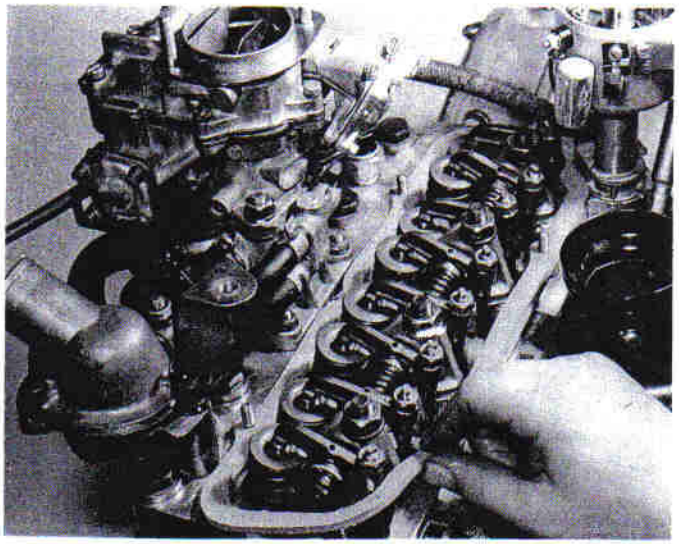
Removal

1 Remove the alternator drivebelt as described in Chapter 12.
2 Unscrew and remove the crankshaft pulley nut. To prevent the crankshaft rotating, either select a gear and have an assistant apply the footbrake hard or remove the starter motor and lock the ring gear teeth with a large cold chisel or screwdriver.
3 Disconnect the hoses from the fuel pump.
4 Unbolt and remove the fuel pump with spacer and rod.
5 Support the engine on a hoist or under the sump and disconnect and remove the right-hand mounting. Unscrew and remove the timing


5.2A Removing a nut ...


5.2B ... and metal packing piece from the valve cover


5.7 Checking valve clearances


5.11 Fitting valve cover gasket

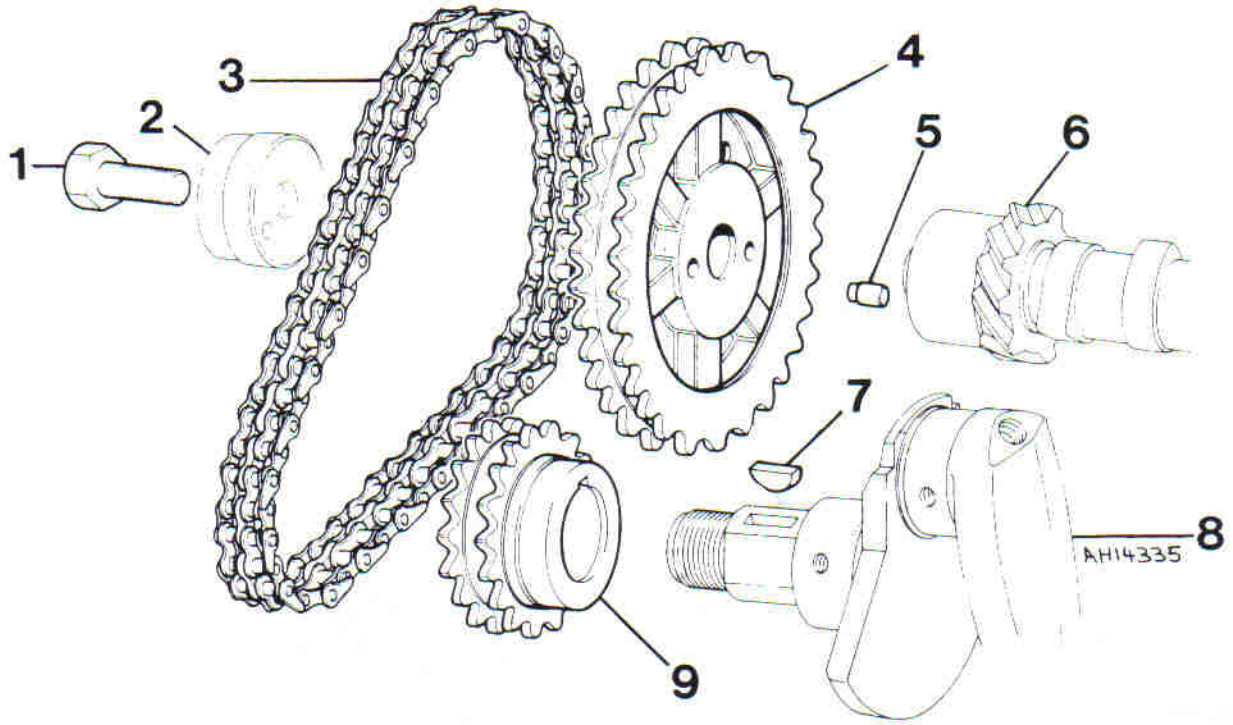


Fig. 1.5 Timing chain and sprockets (Sec 6)

1 Sprocket retaining bolt
2 Fuel pump eccentric cam
3 Timing chain
4 Camshaft sprocket
5 Sprocket locating dowel
6 Camshaft
7 Woodruff key
8 Crankshaft
9 Crankshaft sprocket

cover bolts. The base of the cover is secured by the front two sump pan studs. Unbolt and lower the front end of the sump. Avoid breaking the gasket. Remove the timing cover.

6 Undo and remove the camshaft sprocket securing bolt; this will also release the fuel pump drive cam from the end of the camshaft. Note the timing marks on the camshaft and crankshaft sprockets.

7 Using two tyre levers, carefully ease the two sprockets forwards away from the crankcase. Lift away the two sprockets and timing chain.

8 Remove the Woodruff key from the crankshaft nose with a pair of pliers and note how the channel in the pulley is designed to fit over it. Place the Woodruff key in a container as it is a very small part and can easily become lost. The camshaft sprocket is located on the camshaft by a dowel peg.

Refitting

9 Fit the Woodruff key to the front of the crankshaft.

10 Tap the crankshaft sprocket onto the front of the crankshaft.

11 Turn the sprocket so that the Woodruff key is uppermost.

12 Turn the camshaft until it is in such a position that if the sprocket was fitted the dimple timing mark on the sprocket would be nearest to and in alignment with, the mark on the crankshaft sprocket.

13 Engage the timing chain with the teeth of the crankshaft sprocket. Locate the camshaft sprocket within the upper loop of the chain in such a way that when the sprocket is pushed onto the camshaft, the timing marks will be in alignment. Make sure that the self-tensioning links are on the inside of the chain against the cylinder block (photos).

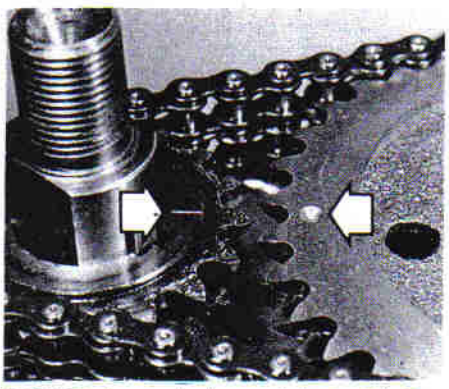
14 Place the camshaft sprocket onto the camshaft so that its positioning dowel engages.

15 Secure the camshaft sprocket by fitting the special cam, which drives the fuel pump, on its locating dowel (photo). Fit the camshaft sprocket retaining bolt.

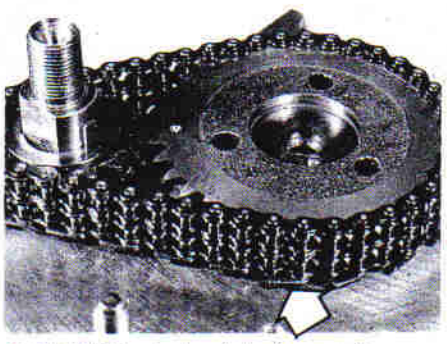
16 Tighten the sprocket bolt to the specified torque (photo).

17 If the timing cover oil seal showed signs of leaking before engine overhaul the old seal should be removed and a new one fitted.

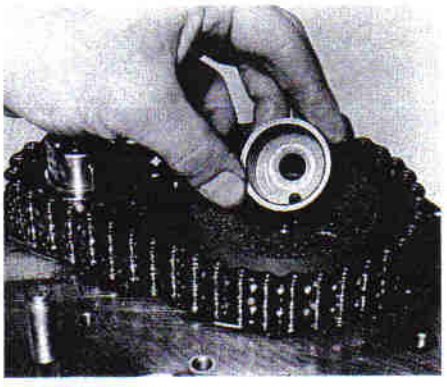
18 Using a screwdriver, carefully remove the oil thrower ring and the



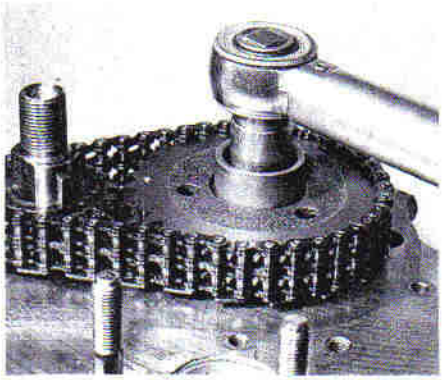
6.13A Timing mark alignment (arrowed) on camshaft and crankshaft sprockets



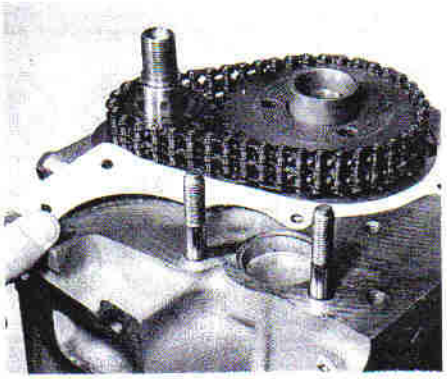
6.13B Self-tensioning links (arrowed) should be inboard



6.15 Fitting fuel pump drive cam to camshaft sprocket

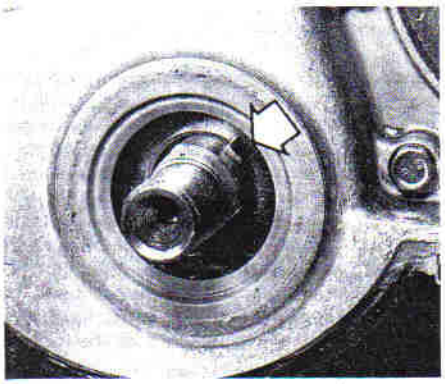


6.16 Tightening the camshaft sprocket bolt

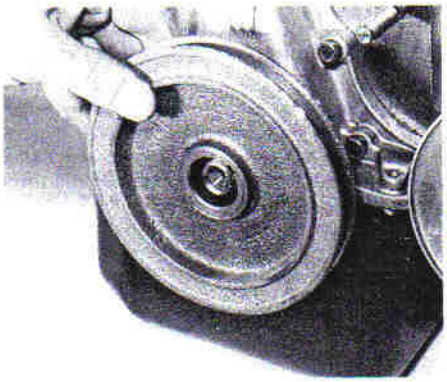


6.20 Fitting new gasket ...

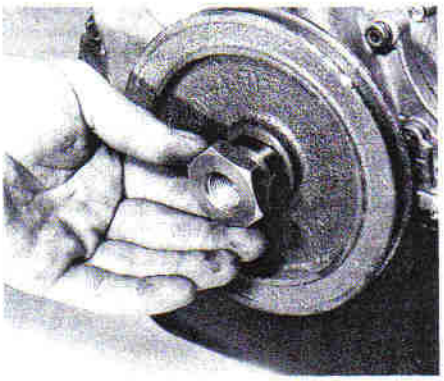
6.21 ... and the timing gear cover



6.22A Woodruff key in position on the crankshaft



6.22B Fitting crankshaft pulley ...



6.22C ... and nut

old oil seal. Fit the new seal making sure it is inserted squarely and tap home with a hammer.
19 Lubricate the oil seal with engine oil. Refit the oil thrower ring.
20 With all traces of old gasket and jointing compound removed from the timing cover and cylinder block mating faces, smear a little grease onto the timing cover mating face and fit a new gasket in position (photo).
21 Fit the timing cover to the cylinder block and finger tighten the securing bolts, and spring washers (photo). Ensure that the fuel pump pushrod bush is in place in the cover.
22 Wipe the hub of the pulley and carefully place into position on the crankshaft. It should locate on the Woodruff key (photos). It may be necessary to adjust the position of the timing cover slightly in order to centralise the oil seal relative to the pulley hub. Refit the crankshaft pulley nut (photo).
23 Tighten the timing cover securing bolts in a diagonal and progressive manner.
24 Tighten the crankshaft pulley nut to the specified torque again holding the crankshaft against rotation as previously described (paragraph 2 this Section).
25 Refit the fuel pump and alternator drivebelt.

7 Cylinder head – removal and refitting

Removal

1 For safety reasons, disconnect the battery negative lead.
2 Refer to Chapter 2 and drain the cooling system.
3 Refer to Chapter 3 and remove the carburettor, air cleaner and spacer block.
4 Undo and remove the five nuts and washers securing the exhaust manifold and hot air ducting to the cylinder head.
5 Detach the cable from the temperature indicator sender unit.
6 Refer to Chapter 4 and disconnect the distributor LT lead and the HT leads. Remove the distributor.
7 Refer to Chapter 2 and remove the thermostat housing from the cylinder head.
8 Disconnect the coolant hoses from the cylinder head.
9 Note the electrical connections to the rear of the alternator and disconnect them.
10 Disconnect the mounting and adjuster link bolts and remove the alternator from the engine (Chapter 12).
11 Unscrew the four nuts securing the valve cover to the top of the cylinder head and lift away the spring washers and metal packing pieces. Remove the valve cover and cork gasket.
12 Unscrew the four rocker pedestal securing nuts in a progressive manner. Lift away the four nuts and spring washers and ease the valve rocker assembly from the cylinder head studs (photos).
13 Remove the pushrods, keeping them in the relative order in which they were removed (photo). The easiest way to do this is to push them through a sheet of thick paper or thin card in the correct sequence.
14 Remove the bolt from the bracket securing the oil dipstick tube to the cylinder head, then pull out the dipstick tube.
15 Unscrew the cylinder head securing bolts half a turn at a time in the reverse order to that shown in Fig. 1.6; don't forget the one within the inlet manifold (photo). When all the bolts are no longer under tension they may be unscrewed from the cylinder head one at a time. This will also release a section of the cooling system pipe secured by two of the bolts. All the bolts have washers.
16 The cylinder head may now be lifted off. If the head is jammed, try to rock it to break the seal. Under no circumstances try to prise it apart from the cylinder block with a screwdriver or cold chisel as damage may be done to the faces of the head or block. If the head will not readily free, turn the crankshaft. The compression generated in the cylinders will often break the gasket joint. If this fails to work, strike the head sharply with a plastic headed hammer, or with a wooden hammer, or with a metal hammer with an interposed piece of wood to cushion the blows. Under no circumstances hit the head directly with a metal

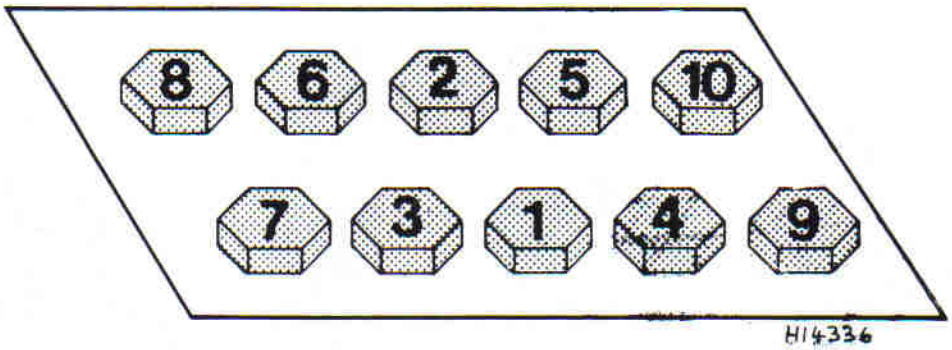
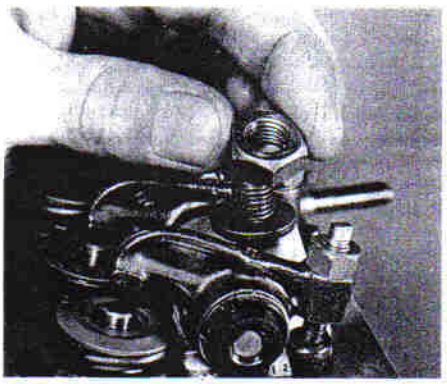


Fig. 1.6 Cylinder head bolt tightening sequence – OHV engine (Sec 7)

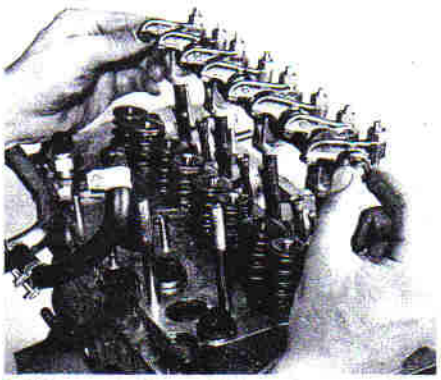
hammer as this may cause the casting to fracture. Several sharp taps with the hammer, at the same time pulling upwards, should free the head. Lift the head off and place on one side.
17 The cylinder head may now be decarbonised or dismantled, refer to Section 17.

Refitting

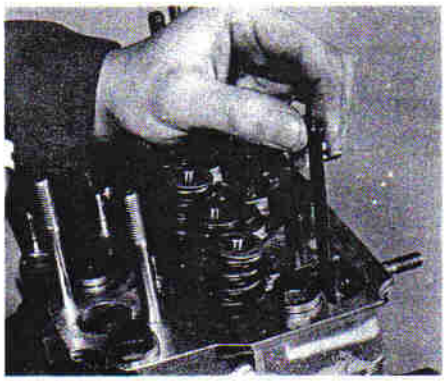
18 After checking that both the cylinder block and cylinder head mating surfaces are perfectly clean, generously lubricate each cylinder with engine oil.
19 Always use a new cylinder head gasket, as the old gasket will be compressed and not capable of giving a good seal.
20 Never smear grease on the gasket as, when the engine heats up, the grease will melt and may allow compression leaks to develop.
21 The cylinder head gasket cannot be fitted incorrectly due to its asymmetrical shape.
22 The locating dowels should be refitted to the front right and left-hand side cylinder head securing bolt holes.
23 Carefully fit the cylinder head gasket to the top of the cylinder block (photo).
24 Lower the cylinder head onto the gasket, taking care not to move the position of the gasket.
25 Screw in the cylinder head bolts finger tight, remembering the bolt within the intake manifold and the metal coolant pipe which is held by the two cylinder head bolts adjacent to the coolant temperature sender unit.
26 Tighten the cylinder head bolts in two stages, in the specified sequence, to the torque given in Specifications (photo).
27 With the cylinder head in position, fit the pushrods in the same order in which they were removed. Ensure that they locate properly in the stems of the tappets and lubricate the pushrod ends before fitment.
28 Unscrew the rocker arm adjuster screws as far as they will go.
29 Fit the rocker gear over the four studs in the cylinder head and lower onto the cylinder head. Make sure the ball ends of the rockers locate in the cups of the pushrods (photo).
30 Fit the four nuts and washers to the rocker pedestal studs and



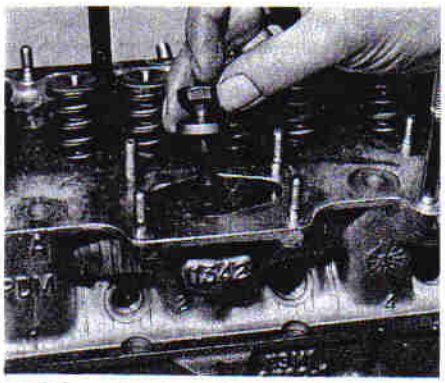
7.12A Removing a rocker pedestal nut ...



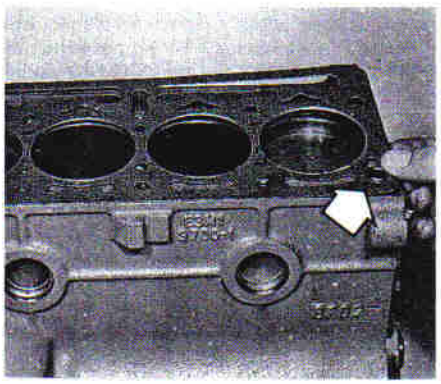
7.12B ... and lifting off the rocker assembly



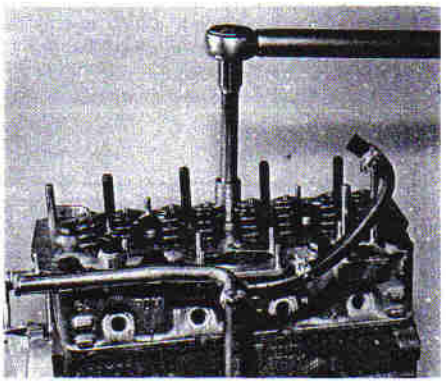
7.13 Lifting out a pushrod



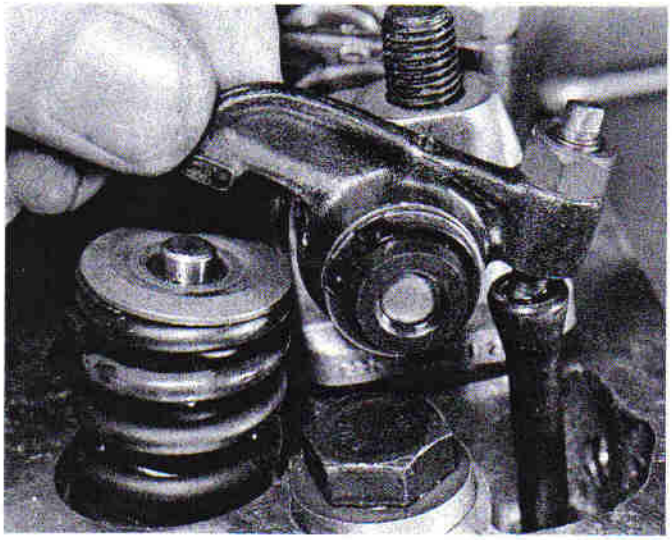
7.15 Removing the cylinder head bolt from inlet manifold



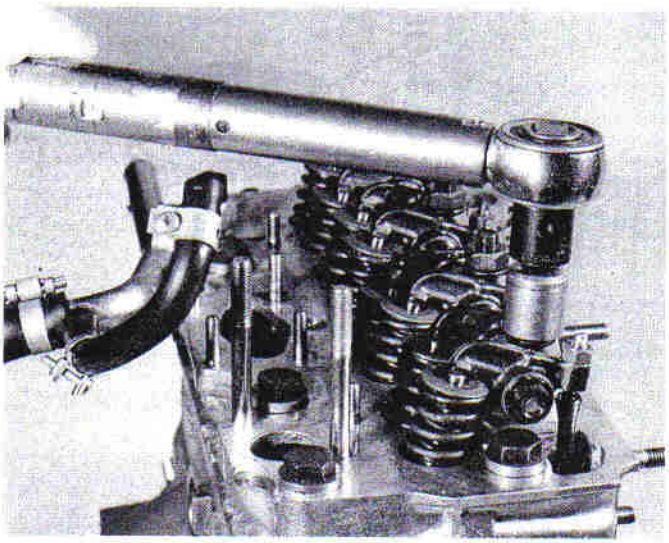
7.23 Fitting cylinder head gasket (locating dowel arrowed)



7.26 Tightening the cylinder head bolts



7.29 Fitting the rocker gear, ball end of rocker locating in pushrod cup



7.30 Tightening rocker pedestal nut

tighten in a progressive manner to the torque wrench setting given in the Specifications (photo).
31 Adjust the valve clearances as described in Section 5.
32 Fit the exhaust manifold and hot air ducting, the thermostat housing and alternator, also the valve cover and oil dipstick tube.
33 Fit the carburettor, air cleaner and spacer block, and the distributor (Chapters 3 and 4).
34 Reconnect all hoses and electrical leads, including the battery.
35 Refill the cooling system.

8 Sump pan – removal and refitting

Removal

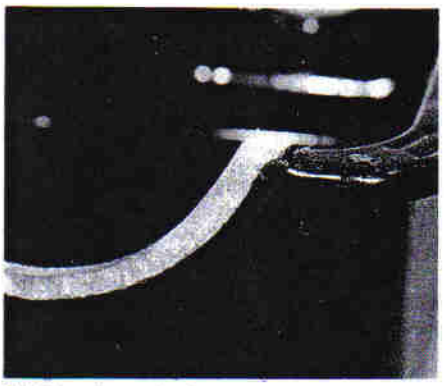
1 Drain the engine oil.
2 Unscrew and remove the four nuts and twelve bolts and lift away the sump pan. If it has stuck on the gasket, carefully tap the side of the mating flange to break the seal. Remove the gasket and clean away any pieces of gasket cement which are adhering to the flanges.
3 Remove the sealing strips from the recesses at either end of the sump pan.

Refitting

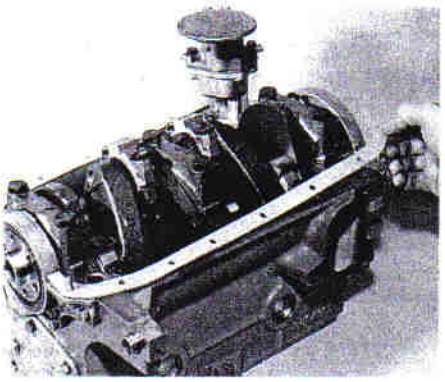
4 Fit the new sealing strips and if necessary, trim their ends until they are just proud of the sump pan flange (photo).
5 Using thick grease, stick the gasket side strips to the crankcase (photo).
6 Apply a blob of jointing compound at the points of overlap of the side gaskets and strips.
7 Offer up the sump pan and screw in and tighten the bolts and nuts progressively (photo).
8 Refill the engine with oil.

9 Pistons/connecting rods – removal and refitting

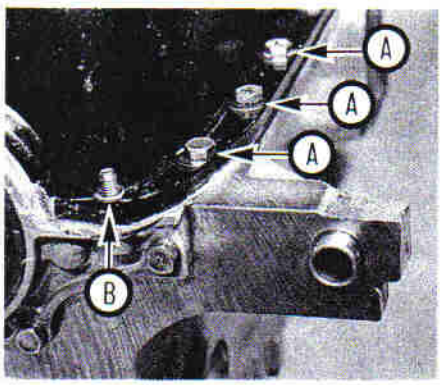
1 Remove the cylinder head as described in Section 7.
2 Remove the sump pan as described in Section 8.
3 Undo and remove the big-end cap retaining bolts and keep them in their respective order for correct refitting.
4 Check that the connecting rod and big-end bearing cap assemblies are correctly marked. Normally the numbers 1 – 4 are stamped on adjacent sides of the big-end caps and connecting rods, indicating which cap fits on which rod and which way round the cap fits. The numbers are located on the sides of the rod and cap furthest away from the camshaft.
5 If numbers are not evident, then use a sharp file to make mating marks across the rod/cap joint. One line for connecting rod No 1, two for connecting rod No 2 and so on. This will ensure that there is no confusion later as it is most important that the caps go back in the correct position on the connecting rods from which they were removed. No. 1 piston is at the timing chain end of the engine.
6 If the big-end caps are difficult to remove, they may be gently tapped with a soft-faced hammer.
7 To remove the shell bearings, press the bearings opposite the groove in both the connecting rod and the connecting rod caps and the bearings will slide out easily.
8 Keep the shells with their original cap or rod if the bearings are not being renewed.



8.4 Trim the ends of the sealing strips



8.5 Locating gasket side strips on crankcase



8.7 Fit and tighten the bolts (A) and nuts (B)

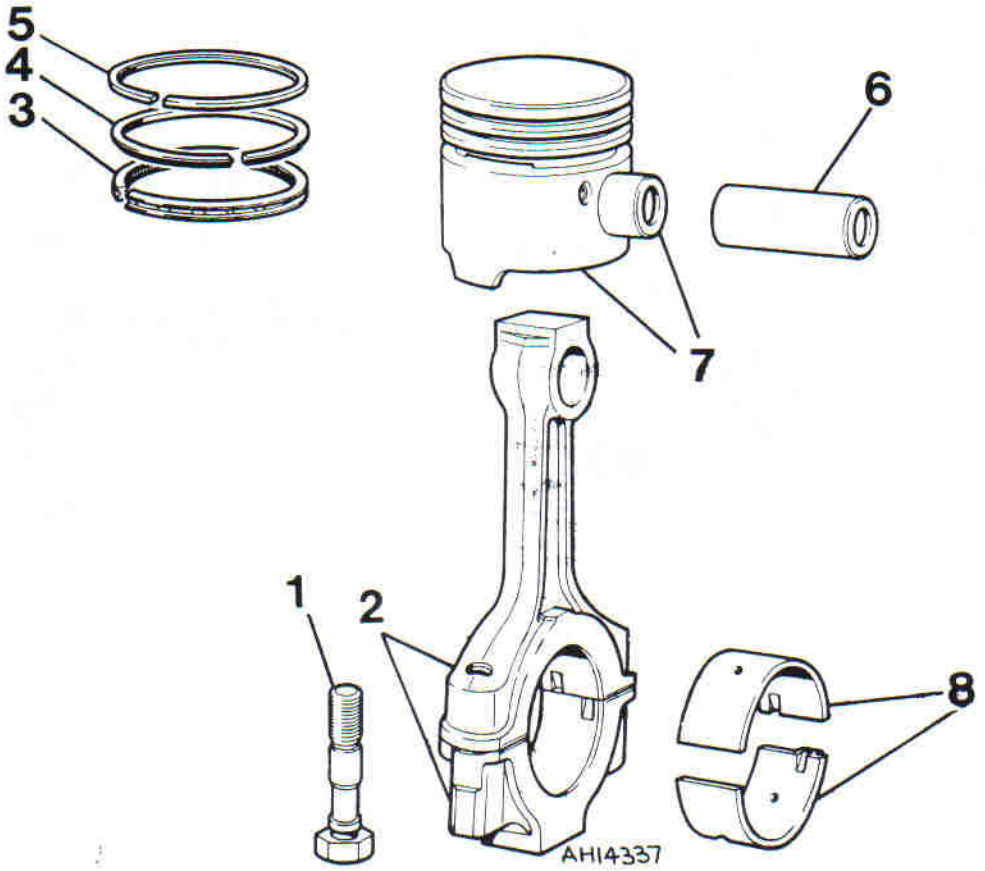


Fig. 1.7 Components of piston/connecting rod assembly (Sec 9)

1 Bolt
2 Connecting rod and cap
3 Oil control ring
4 Compression ring (stepped at base)
5 Compression ring (marked TOP)
6 Gudgeon pin
7 Piston/gudgeon pin
8 Big-end bearing shells

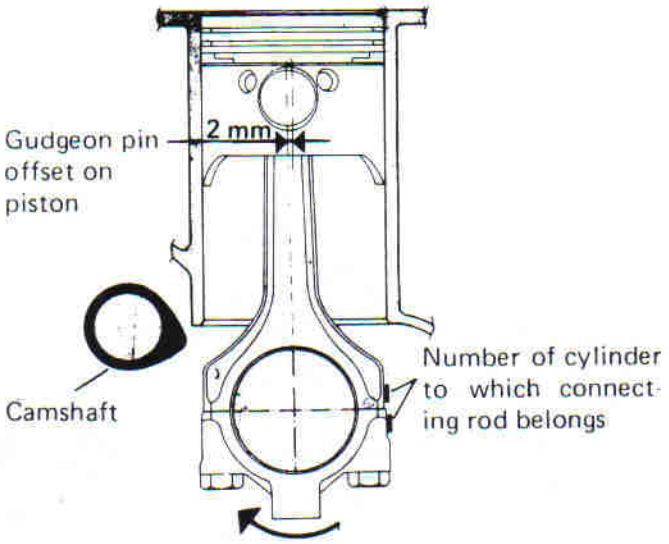
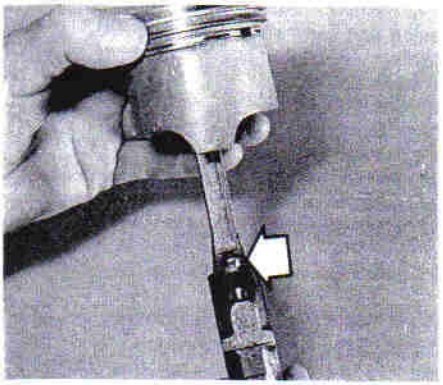
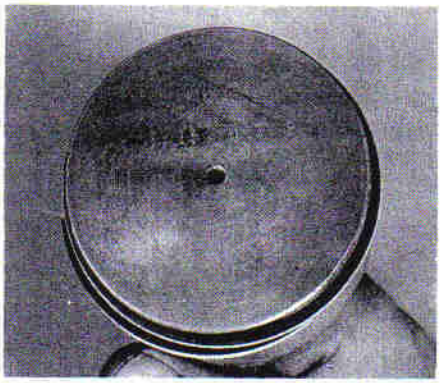


Fig. 1.8 Piston/connecting rod orientation when refitting (Sec 9)

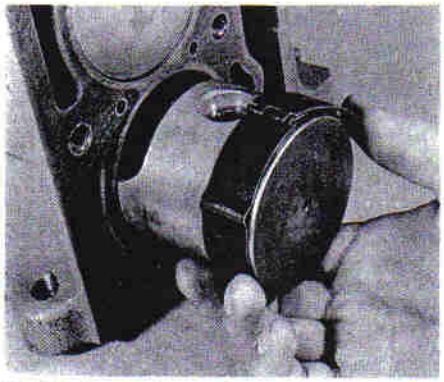
9 Withdraw the pistons and connecting rods upwards and ensure that they are kept in the correct order for replacement in the same bore.
10 If the cylinder has a wear ridge at its upper end then this may make it difficult to remove the piston. In this event, relieve the sharp edge of the ridge by scraping.
11 Dismantling of the pistons is described in Section 18, paragraph 17.
12 Lay the piston and connecting rod assemblies in the correct order ready for refitting into their respective bores.
13 With a wad of clean non-fluffy rag wipe the cylinder bores clean.
14 Position the piston rings so that their gaps are 120° apart and then lubricate the rings.
15 Wipe clean the connecting rod half of the big-end bearing and the underside of the shell bearing. Fit the shell bearing in position with its locating tongue engaged with the corresponding groove in the connecting rod.
16 Fit a piston ring compressor to the top of the piston, making sure it is tight enough to compress the piston rings.
17 Using a piece of fine wire double check that the little jet hole in the connecting rod is clean (photo).
18 The pistons, complete with connecting rods, are fitted to their bores from above. The number stamped on the connecting rod must face away from the camshaft with the arrow on the piston crown pointing towards the timing cover – see also note in Section 18 (photo).
19 With the base of the piston ring compressor resting on the cylinder block, apply the wooden handle of a hammer to the piston crown, strike the hammer head with the hand and drive the piston/rod into its bore (photo).
20 Draw the rod, complete with shell bearing down onto its crankpin.
21 Generously lubricate the crankpin journals with engine oil, and



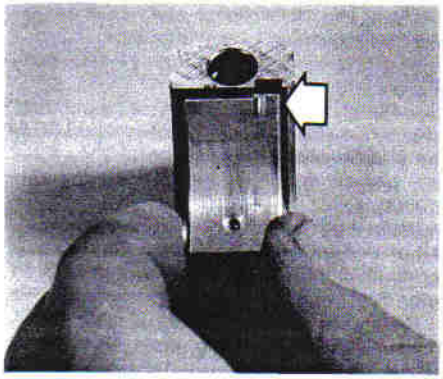
9.17 Oil jet hole in connecting rod (arrowed)



9.18 Arrow on piston crown (Kolbenschmit)

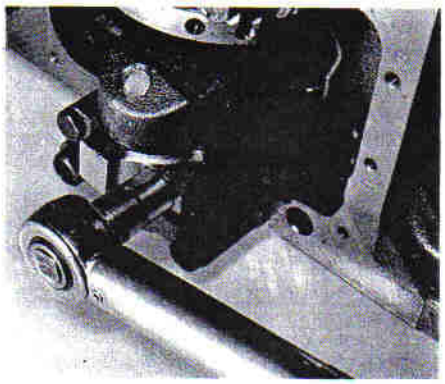


9.19 Fitting a piston using piston ring compressor



9.22 Locating tongue on bearing shell engaged with groove in cap

9.23 Fitting bearing cap to connecting rod



9.24 Tightening the big-end bolts

turn the crankshaft so that the crankpin is in the most advantageous position for the connecting rod to be drawn into it.
22 Wipe clean the connecting rod bearing cap and the back of the shell bearing and fit the shell bearing in position ensuring that the locating tongue at the back of the bearing engages with the locating groove in the connecting rod cap (photo).
23 Generously lubricate the bearing shell and offer up the connecting rod bearing cap to the connecting rod (photo).
24 Screw in the big-end bolts and tighten to the specified torque (photo).
25 Refit the sump pan (Sec 8) and the cylinder head (Sec 7).
26 Refill the engine with oil and coolant.

10 Oil pump – removal and refitting

Removal

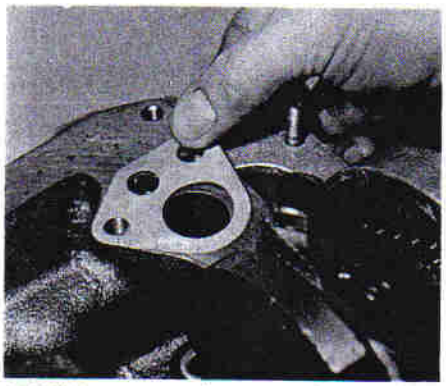
1 Remove the sump pan as described in Section 8.
2 Unscrew the two bolts which hold the oil pump housing to the underside of the crankcase and withdraw the pump. Remove and discard the pump flange gasket.

Refitting

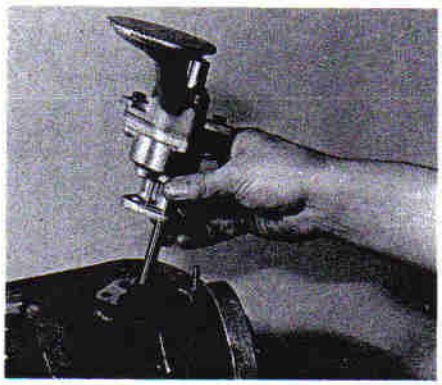
3 Stick a new gasket to the oil pump location on the underside of the crankcase (photo).
4 Locate the oil pump driveshaft in the oil pump and then offer up the complete assembly to the crankcase so that the gear teeth on the driveshaft mesh with those on the camshaft (photo).
5 Fit the securing bolts (photo).
6 Fit the sump pan and refill the engine with oil.

11 Engine mountings – renewal

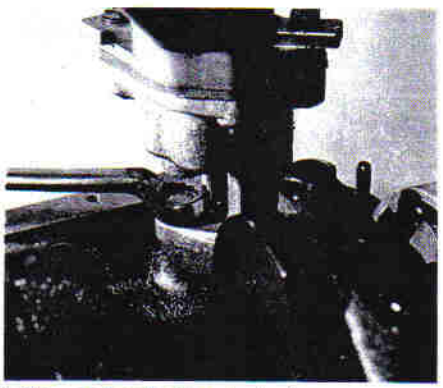
1 The engine/transmission flexible mountings can be removed if the power unit is supported under the sump pan or gearbox with a jack, or



10.3 Fitting a new oil pump gasket to the crankcase



10.4 Fitting the oil pump ...



10.5 ... and tightening the bolts

a hoist is attached to the engine lifting lugs and the weight of the power unit just taken.
2 Unscrew the mounting bracket bolts and remove the mounting (photos).
3 Fit the new mounting and remove the lifting gear.
4 In the unlikely event of all the mountings requiring renewal at the same time, renew them one at a time, never disconnect all the mountings together.

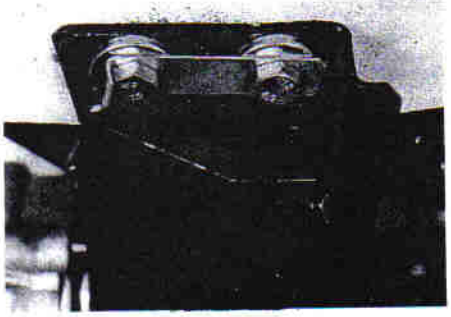
12 Engine – method of removal

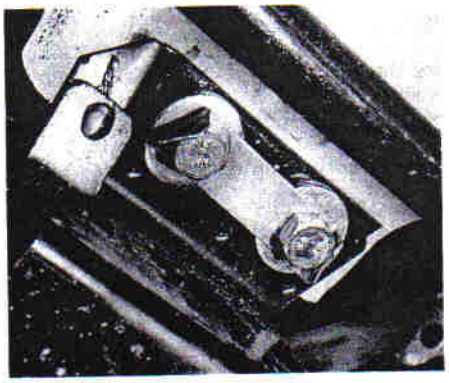
1 The engine and transmission are removed as one unit.
2 The manufacturers recommend that the engine is lowered from the engine bay but we found that on the 45A model the engine and transmission can be lifted out quite comfortably in the normal manner.
3 If it is decided to lower the engine, refer to Part 3, Section 35 for the removal method.

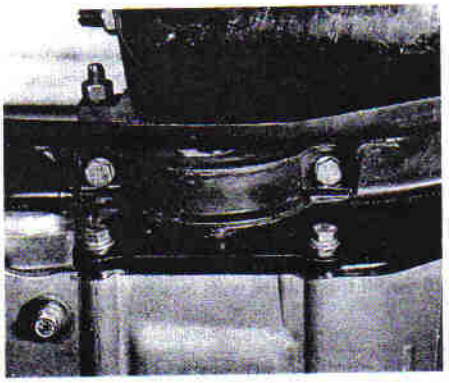
13 Engine/transmission – removal and separation

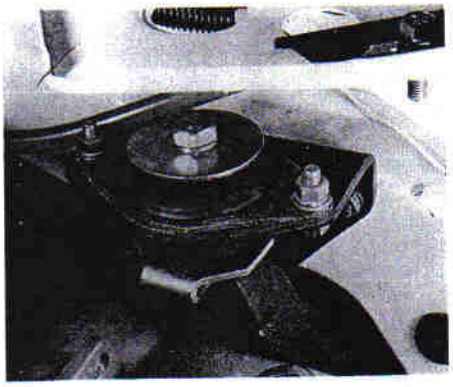
Note: *During the following procedure refer to the relevant Chapters and Sections for removal of ancillary components where the procedure is not detailed here.*

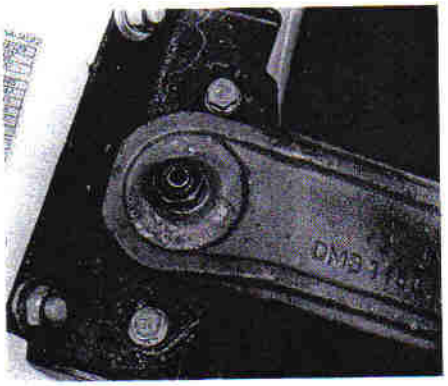
1 Remove the bonnet.
2 Remove the engine splash panels.
3 Remove the spare wheel, then undo and remove the bolts securing the spare wheel carrier and remove it.
4 Drain the cooling system, then remove the top and bottom radiator hoses and the radiator and cooling fan.
5 Disconnect the heater hoses.
6 Drain the oil from the engine, and the transmission if it is to be worked on.
7 Disconnect the alternator, starter motor, coil, reversing light switch, oil pressure transmitter and water temperature transmitter.
8 Disconnect the transmission unit earth strap.
9 Disconnect the clutch cable.
10 Disconnect the speedometer cable.
11 Remove the air cleaner housing.
12 Disconnect the choke cable.
13 Disconnect the accelerator cable or linkage.
14 Disconnect the fuel inlet hose to the fuel pump and plug its end.
15 Disconnect the fuel return hose from the carburettor.
16 Disconnect the exhaust downpipe from the exhaust manifold flange.
17 Raise the front of the vehicle on axle stands and remove the driveshafts.
18 Disconnect the exhaust-to-transmission support bracket.
19 Disconnect the forward end of the gearchange linkage.
20 Attach suitable lifting gear to the engine lifting eyes. One is bolted under the left-hand engine mounting bearer and the other under a clutch bellhousing-to-engine bolt.
21 Using a suitable hoist, just take the weight of the engine, noting that the run of the sling going to the transmission end needs to be slightly longer than the other to tilt the engine as it is lifted.
22 Remove the centre engine mounting (see photo 11.2C) and crossmember, then the left and right-hand mountings.
23 Slowly begin to raise the engine, checking frequently all round that nothing is catching. Keep the transmission end tilted down and swing the whole unit as necessary to clear obstructions (photo).
24 Once clear of the engine bay, swing the engine/transmission unit over and lower it to the ground.
25 Give the engine/transmission a good wash down using proprietary cleaning solvent, then dry it off and transfer it to a bench. Support the engine and transmission on the bench using blocks of wood.
26 Remove the starter motor.
27 Remove the bolts from the engine rear plate (photo).
28 Remove the engine-to-transmission securing bolts and gently separate the transmission from the engine (photo). Take care not to strain the transmission input shaft as the engine and transmission are separated.

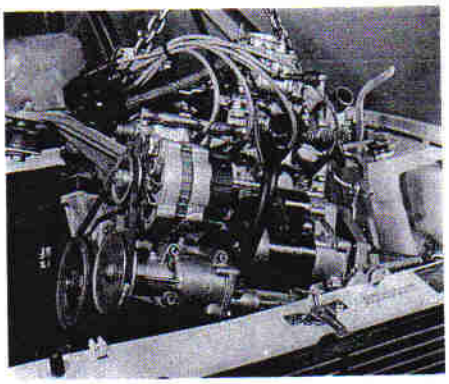

11.2A Engine crossmember rear mounting

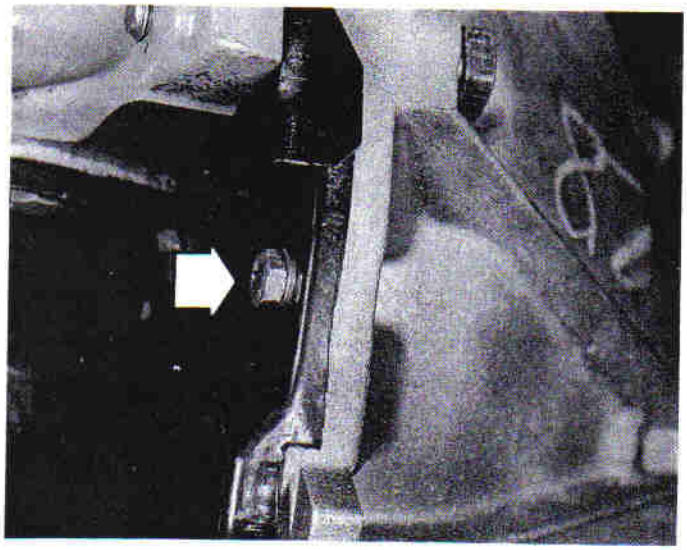

11.2B Engine crossmember front mounting


11.2C Engine centre mounting

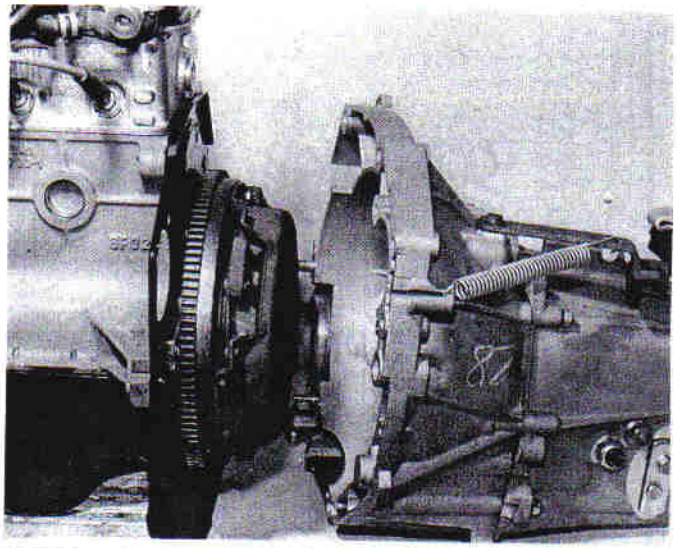

11.2D Left-hand mounting


11.2E Right-hand mounting


13.23 Lifting the engine and transmission unit



13.27 Engine rear plate bolt (arrowed)



13.28 Separating the engine and transmission

14 Engine – dismantling (general)

1 Stand the engine on a strong bench at a suitable working height. Failing this, it can be dismantled on the floor, but at least stand it on a sheet of hardboard.
2 During the dismantling process, the greatest care should be taken to keep the exposed parts free from dirt. As the engine is stripped, clean each part in a bath of paraffin.
3 Never immerse parts with oilways in paraffin, e.g. the crankshaft, but to clean, wipe down carefully with a paraffin dampened rag. Oilways can be cleaned out with a piece of wire. If an air line is available, all parts can be blown dry and the oilways blown through as an added precaution.
4 Re-use of old gaskets is false economy and can give rise to oil and water leaks, if nothing worse. To avoid the possibility of trouble after the engine has been reassembled always use new gaskets throughout.
5 Do not throw the old gaskets away as it sometimes happens that an immediate replacement cannot be found and the old gasket is then very useful as a template. Hang up the gaskets on a suitable nail or hook as they are removed.
6 To strip the engine, it is best to work from the top downwards. The engine oil sump provides a firm base on which the engine can be supported in an upright position. When the stage is reached where the pistons are to be removed, turn the engine on its side. Turn the block upside down to remove the crankshaft.
7 Wherever possible, replace nuts, bolts and washers finger-tight from wherever they were removed. This helps avoid later loss and muddle. If they cannot be replaced, then lay them out in such a fashion that it is clear from where they came.

15 Engine – removing ancillary components

Before dismantling the engine, remove the following engine ancillary components.

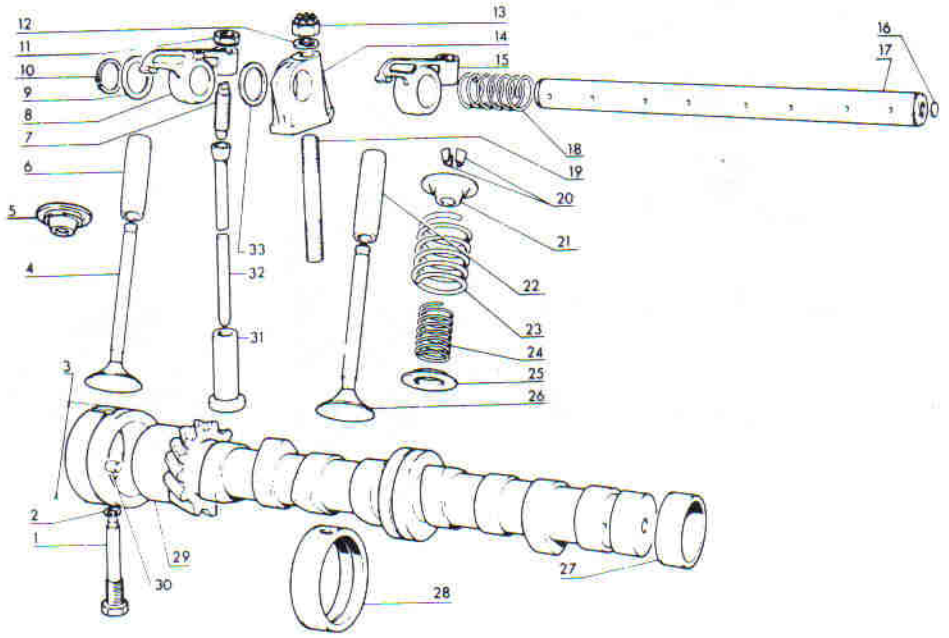
Carburettor (Chapter 3)
Thermostat housing (Chapter 2)
Alternator (Chapter 12)
Coolant pump (Chapter 2)
Distributor (Chapter 4)
Exhaust manifold (Chapter 3)
Fuel pump (Chapter 3)
Oil filter cartridge (Section 3 of this Chapter)
Clutch (Chapter 5)

16 Engine – complete dismantling

1 Unbolt and remove the valve cover.
2 Unscrew the rocker pedestal securing nuts and lift away the rocker assembly.
3 Remove the pushrods, keeping them in their original fitted order.
4 Remove the cylinder head as described in Section 7.
5 Turn the engine on its side and unbolt and remove the sump pan.
6 Remove the piston/connecting rods as described in Section 9.
7 Unscrew and remove the crankshaft pulley nut. To prevent the crankshaft rotating while this is done, either jam the flywheel ring gear, or place a block between a crankshaft counterweight and the inside of the crankcase.
8 Unbolt and remove the timing cover.
9 Remove the timing chain and sprockets as described in Section 6.
10 Unbolt and remove the oil pump as described in Section 10.
11 Unscrew and remove the camshaft front bearing lockscrew noting that the chamfer on the bearing is on the inboard side.
12 Withdraw the camshaft, taking great care not to damage the bearings with the cam lobes.
13 Lift out the cam followers and keep them in their original fitted sequence.
14 Unbolt and remove the flywheel. Jam the ring gear teeth to prevent rotation.
15 Remove the engine rear plate.
16 Turn the cylinder block so that it is standing upside down.
17 Unbolt and remove the crankshaft rear oil seal carrier. Note the sump fixing studs.
18 The main bearing caps should be marked 1, 2 and 3, but if they are not, centre punch them and note which way round they are located.
19 Unscrew the main bearing cap bolts progressively.
20 Remove the bearing caps and half shells. If the shell bearings are to be used again, keep them with their respective caps.
21 Note the semi-circular thrust washers on either side of the centre main bearing which control crankshaft endfloat.
22 Lift the crankshaft from the crankcase.
23 Remove the bearing shells from the crankcase and mark them as to position if they are to be used again.

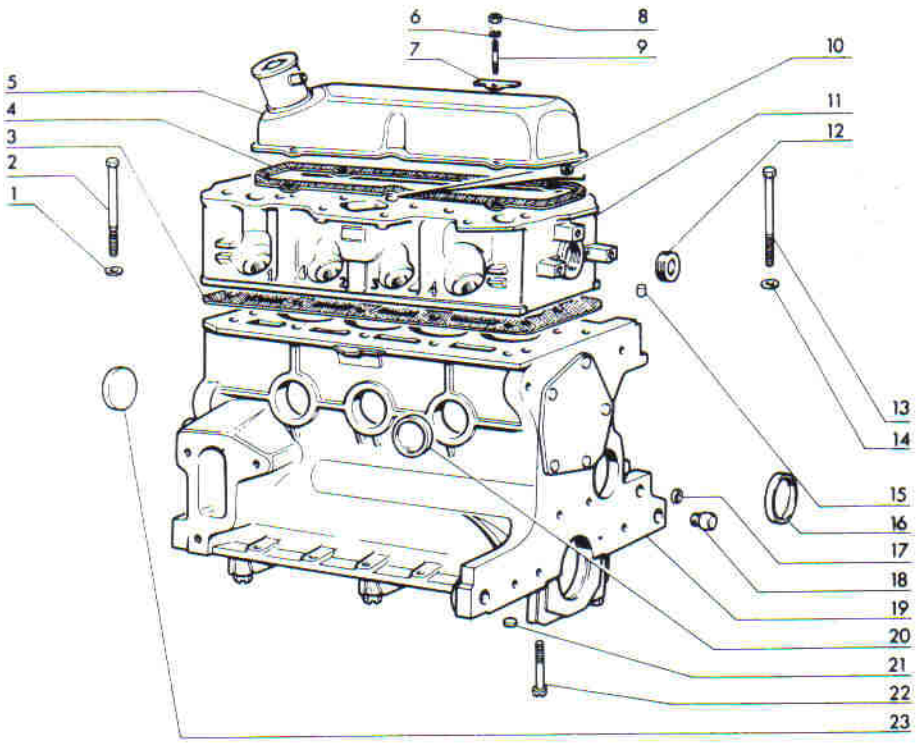
17 Cylinder head – dismantling and decarbonising

1 The exhaust manifold and rocker gear will have been removed from the cylinder head during removal (see Section 7).
2 The valves should now be removed using a universal valve spring compressor.



1 Camshaft bearing lockbolt
2 Washer
3 Camshaft front bearing
4 Exhaust valve
5 Spring cap
6 Valve guide
7 Adjuster screw
8 Rocker arm
9 Thrust washer
10 Circlip
11 Locknut
12 Washer
13 Locknut
14 Pedestal
15 Rocker arm
16 Plug
17 Rocker shaft
18 Coil spring
19 Stud
20 Split collets
21 Spring cap
22 Valve guide
23 Outer valve spring
24 Inner valve spring
25 Spring seat
26 Inlet valve
27 Camshaft bearing
28 Camshaft bearing
29 Camshaft
30 Locating dowel
31 Cam follower
32 Pushrod
33 Washer

Fig. 1.9 Camshaft and rocker gear components (Sec 16)



1 Washer
2 Cylinder head bolt
3 Gasket
4 Rocker cover gasket
5 Valve cover
6 Washer
7 Spacer plate
8 Nut
9 Stud
10 Plug
11 Cylinder head
12 Plug
13 Cylinder head bolt
14 Washer
15 Dowel
16 Plug
17 Plug
18 Dowel
19 Block/crankcase
20 Plug
21 Plug
22 Bolt
23 Plug

Fig. 1.10 Cylinder head and crankcase (Sec 16)

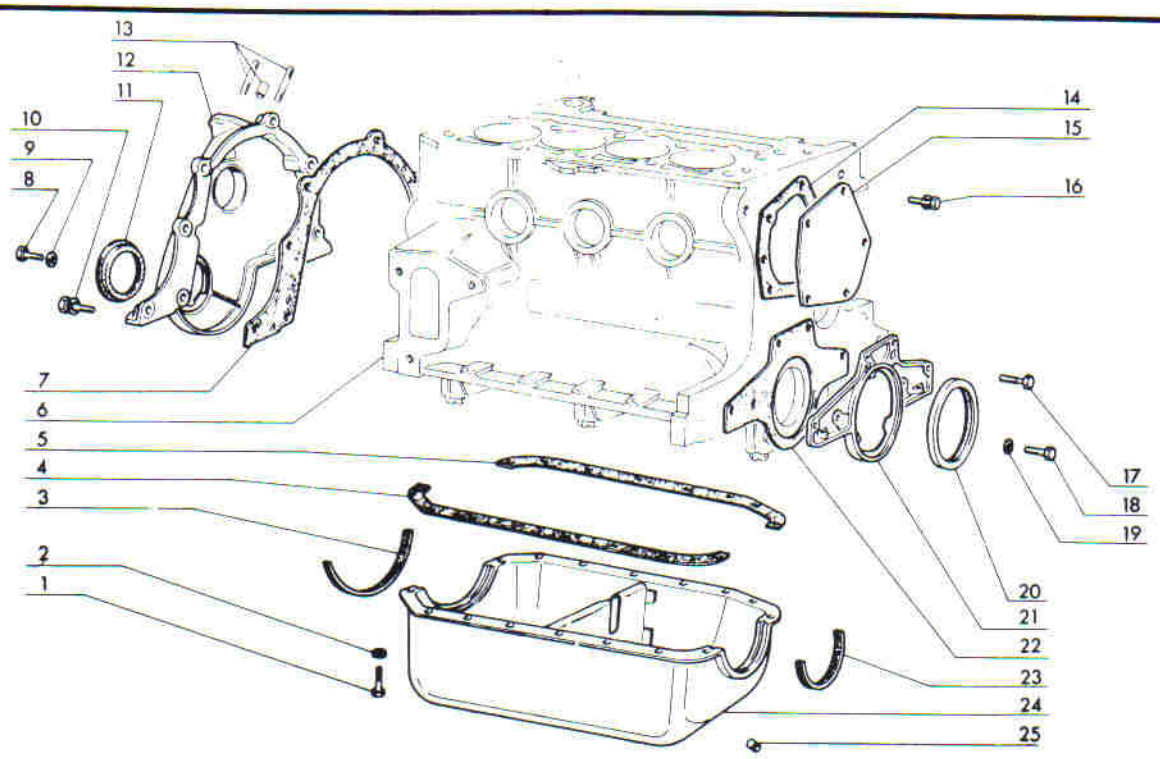


Fig. 1.11 Timing gear cover, sump, oil seals and gaskets (Sec 16)

1 Sump pan bolt
2 Washer
3 Sealing strip
4 Side gasket
5 Side gasket
6 Block/crankcase
7 Gasket
8 Bolt
9 Washer
10 Bolt and washer
11 Crankshaft front oil seal
12 Timing gear cover
13 Fuel pump studs and bush
14 Gasket
15 Cover plate
16 Bolt and washer
17 Bolt
18 Bolt
19 Washer
20 Crankshaft rear oil seal
21 Oil seal housing
22 Gasket
23 Sealing strip
24 Sump pan
25 Drain plug

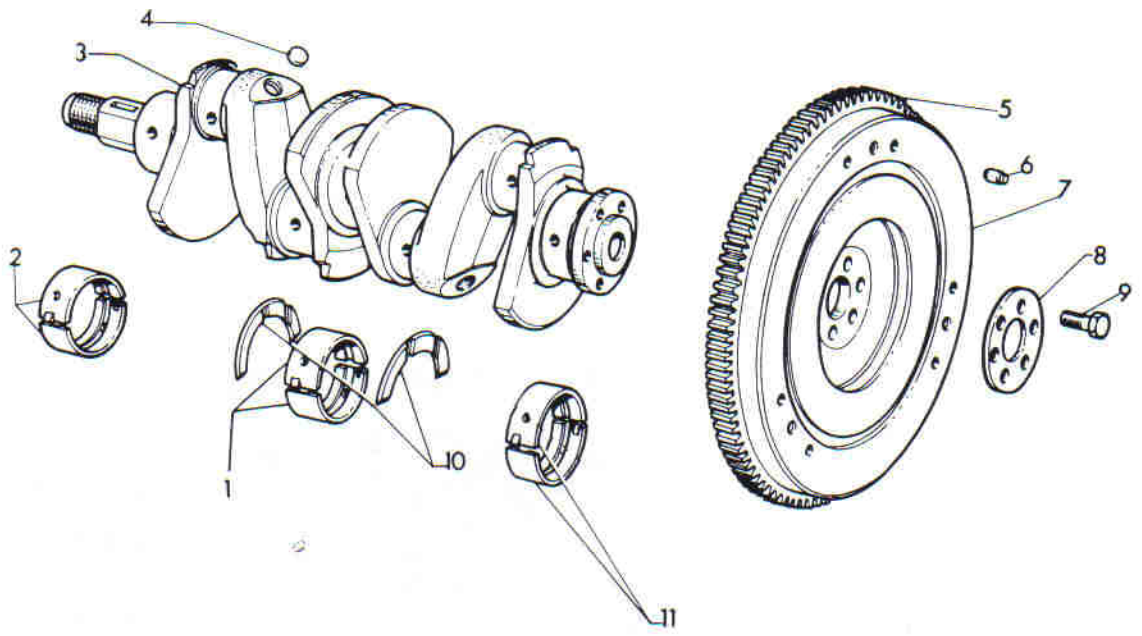


Fig. 1.12 Crankshaft and flywheel (Sec 16)

1 Centre main bearing shells
2 Front main bearing shells
3 Crankshaft
4 Plug
5 Starter ring gear
6 Dowel
7 Flywheel
8 Thrust plate
9 Bolt
10 Thrust washers
11 Rear main bearing shells

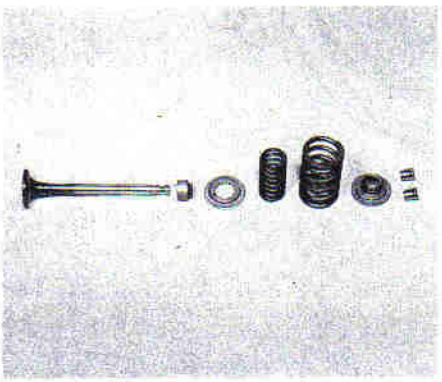
3 Compress the first valve spring and extract the split cotters. If the valve spring refuses to compress, do not apply excessive force, but remove the compressor and place a piece of tubing on the spring retainer and strike it a sharp blow to release the collets from the valve stem. Refit the compressor and resume operations when the collets should come out.
4 Gently release the compressor, take off the spring retaining cap, the valve springs and the spring seat. Remove the valve. Keep the valve with its associated components together and in numbered sequence so that they can be returned to their original positions (photo).
5 A small box with divisions is useful for this purpose. Remove and discard the valve stem oil seals.
6 Remove the other valves in a similar way.
7 Bearing in mind that the cylinder head is of light alloy construction and is easily damaged use a blunt scraper or rotary wire brush to clean all traces of carbon deposits from the combustion spaces and the ports. The valve head stems and valve guides should also be freed from any carbon deposits. Wash the combustion spaces and ports down with paraffin and scrape the cylinder head surface free of any foreign matter with the side of a steel rule, or a similar article.
8 If the engine is installed in the car, clean the pistons and the top of the cylinder bores. If the pistons are still in the block, then it is essential that great care is taken to ensure that no carbon gets into the cylinder bores as this could scratch the cylinder walls or cause damage to the piston and rings. To ensure this does not happen, first turn the crankshaft so that two of the pistons are at the top of their bores. Stuff rag into the other two bores or seal them off with paper and masking tape. The waterways should also be covered with small pieces of masking tape to prevent particles of carbon entering the cooling system and damaging the coolant pump.
9 Press a little grease into the gap between the cylinder walls and the two pistons which are to be worked on. With a blunt scraper carefully scrape away the carbon from the piston crown, taking care not to scratch the aluminium. Also scrape away the carbon from the surrounding lip of the cylinder wall. When all carbon has been removed, scrape away the grease which will now be contaminated with carbon particles, taking care not to press any into the bores. To assist prevention of carbon build-up the piston crown can be polished with a metal polish. Remove the rags or masking tape from the other two cylinders and turn the crankshaft so that the two pistons which were at the bottom are now at the top. Place rag in the cylinders which have been decarbonised, and proceed as just described.
10 Examine the heads of the valves for pitting and burning, especially the heads of the exhaust valves. The valve seatings should be examined at the same time. If the pitting on the valve and seat is very slight, the marks can be removed by grinding the seats and valves together with coarse, and then fine, valve grinding paste.
11 Where bad pitting has occurred to the valve seats it will be necessary to recut them and fit new valves. This latter job should be entrusted to the local agent or engineering works. In practice it is very seldom that the seats are so badly worn. Normally it is the valve that is too badly worn for refitting, and the owner can easily purchase a new set of valves and match them to the seats by valve grinding.
12 Valve grinding is carried out as follows. Smear a trace of coarse carborundum paste on the seat face and apply a suction grinder tool to the valve head. With a semi-rotary motion, grind the valve head to its seat, lifting the valve occasionally to redistribute the grinding paste. When a dull matt even surface is produced on both the valve seat and the valve, wipe off the paste and repeat the process with fine carborundum paste, lifting and turning the valve to redistribute the paste as before. A light spring placed under the valve head will greatly ease this operation. When a smooth unbroken ring of light grey matt finish is produced, on both valve and valve seat faces, the grinding operation is complete. Carefully clean away every trace of grinding compound, take great care to leave none in the ports or in the valve guides. Clean the valve seats with a paraffin soaked rag, then with a clean rag, and finally, if an air line is available, blow the valves, valve guides and valve ports clean.
13 Check that all valve springs are intact. If any one is broken, all should be renewed. Check the free height of the springs against new ones. If some springs are not within specifications, replace them all. Springs suffer from fatigue and it is a good idea to renew them even if they look serviceable.
14 Check that all the oil supply holes in the rocker arms are clear.
15 The cylinder can be checked for warping either by placing it on a piece of plate glass or using a straight-edge and feeler blades. If there is any doubt or if its block face is corroded, have it refaced by your dealer or motor engineering works.
16 Test the valves in their guides for side to side rock. If this is any more than almost imperceptible, new guides must be fitted. Again this is a job for your dealer as a special tool is required to ensure the correct installation depth and the cylinder head must be warmed to 80°C (176°F) before fitting the guides.
17 Commence reassembly by oiling the stem of the first valve and pushing it into its guide which should have been fitted with a new oil seal (photos).
18 Fit the spring seat. Fit the valve springs so that the closer coils are towards the cylinder head (where applicable) and then fit the spring retaining cap (photos).
19 Compress the valve spring and locate the split collets in the valve stem cut-out (photo).
20 Gently release the compressor, checking to see that the collets are not displaced.
21 Fit the remaining valves in the same way.
22 Tap the end of each valve stem with a plastic or copper-faced hammer to settle the components.
23 The cylinder head is now ready for refitting as described in Section 7.

18 Examination and renovation

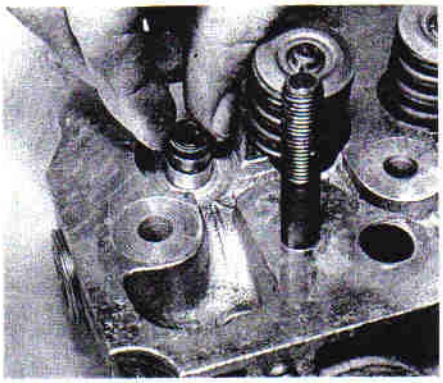
1 With the engine stripped down and all parts thoroughly clean, it is now time to examine everything for wear. The following items should be checked and where necessary renewed or renovated as described in the following Sections.

Cylinder block and crankcase

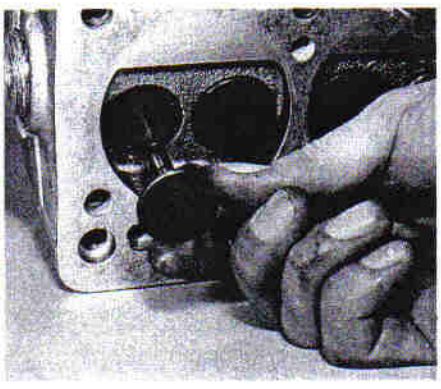
2 Examine the casting carefully for cracks especially around the bolt holes and between cylinders.
3 The cylinder bores must be checked for taper, ovality, scoring and



17.4 Components of the valve assembly

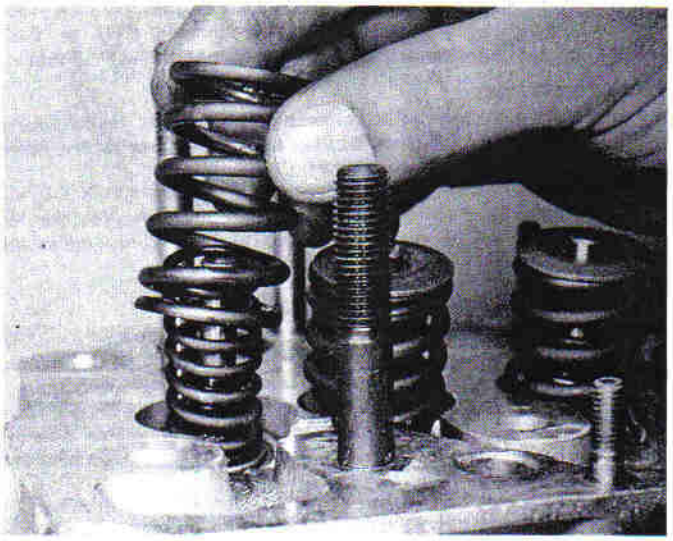


17.17A Fitting a valve guide oil seal ...

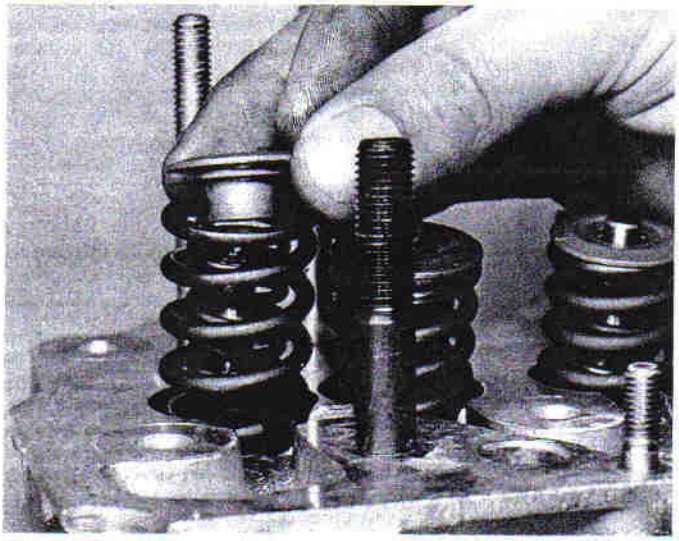


17.17B ... and the valve

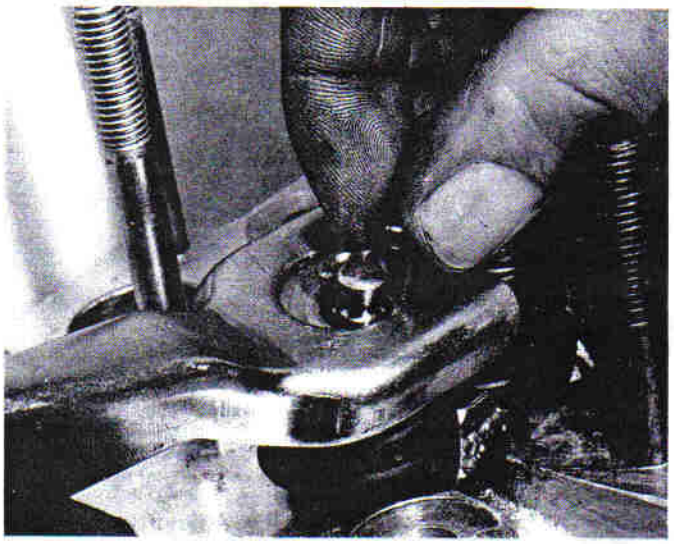
17.18A Fit the inner spring ...



17.18B ... outer spring ...



17.18C ... and retaining cap



17.19 Using a valve spring compressor to compress the springs and fit the valve collets

scratching. Start by examining the top of the cylinder bores. If they are at all worn, a ridge will be felt on the thrust side. This ridge marks the limit of piston ring travel. The owner will have a good indication of bore wear prior to dismantling by the quantity of oil consumed and the emission of blue smoke from the exhaust especially when the engine is cold.

4 An internal micrometer or dial gauge can be used to check bore wear and taper against the Specifications, but this is a pointless operation if the engine is obviously in need of reboring due to excessive oil consumption.

5 Your engine reconditioner will be able to re-bore the block for you and supply the correct oversize pistons to give the correct running clearance.

6 If the engine has reached the limit for reboring then cylinder liners can be fitted, but here again this is a job for your engine reconditioner.

7 To rectify minor bore wear it is possible to fit proprietary oil control rings. A good way to test the condition of the engine is to have it at normal operating temperature with the spark plugs removed. Screw a compression gauge (available from most motor accessory stores) into the first plug hole. Hold the accelerator fully depressed and crank the engine on the starter motor for several revolutions. Record the reading. Zero the tester and check the remaining cylinders in the same way. All four compression figures should be approximately equal and within the tolerance given in the Specifications. If they are all low, suspect piston ring or cylinder bore wear. If only one reading is down, suspect a valve not seating.

Crankshaft and bearings

8 Examine the crankpin and main journal surfaces for signs of scoring or scratches. Check the ovality of the crankpin at different positions with a micrometer. If more than 0.001 inch (0.025 mm) out of round, the crankpin will have to be reground. They will also have to be reground if there are any scores or scratches present. Also check the journals in the same fashion.

9 Wear in a crankshaft can be detected while the engine is running. Big-end bearing and crankpin wear is indicated by distinct metallic knocking, particularly noticeable when the engine is pulling from low engine speeds. Low oil pressure will also occur.

10 Main bearing and journal wear is indicated by engine rumble increasing in severity as the engine speed increases. Low oil pressure will again be an associated condition.

11 Crankshaft grinding should be carried out by specialist engine reconditioners who will supply the matching undersize bearing shells to give the required running clearance.

12 Inspect the connecting rod big-end and main bearing shells for signs of general wear, scoring, pitting and scratching. The bearings should be matt grey in colour.

13 If a copper colour is evident, then the bearings are badly worn and the surface material has worn away to expose the underlay. Renew the bearings as a complete set.

14 At the time of major overhaul it is worthwhile renewing the bearing shells as a matter of routine even if they appear to be in reasonably good condition.

15 Bearing shells can be identified by the marking on the back of the shell. Standard sized shells are usually marked STD or 0.00. Undersized shells are marked with the undersize such as 0.25 mm.

Connecting rods

16 Check the alignment of the connecting rods visually. If you suspect distortion, have them checked by your dealer or engine reconditioner on the special jig which he will have.

17 Where the gudgeon pin is an interference fit in the connecting rod small-end, removal or refitting and changing a piston is a job best left to your dealer or engine reconditioner due to the need for a press and jig and careful heating of the connecting rod.

Pistons and piston rings

Note: *Pistons may be manufactured by either Fiat or Kolbenschmit and the specifications for each make are different. Pistons from different manufacturers must never be mixed in the same engine.*

The standard pistons are manufactured by Kolbenschmit and have the piston grade and diameter stamped on the piston crown. There is also an arrow on the crown which must point to the timing chain end of the engine when fitted.

Fiat pistons may be supplied as spares. They have no markings on the crown, but the name Fiat is stamped into the underside of the piston and the grade is marked on the gudgeon pin boss. Fiat pistons also have oil holes in the piston skirt at 90 degrees to the thrust side, which is on the exhaust manifold side of the engine.

When fitting pistons, the piston-to-bore clearance must always be as given in the Specifications. Pistons and bores are graded A to E, and normally the piston grade must be the same as the cylinder bore grade. Fiat pistons are only available in grades A, C and E, and should be matched to bore grades as follows:

Bore grade	Piston grade
A	*A*
B	*C*
C	*C*
D	*E*
E	*E*

Fitting direction is with the gudgeon pin offset towards the thrust side – see Fig. 1.8.

18 If the cylinders have been rebored, then the reconditioner will supply the oversize pistons and rings and the gudgeon pins. Give the job of fitting the new pistons to the connecting rods to him.

19 If the original piston rings or just new rings are to be fitted to the original pistons, use great care to remove and fit the rings as they are easily broken if expanded too much. Always remove and fit rings from the crown end.

20 If three old feeler blades are slid behind the piston rings and located at equidistant points, the rings may be removed or fitted without their dropping into the wrong grooves and the chance of breakage will also be reduced.

21 If the original pistons are being refitted, make sure that the ring grooves and their oil return holes are cleaned out and freed from carbon. A piece of piston ring is a useful tool for this purpose.

22 The three piston rings are as follows:

Top – Thinner compression, marked TOP (photo)
Second – Thicker compression, step at base
Bottom – Oil control

23 If proprietary wear control rings are to be fitted to overcome bore wear, fit them strictly in accordance with the manufacturer's instructions.

24 Always check the piston ring groove clearance and end gap. Both clearances should be checked with a feeler gauge. Check the end gap when the ring has been pushed squarely down the cylinder bore for two or three inches (photos).

25 If new rings are being used and the cylinder bores have not been rebored, alway make sure that the top compression ring has been stepped to prevent it contacting the bore wear ridge.

Flywheel

26 Check the clutch mating surface of the flywheel. If it is deeply scored (due to failure to renew a worn driven plate), then it may be possible to have it surface ground provided the thickness of the flywheel is not reduced too much.

27 If lots of tiny cracks are visible on the surface of the flywheel then this will be due to overheating caused by slipping the clutch or 'riding' the clutch pedal.

28 With a pre-engaged type of starter motor it is rare to find the teeth of the flywheel ring gear damaged or worn but if they are, then the ring gear will have to be renewed.

29 To remove the ring gear, drill a hole between the roots of two teeth taking care not to damage the flywheel and then split the ring with a sharp cold chisel.

30 The new ring gear must be heated to between 180 and 220°C (356 and 428°F) which is very hot, so if you do not have facilities for obtaining these temperatures, leave the job to your dealer or engine reconditioner.

31 Where such facilities are avilable, then the ring gear should be either pressed or lightly tapped onto its register and left to cool naturally, when the contraction of the metal on cooling will ensure that it is a secure and permanent fit. Great care must be taken not to overheat the ring gear, as if this happens its temper will be lost. A clutch input shaft pilot bearing is not fitted on this engine.

Camshaft

32 Examine the camshaft bearings for wear, scoring or pitting. If evident then the bearings will have to be renewed. The three bearings are of different sizes and they can be removed and new ones fitted using a bolt, nut and distance pieces. When drawing a new bearing into position, make sure that the oil hole is correctly aligned with the one in the crankcase. The centre and rear bearings require reaming after fitting, the bearing at the timing chain end is supplied ready reamed (photo). Note that the timing chain end bearing is graded B to E (see Specifications). The grade letter is stamped on the cylinder block and painted on the bearing – see photo 20.13.

33 The camshaft itself should show no marks or scoring on the journal or cam lobe surfaces. Where evident, renew the camshaft or have it reprofiled by a specialist reconditioner.

34 Check the teeth of the camshaft sprocket for wear. Renew the sprocket if necessary.

Cam followers

35 Examine the bearing surface of the cam followers which are in contact with the camshaft. Any indentations or cracks must be rectified by renewal. Clean sludge and dirt from the cam followers and check their fit in their bores. Side to side rock is unusual except at very high mileage.

Timing chain

36 Examine the teeth on both the crankshaft sprocket and the camshaft sprocket for wear. Each tooth forms an inverted 'V' with the sprocket periphery and if worn, the side of each tooth under tension will be slightly concave in shape when compared with the other side of the tooth, ie; one side of the inverted 'V' will be concave when compared with the other. If any sign of wear is present the sprockets must be renewed.

37 Examine the links of the chain for side slackness and particularly check the self-tensioning links for freedom of movement. Renew the chain if any slackness is noticeable when compared with a new chain. It is a sensible precaution to renew the chain at about 60 000 miles (96 000 km) and at lesser mileage if the engine is stripped down for a major overhaul.

Cylinder head

38 This is covered in Section 17.

Rocker arms and shaft

39 Dismantle the rocker shaft by removing the circlip from the shaft end and sliding off the components, keeping them in strict order of removal and taking careful note of the fitted positions of all washers and spacers (photo). If a bolt is dropped into the rocker pedestal, locating with the cut-out in the shaft, it will prevent the components flying off under spring pressure.

40 Check the shaft for straightness by rolling it on a flat surface. The shaft should be free from wear ridges where the rocker arms locate. Renew the shaft if it is bent or if wear is evident.

41 Check the rocker arms for wear in the bushes by rocking them laterally on the shaft. Any wear will entail the renewal of the arm or renewal of the bushes which is a job for your Yugo dealer.

42 Check the rocker arm tips where they contact the valve stems for wear and pitting and renew the rocker arms as necessary. Similarly check the tappet adjusters and valve pushrods.

43 Check the pushrods for distortion by rolling them on a flat surface.

44 Thoroughly clean the rocker shaft and components ensuring that all oil holes are clear. The holes frequently get blocked with sludge which causes premature wear.

Oil pump

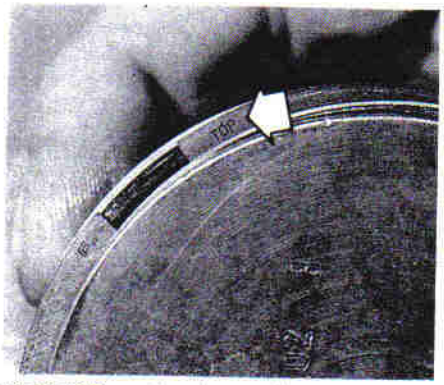
45 Remove the four bolts securing the pump halves and separate them (photo).
46 Lift off the top plate (photo).
47 Remove the relief valve piston, spring and spring seat from the bottom half of the pump (photos).
48 Lift out the gears from the upper half of the pump (photos).
49 Clean all components in paraffin and dry them thoroughly.
50 Refit the gears and check for wear by placing a feeler blade between the gear teeth and the pump body and between the gears and the top plate – refer also to part 3, Section 40. If the gears are worn beyond the limits given in the Specifications, renew the pump.
51 Reassemble the pump in reverse order of dismantling, lubricating all parts liberally with engine oil.

Crankshaft oil seals

52 The rear oil seal is located in a carrier bolted to the rear of the cylinder block.
53 The front seal is located in the timing cover (see Section 6).
54 To renew the seals, prise them carefully from the housings and tap new seals into place using a socket placed around the seal periphery. The open, or spring side of the seal facees inwards. Lubricate the seals with engine oil before fitting.

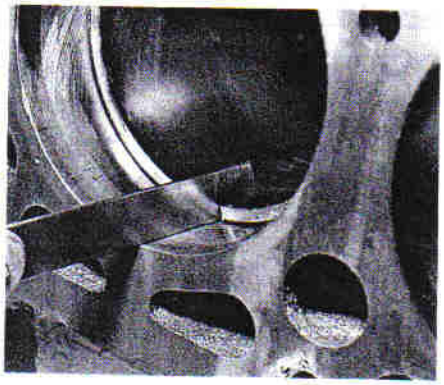
19 Engine – reassembly (general)

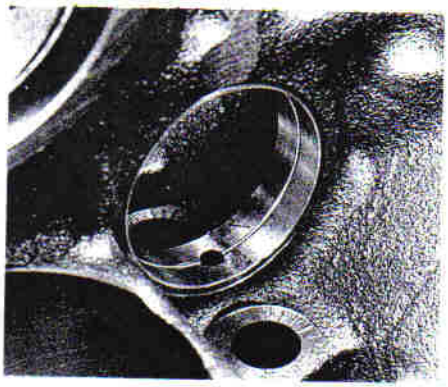
1 To ensure maximum life with minimum trouble from a rebuilt engine, not only must every part be correctly assembled, but everything must be spotlessly clean, all the oilways must be clear, locking washers and spring washers must always be fitted where indicated, and all bearing and other working surfaces must be thoroughly lubricated during assembly. Before assembly begins renew any bolts or studs whose threads are in any way damaged; whenever possible use new spring washers.
2 Apart from your normal tools, a supply of non-fluffy rag, an oil can filled with engine oil, a supply of new spring washers, a set of new gaskets and a torque wrench should be gathered together.



18.22 TOP marking (arrowed) on upper compression ring

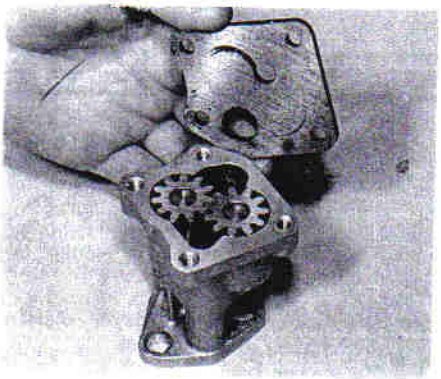

18.24A Checking piston ring groove clearance ...

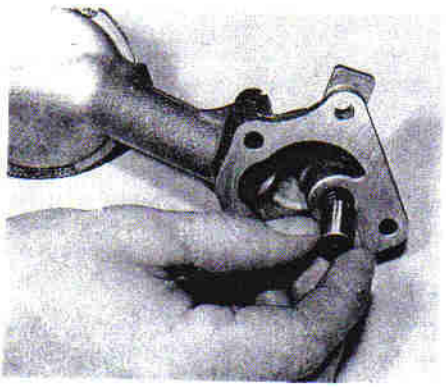

18.24B ... and the end gap


18.32 Camshaft bearing

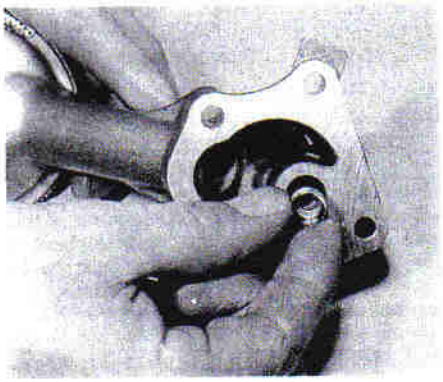

18.39 Removing the rocker shaft end circlip


18.45 Separating the oil pump halves

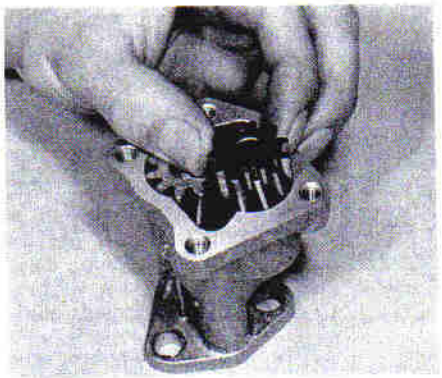

18.46 Lift off the top plate


18.47A Remove the relief valve piston ...

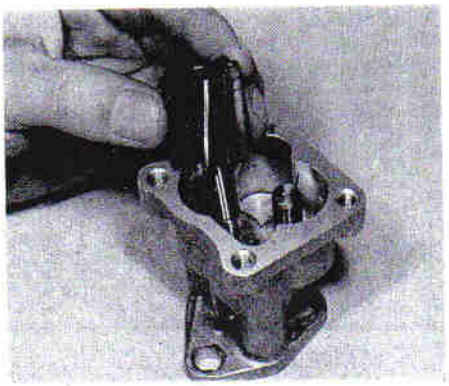

18.47B ... spring ...



18.47C ... and spring seat



18.48A Lift out the driven gear ...



18.48B ... and the driving gear

20 Engine – complete reassembly

Crankshaft and main bearings

1 With the cylinder block inverted on the bench, wipe out the crankcase shell bearing seats and fit the half shells so that their tabs engage in the notches.
2 Stick the semi-circular thrust washers either side of the centre bearing in the crankcase using thick grease. Make sure that the oil grooves are visible when the washers are fitted (photo).
3 If the original bearing shells are being refitted, make sure that they are returned to their original positions.
4 Liberally oil the bearing shells and lower the crankshaft into position. Make sure that it is the correct way round.
5 Wipe out the main bearing caps and fit the bearing shells into them.
6 Oil the crankshaft journals and fit the main bearing caps, the correct way round and in proper sequence (photos).
7 Replace the main bearing cap bolts and screw them up finger-tight.
8 Test the crankshaft for freedom of rotation. Should it be very stiff to turn, or possess high spots, a most careful inspection must be made, preferably by a skilled mechanic with a micrometer to trace the cause of the trouble. It is very seldom that any trouble of this nature will be experienced when fitting the crankshaft.
9 Tighten the main bearing bolts to the specified torque wrench settings (photo).
10 Using a dial gauge or feeler blades inserted between a thrust washer and the crankshaft, check the crankshaft endfloat. If it exceeds the specified limit, the thrust washers can be changed for thicker ones.
11 Bolt on the crankshaft rear oil seal housing using a new gasket. The carrier should have been fitted with a new oil seal and the seal lips greased (photos).

Camshaft

12 Oil the cam followers and return them to their original positions (photo).
13 Oil the camshaft bearings and insert the camshaft, taking great care not to damage the bearings with the cam lobes. Fit the front bearing, chamfer inwards (photo).
14 Screw in the camshaft front bearing lockbolt (photo).

Oil pump

15 Refit the oil pump as described in Section 10.

Timing chain and sprockets

16 Fit the timing chain and sprockets as described in Section 6. Fit the Woodruff key to the crankshaft nose.
17 Using a new gasket, fit the timing chain cover, but leave the bolts finger tight.
18 Apply grease to the lips of the timing cover oil seal and then push the crankshaft pulley into position.
19 Move the timing cover if necessary so that the pulley hub is centralised in the oil seal and then tighten the cover bolts.
20 Screw on the crankshaft pulley nut and tighten to the specified torque. Hold the crankshaft against rotation either by jamming the starter ring gear or by placing a block of wood between a crankshaft web and the inside of the crankcase.

Pistons/connecting rods

21 Fit these as described in Section 9.

Sump pan

22 Fit the sump pan as described in Section 8.

Cylinder head

23 Stand the engine upright and fit the cylinder head as described in Section 7.
24 Insert the pushrods in their original fitted order.
25 With the rocker arm adjuster screws fully unscrewed, locate the rocker gear and screw on the fixing nuts.
26 Adjust the valve clearances as described in Section 5.
27 Locate a new gasket in position and fit the valve cover.
28 Screw on a new oil filter (Section 3).

Flywheel

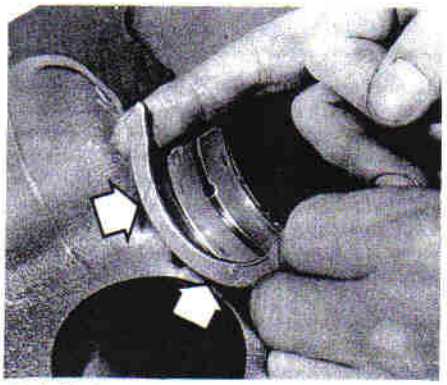
29 Refit the engine rear plate.
30 Offer the flywheel to the crankshaft. With pistons No. 1 and 4 at TDC, the dimple on the flywheel must be uppermost (photo).
31 Screw in and tighten the bolts to the specified torque (photos). The crankshaft may be held against rotation by jamming the starter ring gear.

21 Engine – refitting ancillary components

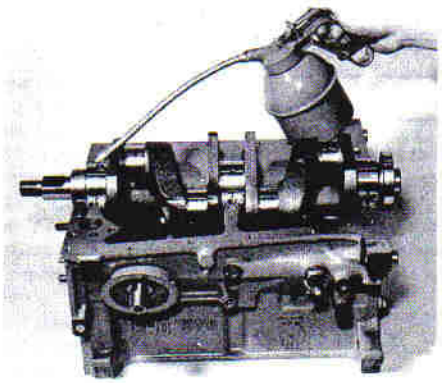
1 Refer to Chapter 5 and refit the clutch, making sure to centralise the driven plate.
2 Fit the coolant pump as described in Chapter 2. Fit the thermostat housing if it was removed noting the air cleaner mounting bracket on the housing studs.
3 Fit the alternator and drivebelt as described in Chapter 12.
4 Refer to Chapter 3 and fit the exhaust manifold and hot air collector, the carburettor and spacer and the fuel pump.
5 Fit the distributor as described in Chapter 4. Fit the oil dipstick guide tube.

22 Engine/transmission – reconnection

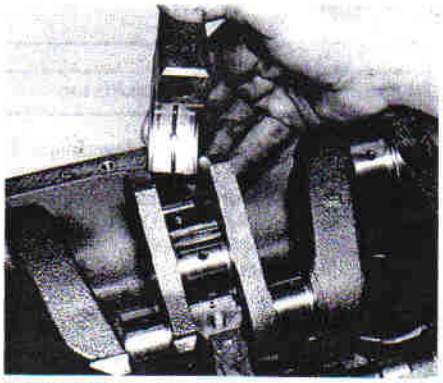
1 Support the weight of the transmission and offer it squarely to the engine. The splined input shaft should pass easily through the hub of the driven plate, provided the plate has been centralised as described in Chapter 5. It may be necessary to align the splines with the hub grooves, in which case have an assistant turn the crankshaft pulley nut. The alignment dowels will make the connection stiff, so drawing the engine and transmission together with two connecting bolts will ease it.
2 Once the engine and transmission are fully engaged, insert and tighten all the connecting bolts. Locate the lifting eyes.
3 Refit the bolts to the engine rear plate and refit the mounting brackets.
4 Bolt on the starter motor.



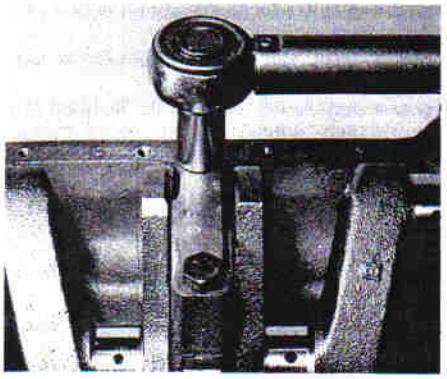
20.2 Fitting thrust washers to centre bearing (oil grooves arrowed)



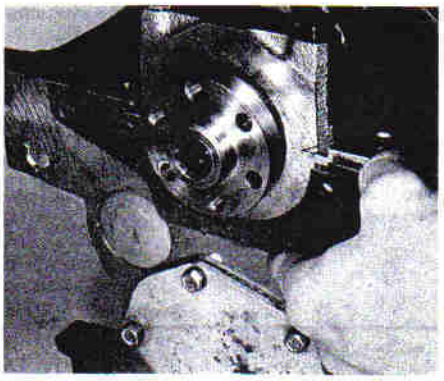
20.6A Oiling the crankshaft journals



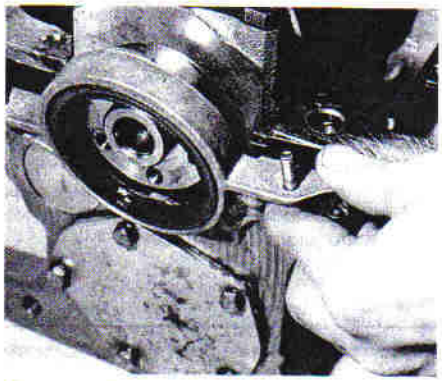
20.6B Fitting a main bearing cap



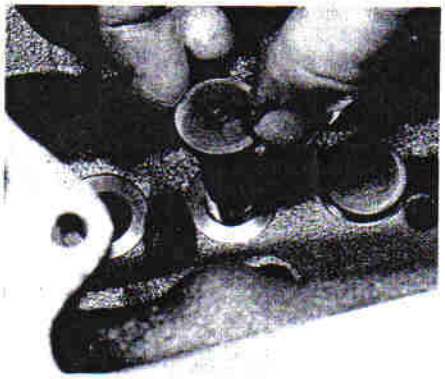
20.9 Tightening the main bearing cap bolts



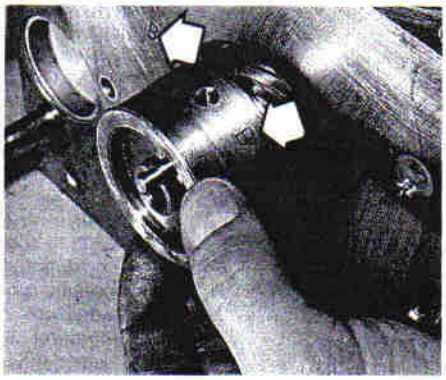
20.11A Using a new gasket ...



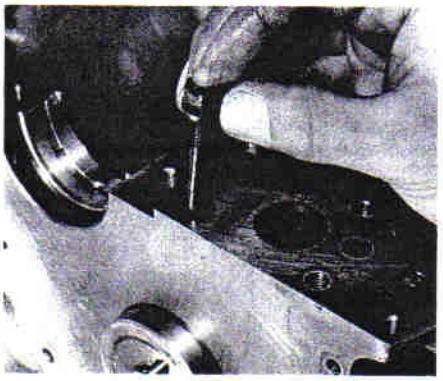
20.11B ... fit the rear oil seal housing ...



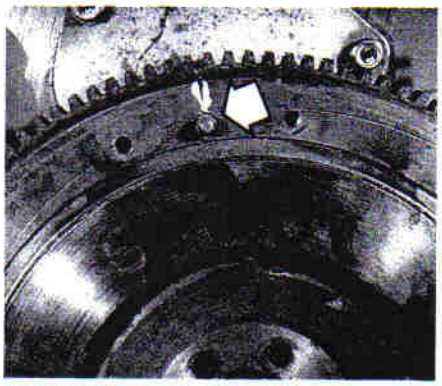
20.12 Fitting a cam follower



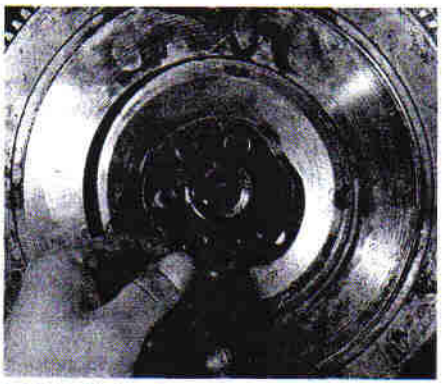
20.13 Fitting the camshaft front bearing. Note grade letters (arrowed) ...



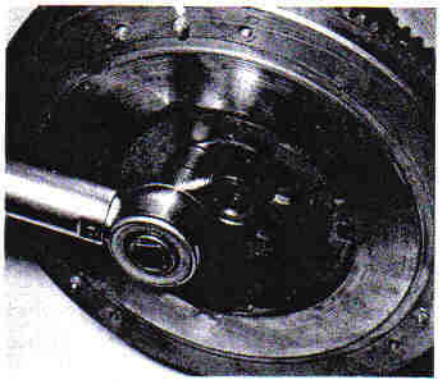
20.14 ... and the locking bolt



20.30 TDC dimple on flywheel (arrowed)



20.31A Fit the plate ...



20.31B ... and tighten the bolts

23 Engine/transmission – refitting

1 The refitting operations are reversals of those described in Section 13.
2 Observe the following special points.
3 Use new lock tabs on the engine mounting crossmember.
4 Tighten the engine mounting and front suspension bolts when the hoist has been removed and the weight of the car is again on its roadwheels.
5 Fill the cooling system.
6 Fill the engine with oil.
7 Replenish lost transmission oil.
8 Reconnect the battery.
9 Adjust the clutch pedal as described in Chapter 5.

24 Engine – initial start-up after overhaul or major repair

1 Make sure that the battery is fully charged and that all lubricants, coolant and fuel are replenished.
2 If the fuel system has been dismantled it will require several revolutions of the engine on the starter motor to pump the petrol up to the carburettor.
3 Turn the carburettor throttle speed screw through one complete turn to increase the idle speed in order to offset the initial stiffness of new engine internal components.
4 As soon as the engine fires and runs, keep it going at a fast idle speed and bring it up to normal working temperature.
5 As the engine warms up there will be odd smells and some smoke from parts getting hot and burning off oil deposits. The signs to look for are leaks of water or oil which will be obvious.
6 Check also the exhaust pipe and manifold connections as these do not alway 'find' their exact gas tight position until warmth and vibration have acted on them and it is almost certain that they will need tightening further. This should be done, of course, with the engine stopped.
7 When normal running temperature has been reached, adjust the engine idle speed as described in Chapter 3.
8 Stop the engine and wait a few minutes to see if any lubricant or coolant is dripping out when the engine is stationary.
9 Road test the car to check that the timing is correct and that the engine is giving the necessary smoothness and power. Do not race the engine – if new bearings and/or pistons have been fitted it should be treated as a new engine and run in at a reduced speed for the first 500 km (300 miles).
10 After the first 1500 km (900 miles) the cylinder head bolts must be re-torqued in the following way (engine cold).
11 Remove the air cleaner and valve cover. Unscrew the first bolt (Fig. 1.6) through a quarter turn and then tighten it to final stage 2 torque (see Specifications).
12 Repeat on the remaining bolts, one at a time.
13 Check and adjust the valve clearances (Section 5).
14 Refit the valve cover and air cleaner.

25 Fault diagnosis – 903 cc (OHV) engine

Symptom	Reason(s)
Engine fails to turn when starter control operated	
No current at starter motor	Flat or defective battery Loose battery leads Defective starter solenoid or switch or broken wiring Engine earth strap disconnected
Current at starter motor	Jammed starter motor drive pinion Defective starter motor
Engine turns but will not start	
No spark at spark plug	Ignition leads or distributor cap damp or wet Ignition leads to spark plugs loose Shorted or disconnected low tension leads Dirty, incorrectly set, or pitted contact breaker points Faulty condenser Defective ignition switch Ignition leads connected wrong way round Faulty coil Contact breaker point spring earthed or broken
No fuel at carburettor float chamber or at jets	No petrol in petrol tank Vapour lock in fuel line (in hot conditions or at high altitude) Blocked float chamber needle valve Fuel pump filter blocked Choked or blocked carburettor jets Faulty fuel pump
Engine stalls and will not restart	
Excess of petrol in cylinder or carburettor flooding	Too much choke allowing too rich a mixture to wet plugs Float damaged or leaking or needle not seating Float level incorrectly adjusted
No spark at spark plug	Ignition failure – sudden Ignition failure – misfiring precedes total stoppage Ignition failure – in severe rain or after traversing water splash
No fuel at jets	No petrol in petrol tank Petrol tank breather choked Sudden obstruction in carburettor Water in fuel system

Symptom	Reason(s)
Engine misfires or idles unevenly	
Intermittent spark at spark plug	Ignition leads loose Battery leads loose on terminals Battery earth strap loose on body attachment point Engine earth lead loose Low tension leads on coil loose Low tension lead to distributor loose Dirty or incorrectly gapped plugs Dirty, incorrectly set, or pitted contact breaker points Tracking across inside of distributor cover Ignition too retarded Faulty coil
Fuel shortage at engine	Mixture too weak Air leak in carburettor Air leak at inlet manifold to cylinder head, or inlet manifold to carburettor
Lack of power and poor compression	
Mechanical wear	Burnt out valves Sticking or leaking valves Weak or broken valve springs Worn valve guides or stems Worn pistons and piston rings
Fuel/air mixture leaking from cylinder	Burnt out exhaust valves Sticking or leaking valves Worn valve guides and stems Weak or broken valve springs Blown cylinder head gasket (accompanied by increase in noise) Worn pistons and piston rings Worn or scored cylinder bore
Incorrect adjustments	Ignition timing wrongly set Contact breaker points incorrectly gapped Incorrect valve clearances Incorrectly set spark plugs Carburation too rich or too weak
Carburation and ignition faults	Dirty contact breaker points Fuel filter blocked Air filter blocked Distributor automatic advance and retard mechanisms not functioning correctly Faulty fuel pump giving fuel starvation
Excessive oil consumption	Excessively worn valve stems and valve guides Worn piston rings Worn pistons and cylinder bores Excessive piston ring gap allowing blow-by Piston oil return holes choked
Oil being lost due to leaks	Leaking oil filter gasket Leaking valve cover gasket Leaking timing gear cover gasket Leaking sump gasket Loose sump plug
Unusual noises from engine	
Excessive clearances due to mechanical wear	Worn valve gear (noisy tapping from valve cover) Worn big-end bearing (regular heavy knocking) Worn timing chain and gears (rattling from front of engine) Worn main bearings (rumbling and vibration) Worn crankshaft (knocking, rumbling and vibration)
Pinking on acceleration	Fuel octane rating too low Ignition timing over-advanced Carbon build-up in cylinder head Valve timing incorrect (after rebuild) Mixture too weak Overheating

PART 3 1116 CC, 1298 CC AND 1301 CC (OHC) ENGINE

26 Valve clearances – checking and adjusting

It is important that each valve clearance is set correctly, otherwise the timing will be wrong and engine performance poor. If there is no clearance at all, the valve and its seat will soon burn. Always set the clearances with the engine cold.

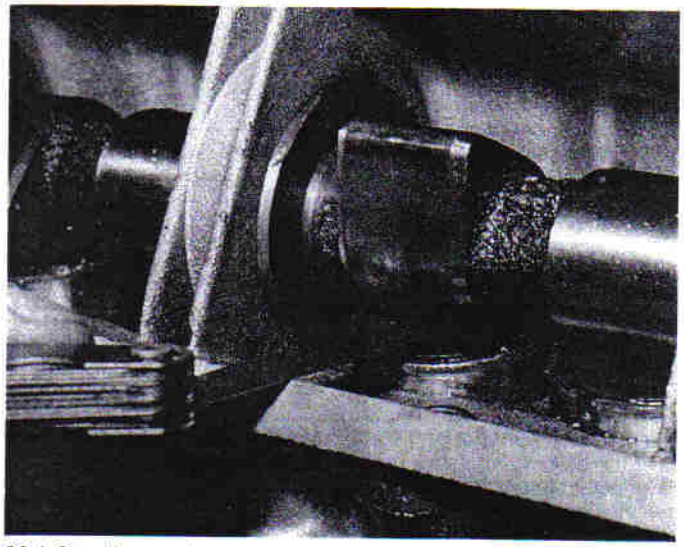
1 Remove the camshaft cover. Jack-up a front wheel and engage top gear so that by turning the wheel, the crankshaft can be rotated.

2 Each valve clearance must be checked when the high point of the cam is pointing directly upward away from the cam follower.

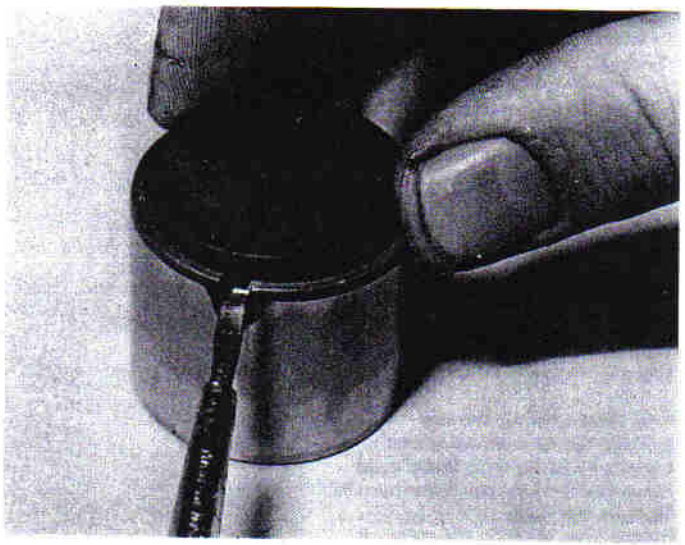
3 Check the clearances in the firing order 1-3-4-2. No. 1 cylinder being at the timing belt end of the engine. This will minimise the amount of crankshaft rotation required.

4 Insert the appropriate feeler blade between the heel of the cam and the cam follower shim of the first valve. If necessary alter the thickness of the feeler blade until it is a stiff, sliding fit. Record the thickness, which will, of course, represent the valve clearance for this particular valve (photo).

5 Turn the crankshaft, check the second valve clearance and record it.



26.4 Checking a valve clearance using a feeler blade



26.8B Extracting a shim from a cam follower (components removed for clarity)

6 Repeat the operations on all the remaining valves, recording their respective clearances.

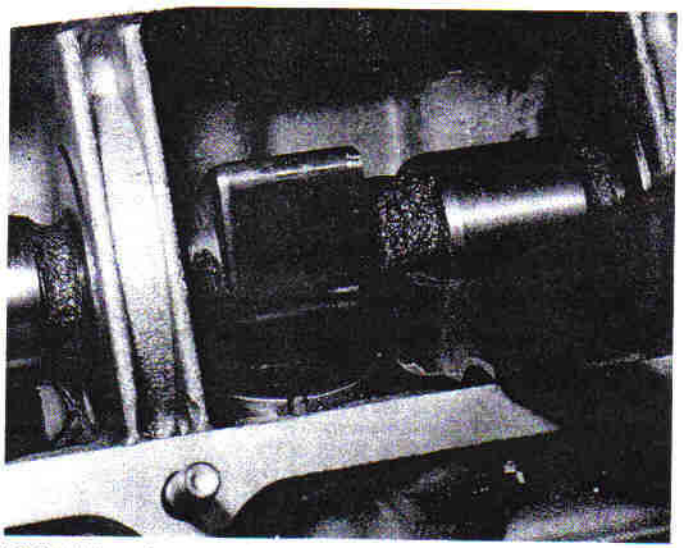
7 Remember that the clearances for inlet and exhaust valves differ – see Specifications. Counting from the timing cover end of the engine, the valve sequence is:

Inlet	*2-3-6-7*
Exhaust	*1-4-5-8*

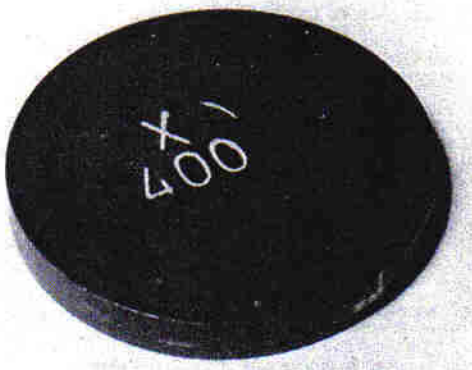
8 Clearances which are incorrect will mean the particular shim will have to be changed. To remove the shim, turn the crankshaft until the high point of the cam is pointing directly upward. The cam follower will now have to be depressed so that the shim can be extracted. Special tools are available to do the job, otherwise you will have to make up a lever to locate on the rim of the cam follower. This must allow room for the shim to be prised out by means of the cut-outs provided in the cam follower rim (photos).

9 Once the shim is extracted, establish its thickness and change it for a thicker or thinner one to bring the previously recorded clearance within specification. For example, if the measured valve clearance was 1.27 mm (0.05 mm) too great, a shim *thicker* by this amount will be required. Conversely, if the clearance was 1.27 mm (0.05 in) too small, a shim *thinner* by this amount will be required.

10 Shims have their thickness (mm) engraved on them; although the



26.8A Using a home made tool to depress a cam follower



26.10 Shim thickness

engraved side should be fitted so as not to be visible, wear still occurs and often obliterates the number. In this case, measuring their thickness with a metric micrometer is the only method to establish their thickness (photo).
11 In practice, if several shims have to be changed, they can often be interchanged, so avoiding the necessity of having to buy more new shims than is necessary.
12 On completion, refit the camshaft cover and gasket.

27 Camshaft and camshaft carrier – removal and refitting

1 Disconnect the battery.
2 Remove the air cleaner housing (Chapter 3).
3 Disconnect the fuel inlet hose at the carburettor.
4 Disconnect the distributor vacuum hose.
5 Disconnect the accelerator cable, or linkage and undo the camshaft cover nuts securing the accelerator cable bracket to the camshaft carrier. On some models the fuel return hose bracket is secured by one of the camshaft cover top nuts. Where applicable, remove this nut and release the hose bracket.
6 Remove the remaining cover nuts and lift off the cover.
7 Remove the timing belt as described in Section 28.
8 Restrain the camshaft sprocket and slacken the sprocket bolt. Remove the bolt and sprocket.
9 Remove the timing belt rear cover. The lower bolt is accessible from below.
10 Remove the camshaft carrier bolts. Note that three different lengths of bolt are used (Fig. 1.13). Using a soft-faced mallet, gently tap the camshaft carrier to break the seal around its gasket.
Note: *Before attempting to lift the camshaft carrier it should be noted that in all probability the cam followers will fall out if it is raised too quickly, thus not only is there risk of damage to them, but it will not be known which valve each follower serves. As it necessary to refit the followers to the same bore from which they were removed, lift the carrier carefully until each cam follower can be released and placed onto the valve stem which it serves. It is unlikely that the adjustment shims will fall out of the followers, but watch that this does not happen, as the shims must be refitted to their relevant followers.*
11 Remove the camshaft end cover and withdraw the camshaft, taking great care that the cams do not damage the bearing journals (photos).
12 Refitting is a reversal of removal, bearing the following points in mind.
13 Use new gaskets where applicable (photo).
14 Check that the crankshaft pulley or flywheel timing marks are still in alignment and line up the camshaft sprocket mark with the timing mark on the timing belt rear cover. This procedure must be observed to prevent the valves hitting the piston crowns.
15 Keep the cam followers in their bores by using thick grease when refitting the camshaft carrier (photo). Insert the bolts, making sure that the different length bolts are correctly located. Tighten the bolts to the specified torque in the order given in Fig. 1.13.
16 Fit the camshaft sprocket and tighten its retaining bolt to the specified torque, restraining the sprocket with a piece of angle iron (photo).
17 Fit and tension the timing belt as described in Section 28.
18 Refit the camshaft cover using a new gasket (photos). Remember to refit the cable, and where applicable the fuel return hose bracket.

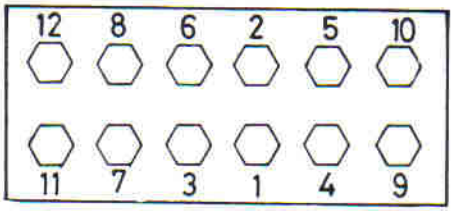
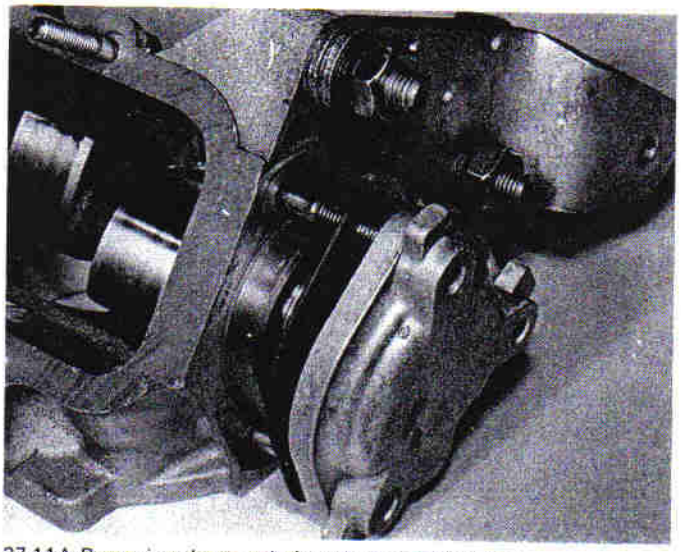


Fig. 1.13 Identification and tightening sequence of camshaft carrier bolts (Sec 27)

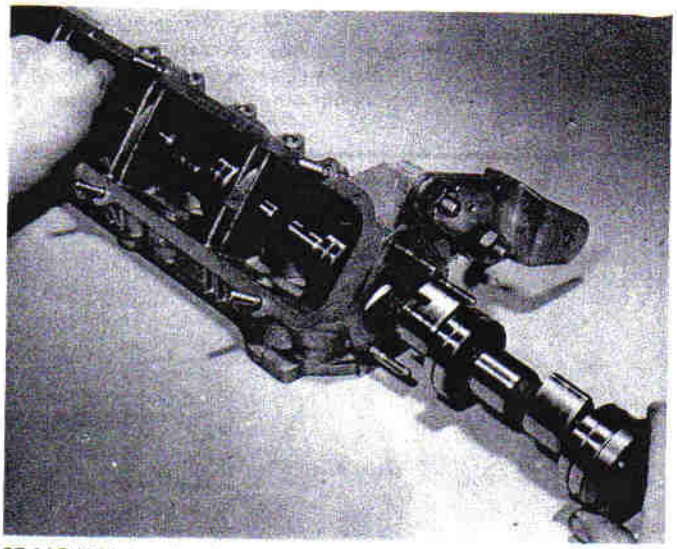
Longest bolts – 12, 8, 6, 2, 5, 10
Intermediate length bolt – 11 (camshaft sprocket end)
Shortest bolts – 7, 3, 1, 4, 9

28 Timing belt – removal and refitting

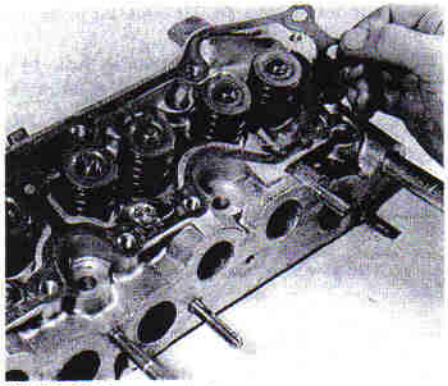
1 Set No. 4 piston at TDC on its compression stroke. Do this by turning the crankshaft pulley nut or by jacking up a front roadwheel, engaging a gear and turning the wheel until the mark on the flywheel is in line with the TDC mark on the flywheel bellhousing aperture. Remove No. 4 spark plug, place a finger over the plug over the plug hole and feel the compression being generated as the crankshaft is rotated and the piston rises up the cylinder bore.
2 On some models the TDC marks on the crankshaft pulley and belt cover may be visible and can be used instead.
3 Remove the alternator drivebelt (Chapter 12). Unbolt and remove the timing belt cover.
4 Check that the camshaft sprocket timing mark is aligned with the pointer on the belt rear cover. On nearly all models the mark is a line scribed on the rear (inner) face of the sprocket; the dot on the front (outer) face should be ignored (photo). On a few very early 3/4/5 series models with the 1116 cc engine, there is no scribed line on the sprocket; in this case the dot must be aligned with the rib on the engine mounting bracket – roughly as shown in photo 27.16.
5 Slacken the nut in the centre of the tensioner pulley and push it on the support to release the tension on the belt, then retighten the nut. Slide the drivebelt off the sprockets and pulleys. Note which way round the belt is fitted, usually so that the lettering on the belt can be read from the crankshaft pulley end of the engine.



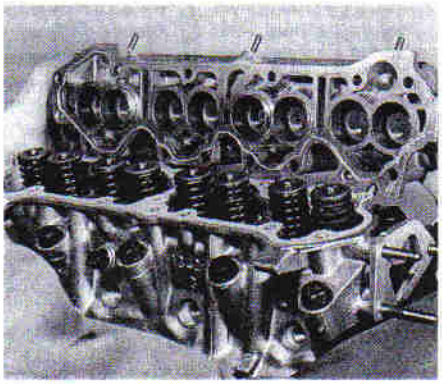
27.11A Removing the camshaft end cover and gasket



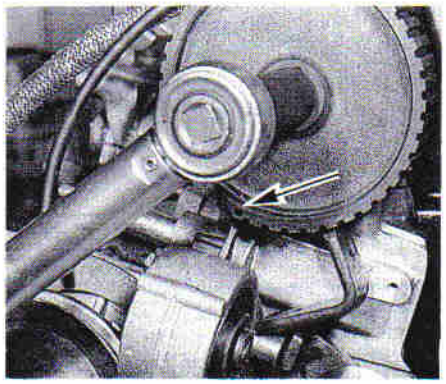
27.11B Withdrawing the camshaft



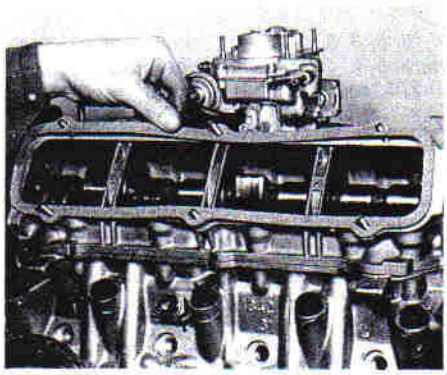
27.13 Fitting camshaft carrier gasket to the cylinder head



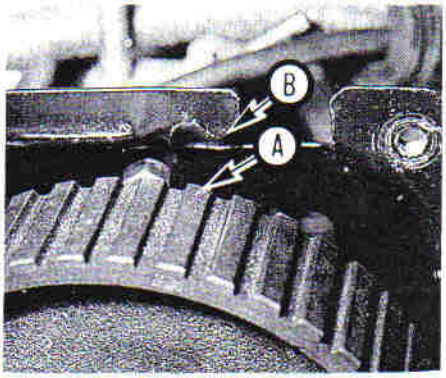
27.15 Keep the cam followers in their bores when refitting the camshaft carrier



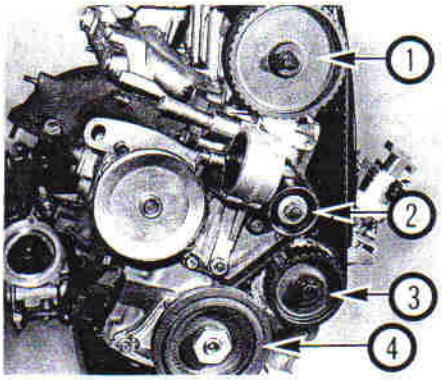
27.16 Tightening the camshaft sprocket bolt. The dot (arrowed) is not the timing mark for most models – see text



27.18 Fitting a new gasket to the camshaft cover



28.4 Camshaft sprocket timing mark (line on rear face – arrow A indicates location) aligned with pointer on the belt rear cover (arrow B). Some early models have different marks – see text



28.8 Timing belt in position
1 Camshaft sprocket
2 Belt tensioner
3 Auxiliary shaft sprocket
4 Crankshaft pulley

6 Check that the crankshaft pulley and camshaft sprocket have not been moved from their previously aligned positions.

7 To check that the auxiliary shaft sprocket has not moved, take off the distributor cap and check that the tip of the rotor arm is aligned with the index mark on the distributor rim, or No. 4 HT lead terminal in the distributor cap.

8 Fit the new belt. Start at the crankshaft pulley and, taking care not to kink or strain the belt, slip it over the camshaft sprocket. The camshaft may have to be turned slightly to mesh the sprocket with the teeth on the belt. Fit the belt on the tensioner pulley last; if this is difficult, do not lever or force the belt on, recheck the belt (photo).

9 Release the tensioner nut, then retighten it. Rotate the crankshaft through two complete revolutions. Slacken and retighten the tensioner nut. The belt tension may be checked by twisting the belt through 90 degrees with the finger and thumb on its longest run between the camshaft and auxiliary shaft sprockets. It should just turn through this angle without undue force. It is advisable to have the belt tension checked by a dealer at the earliest opportunity.

10 Refit the timing belt cover. Fit and tension the alternator drivebelt (Chapter 12).

29 Cylinder head – removal and refitting

1 Disconnect the battery negative lead.

2 Remove the spare wheel.

3 Drain the cooling system (Chapter 2).

4 Disconnect the fuel inlet and return hoses to the carburettor, and release the return hose from the brackets on the camshaft carrier and cylinder head.

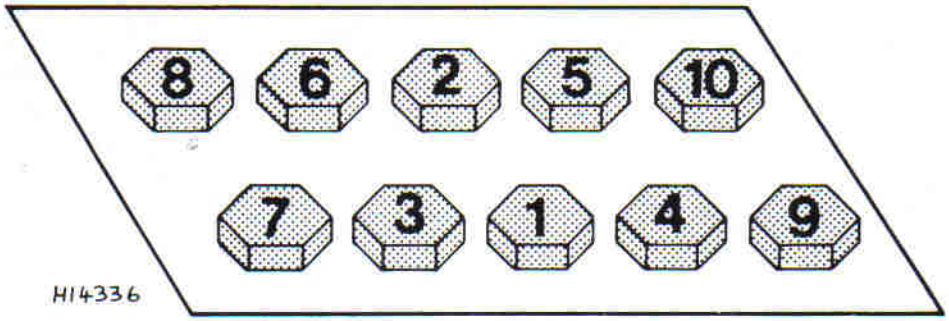


Fig. 1.14 Cylinder head bolt tightening sequence – OHC engines (Sec 29)

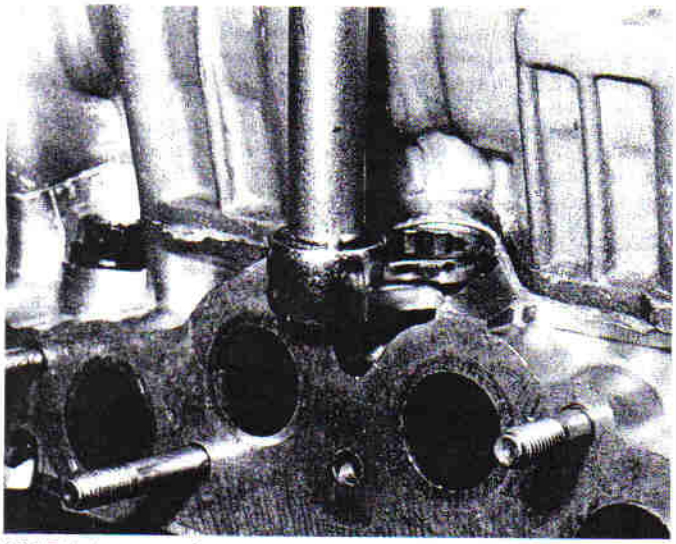
5 Disconnect the accelerator cable or linkage and the choke cable (Chapter 3).
6 Disconnect the brake servo vacuum hose.
7 Disconnect the HT leads from the spark plugs.
8 Disconnect the coolant temperature sender leads.
9 Disconnect the coolant hoses from the thermostat housing, carburettor and the pump-to-heater hose.
10 Disconnect the exhaust downpipe from the exhaust manifold.
11 Remove the front bolt from the upper engine mounting torsion bar and swing the torsion bar up out of the way.
12 Disconnect the distributor vacuum hose.
13 Remove the timing belt as described in Section 28.
14 Remove the timing belt rear cover. The lower bolt is accessible from below.
15 Remove the cylinder head bolts progressively and in the reverse order to that shown in Fig. 1.14.

Note: *A crowfoot spanner will be required to reach some of the bolts with the camshaft carrier fitted. If this is not available, then the camshaft carrier must first be removed as described in Section 27 (photo).*

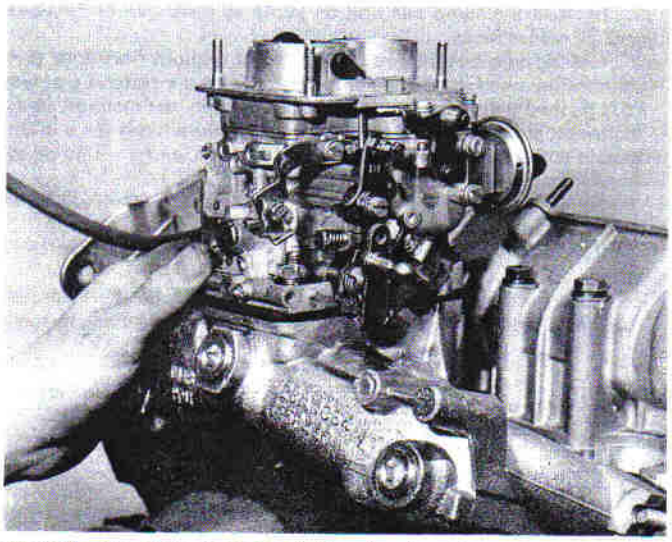
16 Release the cylinder head from the block by tapping it with a soft-faced mallet. Do not try to prise the head from the block.
17 Lift off the cylinder head, complete with carburettor and manifolds, and remove it to the bench.
18 Remove the hot air collector from the manifold.
19 Remove the nuts from the inlet manifold and lift off the inlet manifold and carburettor (photo).
20 Remove the exhaust manifold.
21 If the camshaft carrier is still in place, remove it as described in Section 27.
22 Overhaul of the cylinder head is described in Section 39.
23 Refitting the cylinder head is a reversal of removal, bearing the following points in mind.
24 Thoroughly clean all traces of old gasket from the cylinder head and block mating surfaces.
25 Always use a new gasket, and fit it with the lettering side uppermost. Lower the head gently onto the block and over the locating dowels (photo).
26 Fit and tighten the cylinder head bolts in the sequence shown in Fig. 1.14 to the torque given in the Specifications (photo). No further tightening is required if fitted with 10 mm bolts. However, if 12 mm bolts are fitted, the torque should be checked after 1000 miles or one month (cold).

Note: *Cylinder head bolts must only be used a maximum of four times. If any doubts exist about this, renew the bolts.*

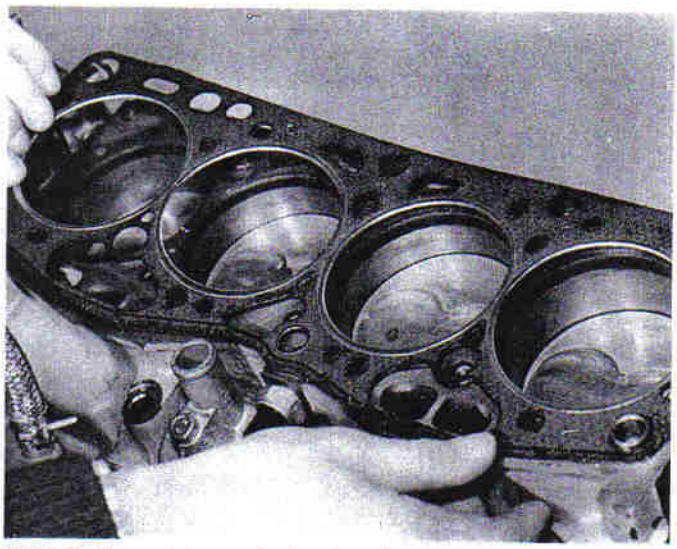
27 On completion check and adjust the valve clearances as described in Section 26.



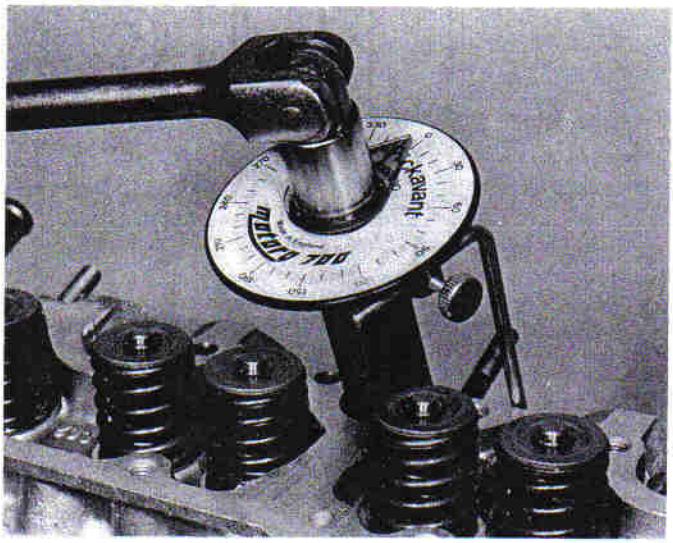
29.15 Using a crowfoot spanner to remove the cylinder head bolts



29.19 Removing the inlet manifold and carburettor



29.25 Fit the gasket over the locating dowels



29.26 Angle tightening the cylinder head bolts

30 Sump pan – removal and refitting

1 Drain the engine oil.
2 Raise the front of the vehicle on axle stands.
3 Just take the weight of the engine on a trolley jack positioned under the transmission unit.
4 Remove the engine crossmember and centre mounting.
5 Remove the sump pan bolts, gently release the seal and lower the sump pan.
6 Refit in reverse order using a new gasket and tighten the bolts.
7 Fill the engine with oil when the car is standing level.

31 Oil pump – removal and refitting

1 Remove the sump pan as described in Section 30.
2 Unbolt the oil pump and withdraw it complete with driveshaft.
3 Use a new gasket when refitting the pump and prime the pump by pouring engine oil through the pick-up filter screen.

32 Pistons/connecting rods – removal and refitting

Removal

1 Remove the sump pan and oil pump as described in Sections 30 and 31 respectively.
2 The big-end bearings can be renewed without having to remove the cylinder head if the caps are unbolted and the pistons/connecting rods pushed gently up the bore about one inch, the crankpin being at its lowest point. If the big-end bearings are worn however, it is almost certain that the main bearings will also be worn, and it would be better to remove the engine for complete overhaul.
3 To remove the pistons/connecting rods, remove the cylinder head as described in Section 29.
4 If fitted, remove the oil return pipe and the crankcase breather drain tube.
5 Unscrew the nuts or bolts from the big-end caps, then remove the caps with their bearing shells. The caps and their connecting rods are numbered 1,2,3 and 4 from the timing belt end of the engine. The numbers are on the opposite side of the engine to the auxiliary shaft, and this is the way they must be refitted.
6 Push each connecting rod and piston up out of the bore taking care not to scratch the bore with the connecting rod. Before doing this however, feel around the top of the bore for a wear ridge. If this is evident, then it must be removed by careful use of a scraper, or the piston rings may be damaged on removal.
7 Dismantling and overhaul procedures for the piston/connecting rod assemblies are given in Part 2, Section 18 of this Chapter, but note the following concerning the OHC engines.
8 As from January 1987, the connecting rods have two oil spray holes drilled in them. The big-end shells also have two holes to allow passage of oil. Ensure that the correct type of replacement shells are fitted.

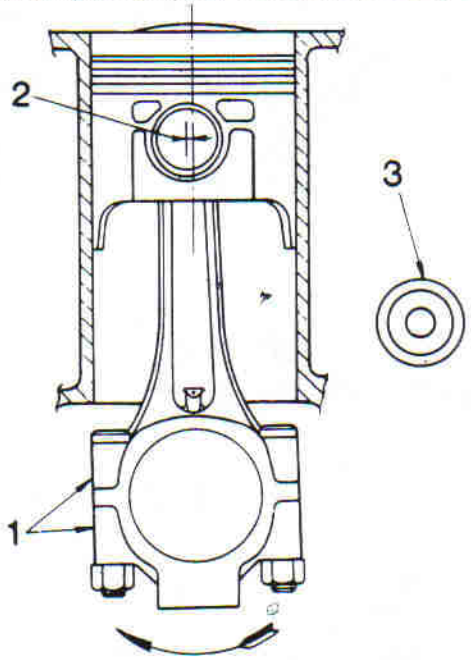


Fig. 1.15 Piston/connecting rod orientation when refitting (Sec 32)

1 Matching numbers
2 Gudgeon pin offset
3 Auxiliary shaft
Arrow indicates direction of rotation of crankshaft viewed from timing belt end

Refitting

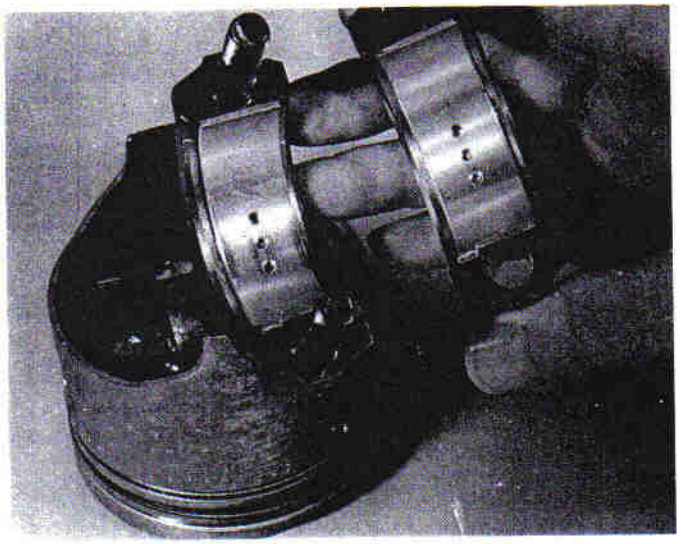
9 Clean the insides of the connecting rod and bearing caps thoroughly, oil the new shells and fit them to the connecting rod and cap (photo).
10 Check that the piston ring gaps are evenly spaced at 120 degree intervals.
11 Oil the rings and cylinder bore.
12 Fit a piston ring compressor to the piston to compress the rings.
13 Insert the piston/connecting rod into its cylinder bore, ensuring that it is the correct way round. The cap and rod numbers must face away from the auxiliary shaft (Fig. 1.15). If there is an arrow on the piston crown, it must point to the flywheel (OHC only).
14 Push the piston into the bore until the clamp is resting on the cylinder head, then use a hammer handle to push the piston into the bore (photo).
15 Oil the big-end journal, then pull the connecting rod down onto the journal. Fit the cap and tighten the nuts or bolts to the specified torque (photo).
16 The remaining procedure is a reversal of removal.

33 Engine mountings – renewal

1 The procedure is as described in Part 2, Section 11 except that on 3/4/5 series models the right-hand mounting is different and there is a torsion bar between the engine and the bulkhead (photos).
2 Also, on 3/4/5 series models there is no left-hand mounting on the transmission unit.

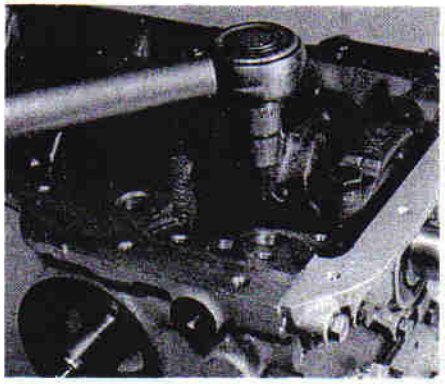
34 Engine – method of removal

The engine complete with transmission should be removed by lowering it to the floor and withdrawing it from under the front of the car which will have been raised to provide adequate clearance.

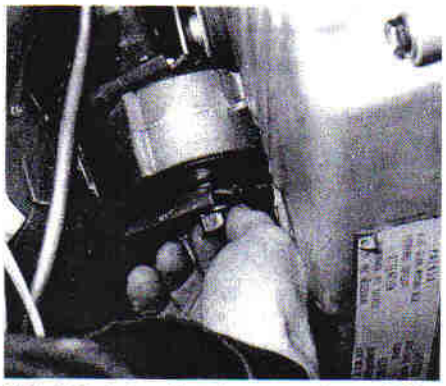


32.9 New shells fitted to cap and connecting rod

32.14 Pushing the piston into its bore



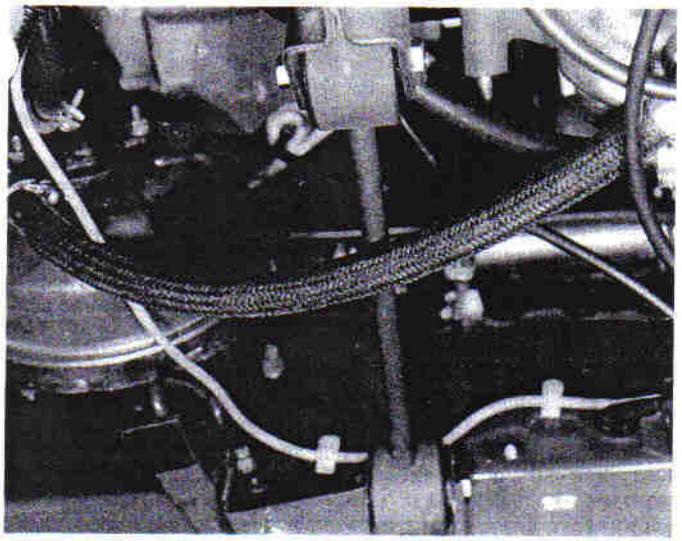
32.15 Tightening a big-end cap nut



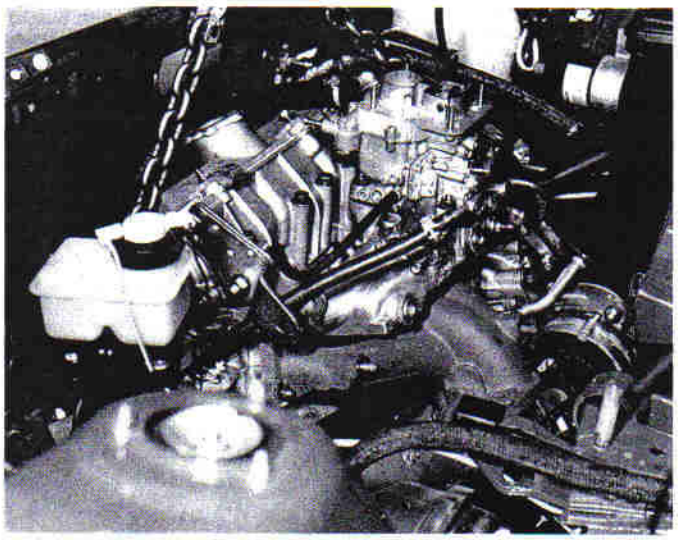
33.1A Right-hand engine mounting on 311 model

35 Engine/transmission – removal and separation

1 During the removal procedure refer to the relevant Chapters and Sections for removal/disconnection of anciliary components where the procedure is not detailed here.
2 Remove the battery.
3 Remove the bonnet and the spare wheel. On 55 and 65 models remove the spare wheel carrier.
4 Remove the engine splash panels.
5 Drain the cooling system and remove the radiator and cooling fan, and the hoses from the thermostat housing.
6 Disconnect the heater hoses. Note that the top hose is the inlet.
7 Disconnect the coil and, where fitted, the electronic ignition control unit.
8 Disconnnect the alternator, starter motor, engine earth lead (under one of the starter motor bolts), coolant temperature sender, oil pressure switch and reversing light.
9 Remove the air cleaner housing.
10 Disconnect the fuel supply line to the pump and, where fitted, the fuel return line from the carburettor.
11 Disconnect the clutch cable.
12 Disconnect the choke cable and the accelerator cable or linkage.
13 Remove the spark plugs, HT leads and the distributor (to give more clearance and lessen the danger of damage to the distributor).
14 Disconnect the speedometer cable from the transmission unit.
15 Disconnect the brake servo vacuum hose.
16 Loosen the nuts on the upper engine mounting torsion bar, but do not remove the bolts yet.
17 Disconnect the exhaust downpipe from the exhaust manifold and remove the hot air collector.
18 Raise the front of the vehicle onto axle stands, sufficiently high for the engine to be removed from under the vehicle.
19 Disconnect the gearchange linkage.
20 Disconnect the exhaust bracket from the transmission unit.
21 Remove the anti-roll bar.
22 Remove the driveshafts.
23 Attach a sling to the engine and just begin to take the weight (photo).
24 Remove the engine torsion bar (where applicable).
25 Remove the engine lower crossmember and the centre mounting.
26 Remove the right-hand mounting and on 55 and 65 models the left-hand mounting.
27 Lower the engine carefully from the engine bay, checking all round that everything has been disconnected and that the engine does not foul on the bulkhead fittings.
28 Once the engine is on the ground, remove the sling and pull the engine from under the vehicle. This last operation is made easier if an old piece of carpet is placed under the engine before lowering.
29 Give the engine/transmission unit a good wash down with proprietary engine cleaner and dry off, then transfer it to a bench. Support the engine and transmission on the bench using blocks of wood.
30 Remove the starter motor.
31 Remove the engine-to-transmission securing bolts and gently separate the engine from the transmission. Take care not to strain the transmission input shaft as the engine and transmission are separated.



33.1B Torsion bar on 311 model



35.23 Taking the weight of the engine

36 Engine – dismantling (general)

Refer to part 2, Section 14.

37 Engine – removing ancilliary components

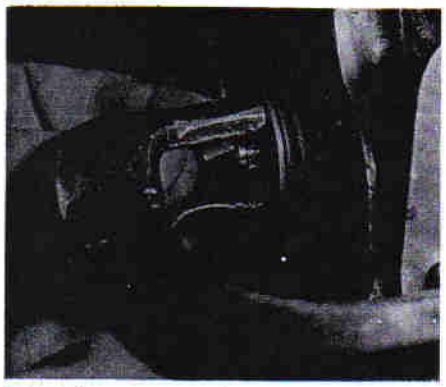
Refer to Part 2, Section 15 and also remove the intake manifold.

38 Engine – complete dismantling

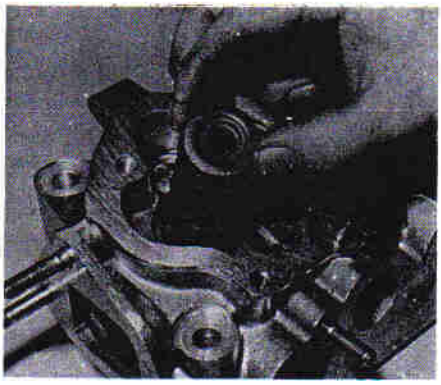
1 Have the engine resting squarely and supported securely on the work surface.
2 Unbolt and remove the timing belt cover.
3 Grip the now exposed timing belt with the hands and loosen the camshaft sprocket.
4 Release the timing belt tensioner pulley centre bolt, then slip the belt from the pulley and sprockets to remove it. Note which way round the belt is fitted, usually so that the lettering on the belt can be read from the crankshaft pulley end of the engine.
5 Remove the camshaft sprocket.
6 Unbolt and remove the camshaft timing belt cover backing plate.
7 Unbolt and remove the camshaft cover.
8 Unbolt the camshaft carrier and lift it off very slowly, at the same time pushing the cam followers and their shims down with the fingers securely onto their respective valve springs. It is easy to remove the camshaft carrier too quickly with some of the cam followers stuck in it and as the carrier is lifted away, the cam followers will fall out. If this happens, the valve clearances will be upset as the cam followers and shims cannot be returned, with any certainty, to their original positions. Keep the cam followers and shims in their originally fitted order.
9 Unscrew and remove the cylinder head bolts, grip the manifold, rock the head and remove the complete cylinder head/manifold/carburettor assembly. Remove and discard the cylinder head gasket.
10 Unbolt the coolant pump from the side of the cylinder block and remove it complete with coolant distribution pipe. Remove the crankcase breather.
11 Remove the distributor/oil pump driveshaft. This is simply carried out by inserting a finger into the hole vacated by the distributor and wedging it in the hole in the end of the driveshaft. Lift the shaft out of mesh with the auxiliary shaft.
12 Unbolt and remove the sprocket from the end of the auxiliary shaft. The sprocket is held to the shaft with a Woodruff key.
13 Unbolt the auxiliary shaft retainer and withdraw the shaft from the crankcase.
14 Unscrew and remove the crankshaft pulley nut. This is very tight and the flywheel starter ring gear will have to be jammed with a cold chisel or a suitably bent piece of steel to prevent the crankshaft rotating.
15 Withdraw the crankshaft sprocket, which is located by the Woodruff key.
16 Unbolt the front engine mounting bracket from the cylinder block, together with the timing belt cover screw anchor bush. Unbolt and remove the timing belt tensioner pulley.
17 Unscrew the flywheel securing bolts. The starter ring gear will again have to be jammed to prevent the crankshaft rotating as the bolts are unscrewed. Mark the flywheel position in relation to the crankshaft mounting flange, then remove it.
18 Unbolt the front and rear crankshaft oil seal housing bolts from the crankcase and the sump. Remove the oil seal housings.
19 Turn the engine on its side, extract the remaining sump bolts and remove the sump. If it is stuck, try tapping it gently with a soft-faced hammer. If this fails, cut all round the sump-to-gasket flange with a sharp knife. Do not try prising with a large screwdriver; this will only distort the sump mating flange.
20 With the sump removed, unbolt and remove the oil pump.
21 Where they are fitted, remove the bolts from the oil return and crankcase breather drain tubes and remove the tubes.
22 Remove the pistons/connecting rods as described in Section 32.
23 Before unbolting the main bearing caps, note that they are marked with one, two, three or four notches. No. 5 main bearing cap is unmarked. Note that the notches are nearest the auxiliary shaft side.
24 Unbolt and remove the main bearing caps. If the bearing shells are to be used again, tape them to their respective caps. The bearing shell at the centre position is plain, the others have a lubricating groove.
25 Carefully, lift the crankshaft from the crankcase, noting the thrust washers at No 5 main bearing. These control the crankshaft endfloat.

39 Cylinder head – dismantling and decarbonising

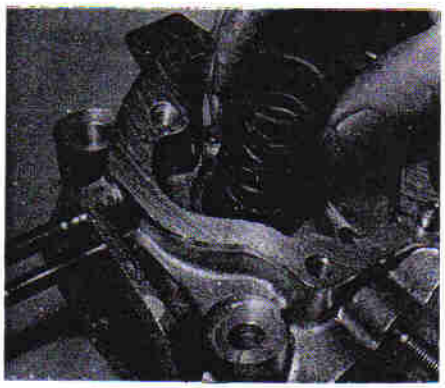
1 The operations are similar to those described for the OHV engine in Section 17 in respect of decarbonising and valve grinding.
2 To remove a valve, use a valve spring compressor to compress the first valve and then extract the split collets (photo).
3 Release the valve spring compressor.
4 Withdraw the valve spring cap and the double valve springs (photos).
5 Remove the valve (photo).
6 Remove the spring seat (photos).
7 Discard the valve stem oil seal and fit a new one (photo).
8 Remove the remaining valves in a similar way and keep the components in their original fitted sequence (photo).
9 Reassembly is a reversal of removal. Refit the components to their original positions, but renew the valve springs if their free length is less than that of a new spring or if the springs have been in operation for more than 80 000 km (50 000 miles).
10 The original valve clearance adjusting shims will no longer provide the correct clearances if the valves have been ground in or the seats recut. Only where dismantling of a valve was carried out to renew a spring is there any purpose in returning the shims to their original locations. Try to obtain the loan of eight thin shims from your dealer and insert them into the cam followers before assembling the cam followers to the carrier. Retain the shims wth thick grease.
11 Fit the camshaft carrier, complete with cam followers and shims to the cylinder head. Note that if the cylinder head is to be refitted with the camshaft carrier in place, a crowfoot spanner will be required for access to some of the head bolts. If a suitable spanner is not available, leave fitting the camshaft carrier until the cylinder head has been refitted.
12 Adjust the valve clearances as described in Section 26.



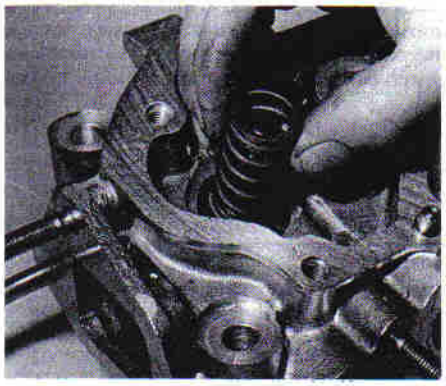
39.2 Using a valve spring compressor to remove the valve collets



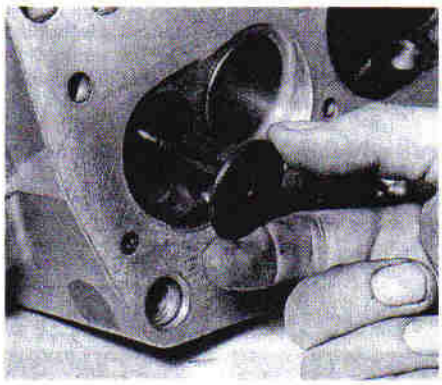
39.4A Lift off the valve spring cap ...



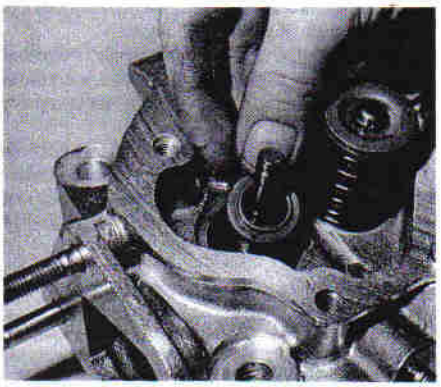
39.4B ... outer spring ...



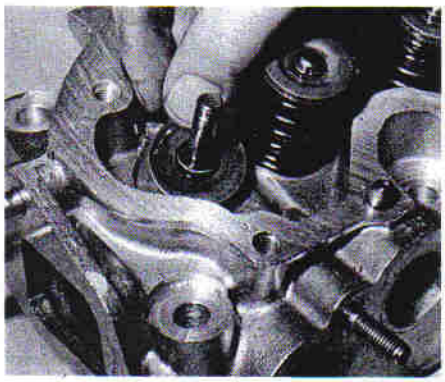
39.4C ... and inner spring



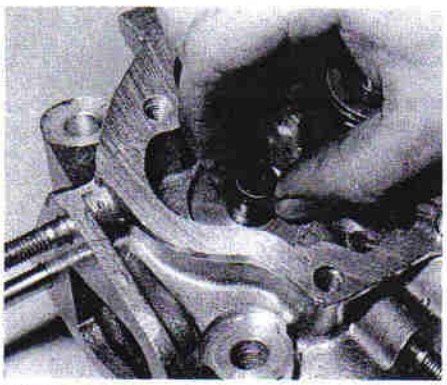
39.5 Remove the valve



39.6A Remove the upper ...



39.6B ... and lower components of the spring seat



39.7 Pull off the valve stem oil seal

40 Examination and renovation

1 The procedure for the following components is as described in Part 2, Section 18:

Cylinder block and crankcase
Crankshaft and bearings
Pistons and piston rings
Flywheel

2 Details of those components for which the procedures are different are given in the following paragraphs.

Oil pump

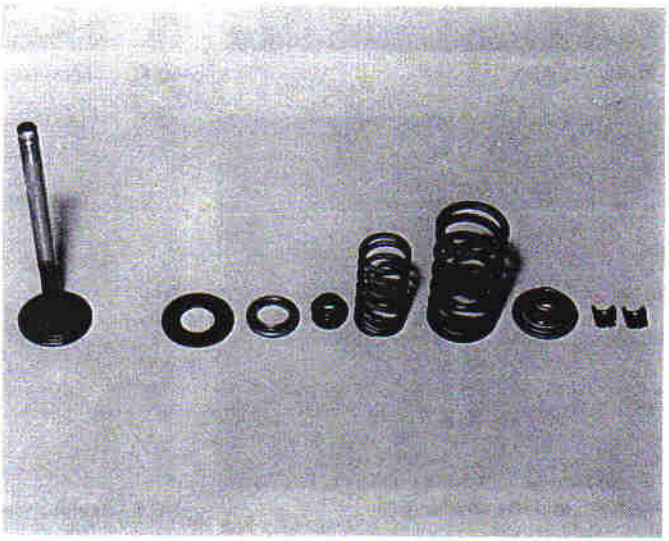
3 Carefully, clamp the housing in a vice, shaft downwards.
4 Take off the pump cover, with the suction pipe. This will release the oil pressure relief valve inside which can be lifted off (photos).
5 Remove the internal cover plate.
6 Take out the driveshaft and the gears (photos).
7 Clean and examine all the parts. Measure the clearances against the Specifications. The end clearance is measured by putting a straight-edge across the cover face.
8 The oil pump should only need replacement after a very high mileage, when the rest of the engine is showing great signs of wear.
9 The length of a new gear can be measured against the old gear to see if a new gear will restore the specified end clearance. Otherwise the housing must be changed.
10 The driven gear shaft is mounted in the housing with an interference fit. If there is any slackness, a new housing (which will come with shaft fitted) must be used.
11 The oil pump shares its drive with the distributor.

Camshaft, cam followers and shims

12 The camshaft journals and cams should be smooth, without grooves or scores (photo).
13 Wear in the camshaft carrier bearings can only be rectified by renewal of the carrier.
14 Cam follower wear is usually very small and when they show slackness in their bores, it is probably the light alloy of the camshaft carrier which has worn.
15 Always measure the thickness of the valve clearance shims using a metric micrometer. Any grooving or wear marks in the shims should be rectified by renewal with shims of similar thickness.

Auxiliary shaft

16 The shaft journals, the fuel pump eccentric, and the drivegear for the distributor and oil pump should be smooth and shiny. If not, the shaft will have to be renewed (photo).



39.8 Valve components laid out in order

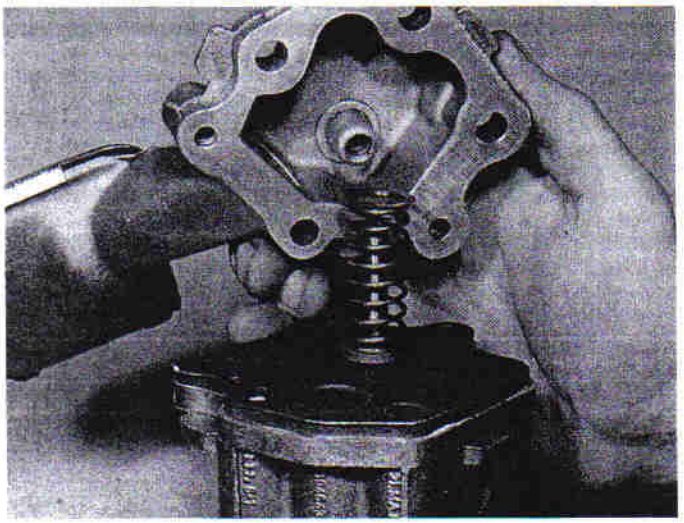
17 The bushes should still be tight in the cylinder block, their oil holes lined up with those in the block.
18 Measure the bearing clearance. If excessive, the bushes will have to be renewed. They are a press fit, and require reaming with a special reamer after fitting. This is a job best done by a Yugo agent with the special tools.
19 Ensure the new bushes are fitted with the oil holes lined up.
20 Also check the driven gear and its bush.
21 It is recommended that a new oil seal is fitted in the endplate. Hold the shaft in a vice, and remove the pulley. Fit the new oil seal in the endplate, lips inwards.

Timing belt tensioner

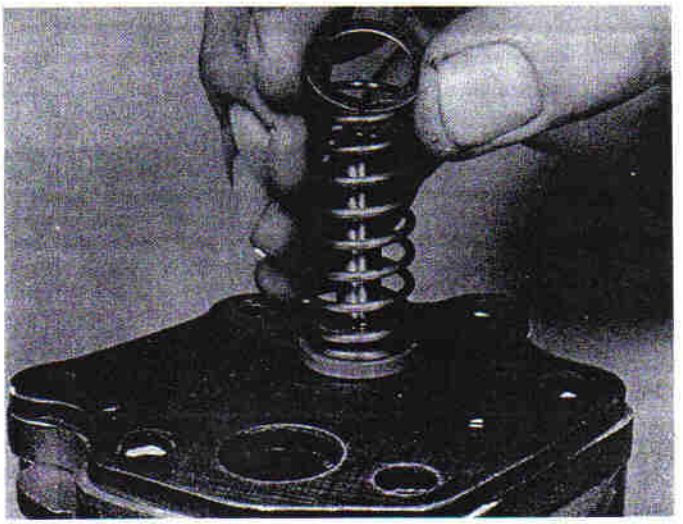
22 Check that the bearing revolves smoothly and freely, and has no play. Do not immerse it in cleaning fluid, as it is partially sealed. Wipe the outside, and then smear in some new general purpose grease.
23 The action of the spring will have been felt when the belt was taken off. It should be cleaned, and oiled, to prevent seizure through dirt and rust.
24 Note the circlip on the engine right-hand mounting bracket. This retains the timing belt tensioner plunger.

41 Engine – reassembly (general)

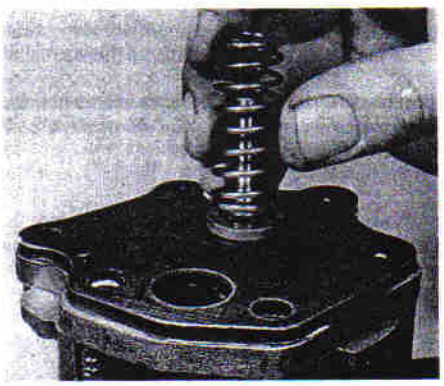
Refer to Part 2, Section 19.



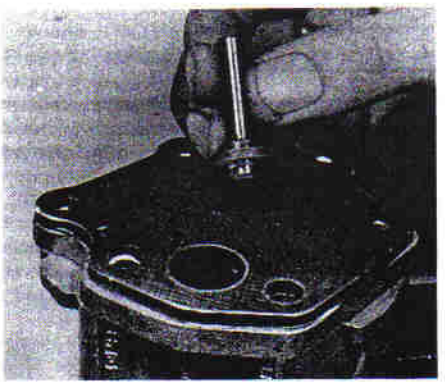
40.4A Take off the pump cover ...



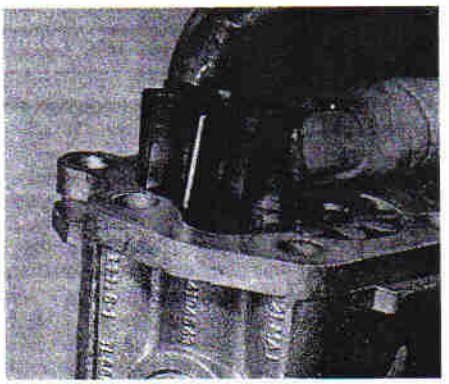
40.4B ... lift off the washer ...



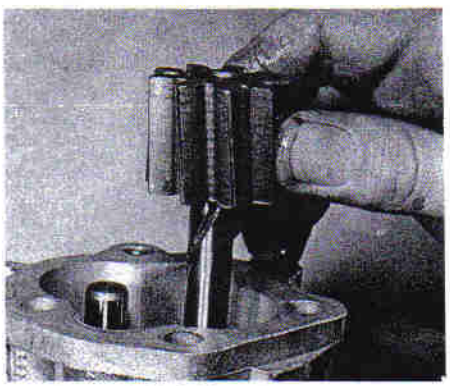
40.4C ... spring ...



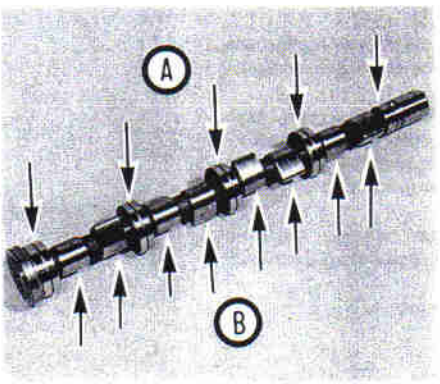
40.4D ... and valve



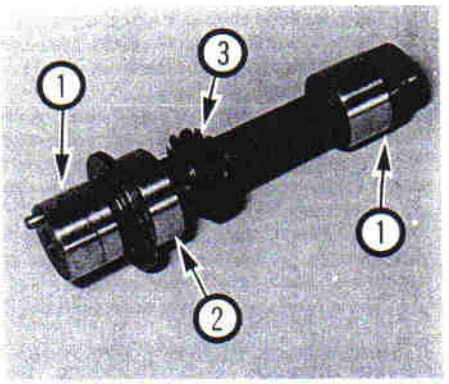
40.6A Lift out the driven gear ...



40.6B ... and the driving gear



40.12 Camshaft journals (A) and cams (B)



40.16 Auxiliary shaft
1 Bearing journals
2 Fuel pump eccentric
3 Oil pump/distributor drivegear

42 Engine – complete reassembly

Crankshaft and main bearings

1 Fit the bearing shells to their crankcase seats and to their caps. The seatings and backs of the shells must be spotlessly clean, otherwise tight spots will occur when the crankshaft is fitted. The centre bearing shell is plain (photos).
2 Fit the thrust washer halves to their locations at No 5 bearing, noting that the oil grooves in the washers face outwards (photo).
3 Oil the surfaces of the bearing shells liberally and lower the crankshaft into position.
4 Fit the main bearing caps to their correct locations, the correct way round (numerical marks towards the auxilary shaft). The rear cap is unmarked. Tighten the cap bolts to the specified torque (photos).
5 Check that the crankshaft rotates smoothly and freely.
6 At this stage, the crankshaft endfloat should be checked. Prise the crankshaft fully in one direction and measure the gap between the machined face of the flywheel mounting flange and the crankcase. Now push the shaft in the opposite direction and measure again. Ideally, a dial gauge should be used for these measurements, but feeler blades will serve as a reasonable alternative. The difference between the two dimensions (feeler blades) or the total movement of the crankshaft (dial gauge) should be within the specified tolerance. If it is not, the thrust washers at No 5 main bearing will have to be changed; this will require taking out the crankshaft again to reach them.
7 Fit new oil seals to the housings and, using new gaskets, bolt the housings to the front and rear ends of the crankshaft, having first filled the oil seal lips with grease (photos).

Pistons/connecting rods

8 The refitting operations are described in Section 32.

Auxiliary shaft

9 Lubricate the auxiliary shaft bearings and fit the shaft into the crankcase.
10 Fit a new seal to the endplate and fit the plate to the crankcase, using a new gasket.
11 Fit the belt sprocket and partially tighten its bolt. Using an oil filter strap wrench or similar device to hold the sprocket against rotation, tighten the bolt to the specified torque (photo).

Oil pump, sump pan and crankcase breather

12 Use a new gasket and fit the oil pump and driveshaft (photos).
13 Fit and tighten the retaining bolts.
14 Where applicable, bolt in place the oil return pipe and crankcase breather drain tube.
15 Use a new sump gasket, sticking it in place with grease or sealing compound, lift on the sump and fit and tighten the bolts (photos).
16 Insert the distributor/oil pump drivegear into the distributor hole (photo).
17 Fit the crankcase breather into its recess in the crankcase. Fit and tighten its securing bolt (photo).

Flywheel, crankshaft sprocket and crankshaft pulley

18 Fit the end plate in position on the crankcase (photo). It is secured by the two upper transmission bolts which are fitted later.
19 Ensure that the flywheel and crankshaft mating surfaces are clean. Line up the crankshaft and flywheel marks made during removal, then fit the plate and bolts (photo). If a new flywheel is being fitted, the crankshaft must be set to TDC (Woodruff key at front end pointing directly up) and the flywheel timing mark must be at the 12 o'clock position.
20 Tighten the bolts to the specified torque, preventing the flywheel from turning while this is done (photo).
21 Fit the crankshaft sprocket to the crankshaft, locating the Woodruff key. Its timing mark must be in line with the Woodruff key (photo).
22 Fit the crankshaft pulley and nut and tighten the nut to the specified torque, again restraining the crankshaft by locking the flywheel as you do so.

Cylinder head

23 Refitting is described in Section 29.

Camshaft carrier and camshaft

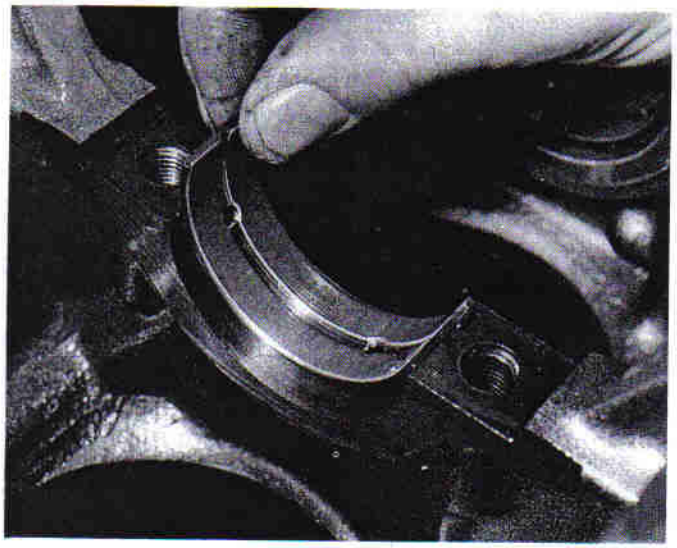
24 Refitting is described in Section 27.

Timing belt and tensioner

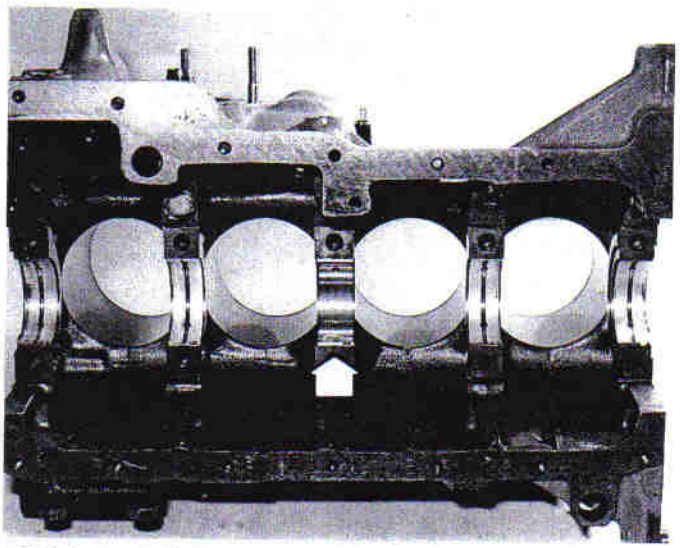
25 Fit the tensioner arm over its spigot, then fit the roller, washers and nut finger tight (photos).
26 Fit the engine mounting which incorporates the tensioner spring and piston. Grease the piston and operate it a few times to lubricate it before fitting.
27 Fit the timing belt rear cover (photo).
28 Fitting and tensioning of the timing belt is described in Section 28.

43 Engine – refitting ancillary components

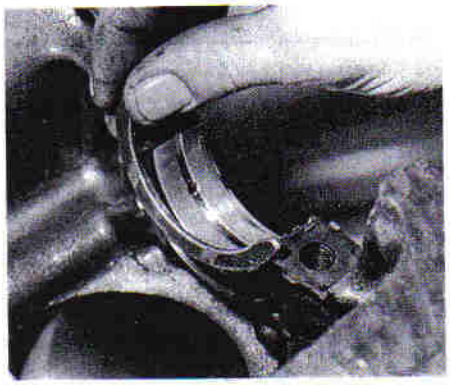
1 Bolt on the carburettor (Chapter 3).
2 Fit the coolant pump and thermostat housing (Chapter 2).
3 If it has been removed, refit the alternator mounting bracket, then fit the alternator and tension the drivebelt (Chapter 12) (photo).
4 Fit the manifolds (Chapter 3).
5 Fit the distributor (Chapter 4).
6 Fit the fuel pump (Chapter 3).
7 Fit the clutch (Chapter 5).
8 Fit a new oil filter (Section 3 of this Chapter).



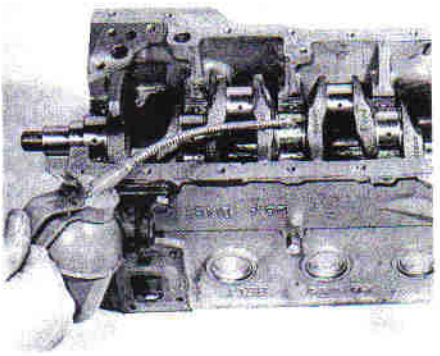
42.1A Fitting a bearing shell to the crankcase seat



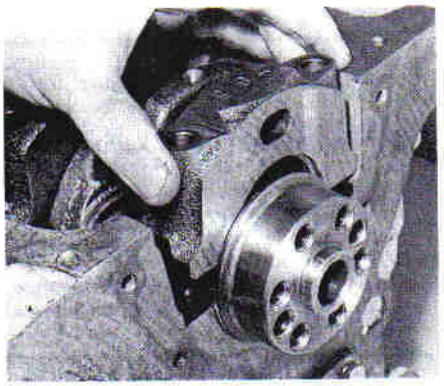
42.1B Centre shell (arrowed) has no groove



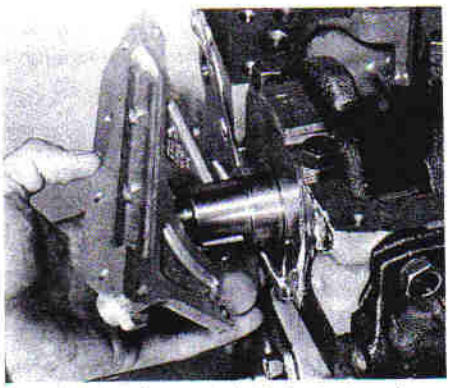
42.2 Fitting a thrust washer to No 5 bearing



42.4A Oil the journals ...

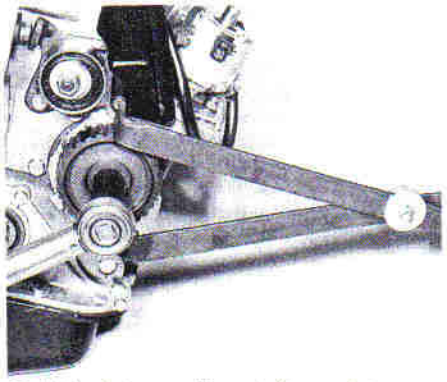


42.4B ... and fit the caps

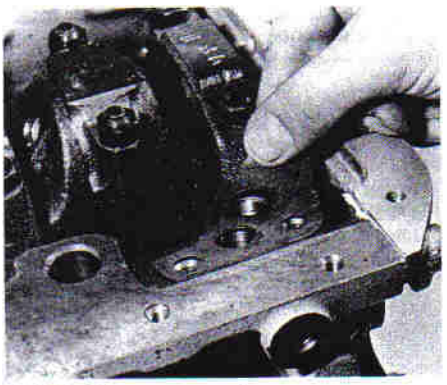


42.7A Fitting the crankshaft front oil seal housing

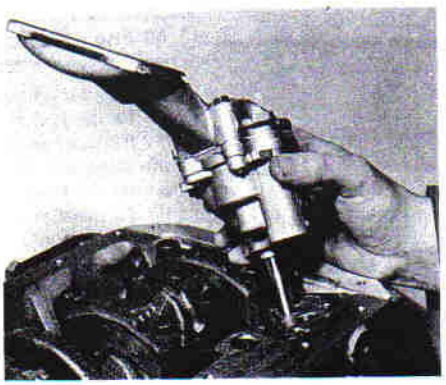
42.7B Fitting the rear crankshaft oil seal housing



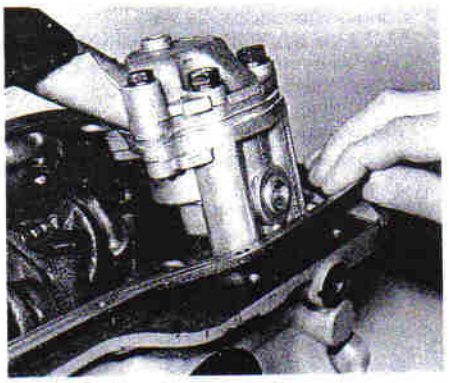
42.11 Lock the auxiliary shaft sprocket while tightening the bolt



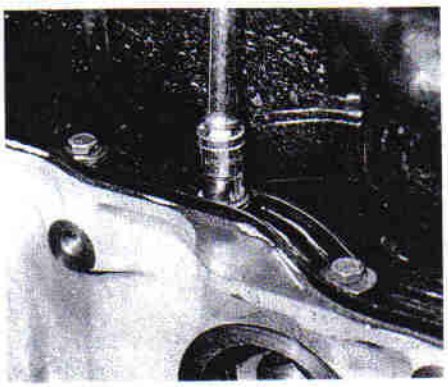
42.12A Using a new gasket ...



42.12B ... fit the oil pump and driveshaft ...

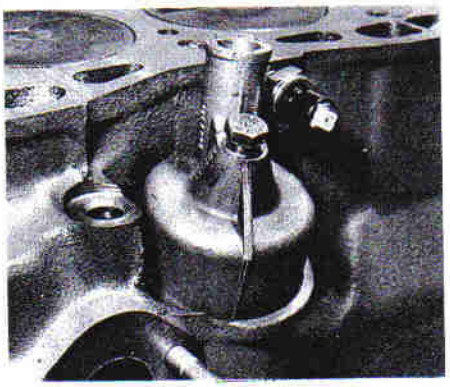


42.15A Fitting the sump gasket

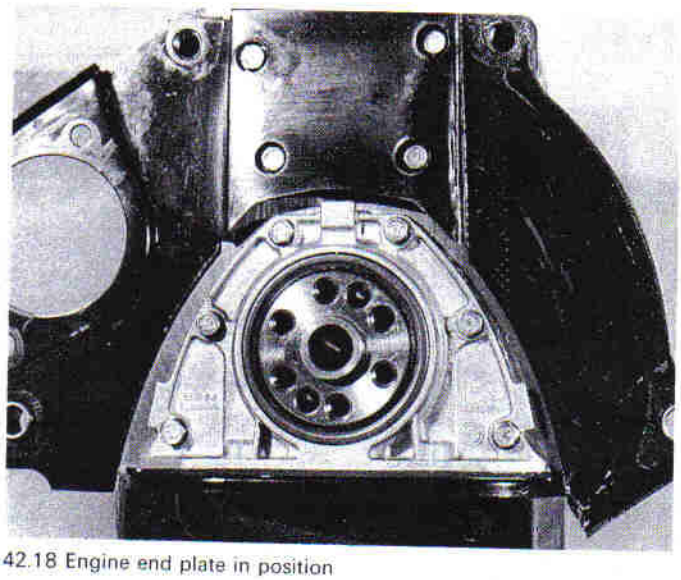


42.15B Tighten the sump bolts

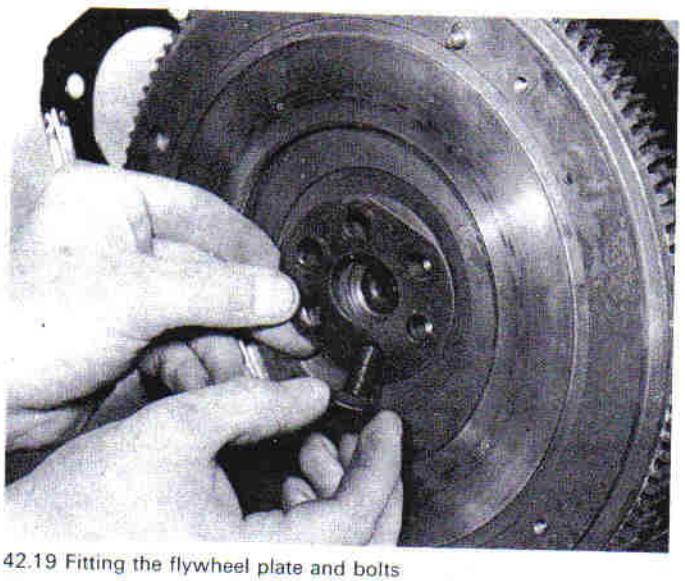
42.16 Fitting the distributor/oil pump drivegear



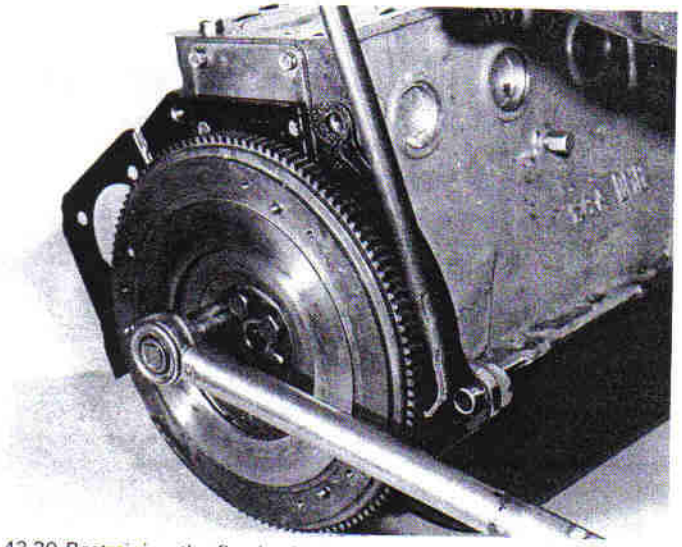
42.17 Crankcase breather and retaining bolt



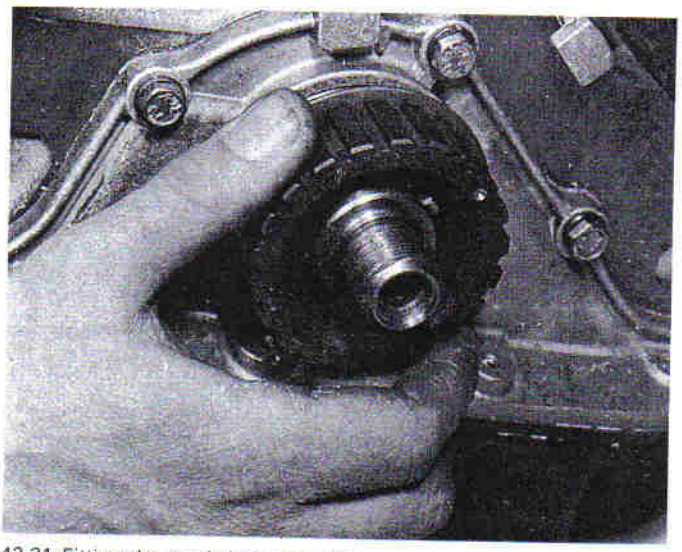
42.18 Engine end plate in position



42.19 Fitting the flywheel plate and bolts

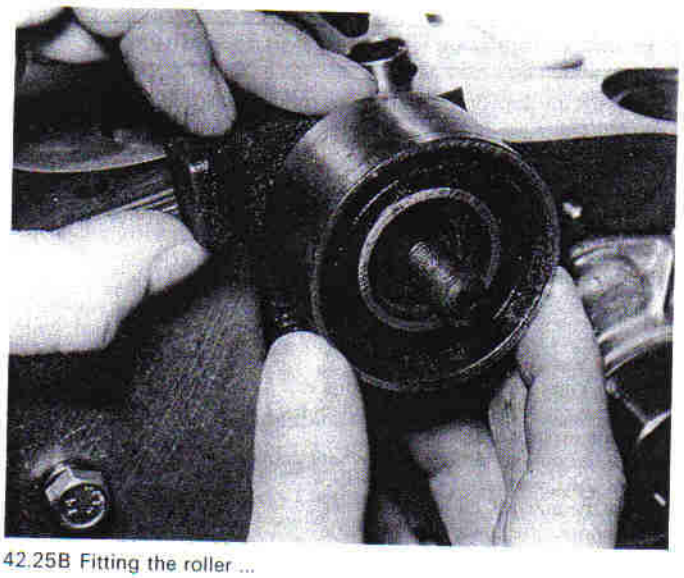


42.20 Restraining the flywheel while the bolts are tightened

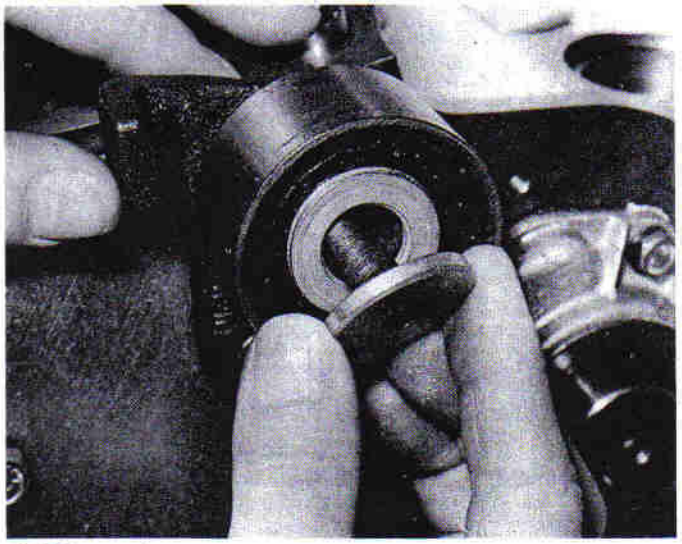


42.21 Fitting the crankshaft sprocket

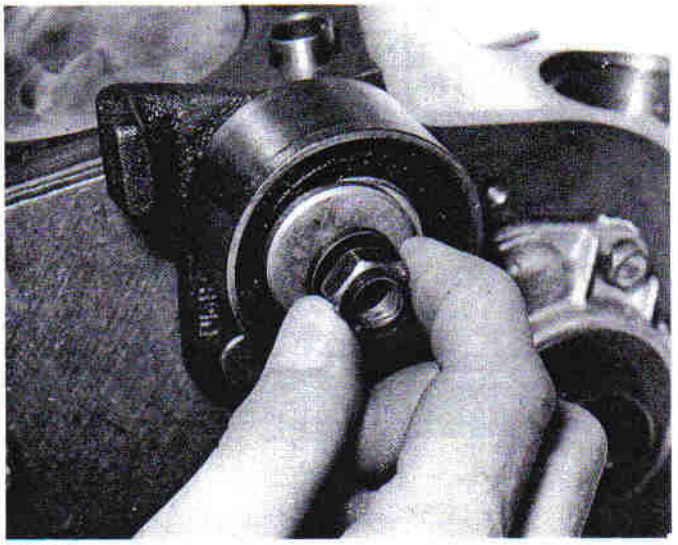
42.25A Fitting the tensioner arm over its spigot



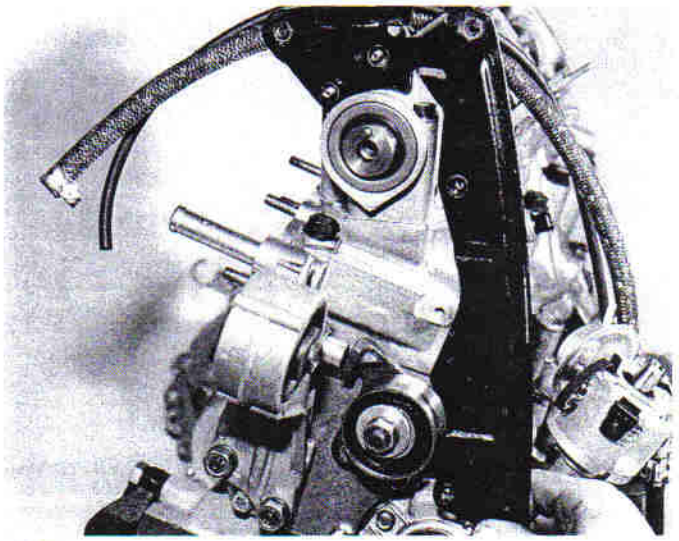
42.25B Fitting the roller ...



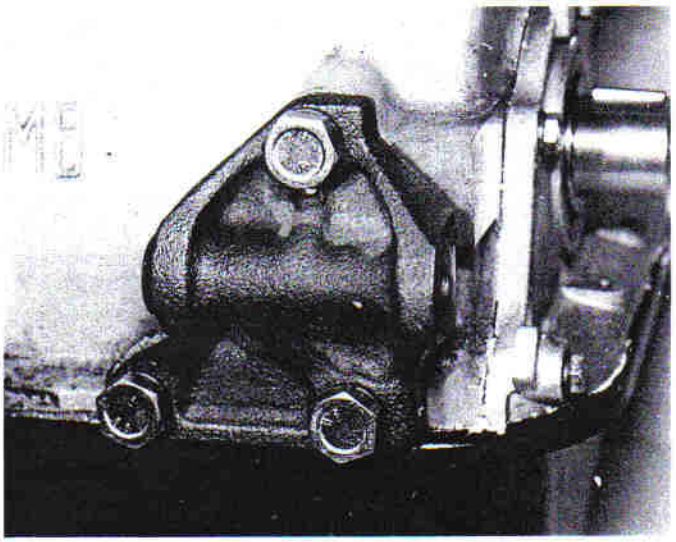
42.25C ... washers ...



42.25D ... and nut



42.27 Fitting the timing belt rear cover



43.3 Alternator mounting bracket

44 Engine/transmission – reconnection and refitting

1 Offer the transmission to the engine making sure that the clutch has been centralised as described in Chapter 5. Take care not to strain the transmission input shaft.
2 Draw the engine and transmission together by screwing in the connecting bolts. Refit the lifting lugs and hose and wiring clips.
3 Bolt the lower cover plate to the face of the flywheel housing.
4 Bolt the starter motor into position.
5 Bolt the mounting brackets into place.
6 Place the engine/transmission on the floor ready for raising by hoist or jack into the engine compartment.
7 Raise the car and position it over the engine/transmission.
8 Move the engine/transmission upwards until the left (where applicable) and right-hand mountings can be connected.
9 Remove the lifting gear and connect the centre mounting, then refit the engine lower crossmember.
10 Refit the engine tension bar (where applicable).
11 Refit the driveshafts.
12 Refit the anti-roll bar.
13 Reconnect the gearchange linkage.
14 Refit the exhaust downpipe to the manifold and refit the hot air collector. Reconnect the exhaust bracket to the transmission.
15 Reconnect the brake servo vacuum hose.
16 Reconnect the speedometer cable to the transmission.
17 Refit the distributor, spark plugs and HT leads.
18 Reconnect the choke cable and the accelerator cable or linkage.
19 Reconnect the clutch cable.
20 Reconnect the fuel supply line to the pump and, where fitted, the fuel return line to the carburettor.
21 Refit the air cleaner housing.
22 Reconnect the alternator, starter motor, engine earth lead, coolant temperature sender, oil pressure switch and reversing light.
23 Reconnect the coil and, where fitted, the electronic ignition control unit.
24 Reconnect the heater hoses.
25 Refit the radiator, cooling fan and thermostat housing hoses.
26 Refit the engine splash panels.
27 Refit the bonnet, spare wheel, and, where applicable, the spare wheel carrier.
28 Refit the battery.
29 Refill the cooling system, and refill the engine with oil when the vehicle is resting on its wheels.

45 Engine – initial start-up after major overhaul

1 If new bearings and rings have been fitted, it is likely that the engine will be stiff to turn so make sure the battery is well charged.

2 Switch on the ignition and check that appropriate warning lights come on.
3 Start up the engine. If it refuses to start, refer to the *'Fault diagnosis'* Section in the introduction to this manual.
4 Watch the oil pressure warning light and alternator charging indicator light. If there is no charge or if the oil pressure warning light does not go out after a second or two, having had time to fill the new oil filter, switch off and recheck.
5 If the warning lights go out, set the engine to run on fast idle and check the engine for leaks.
6 Check the coolant level; it will probably go down as air locks are filled.
7 Keep the engine running at a fast idle and bring it up to normal working temperature. As the engine warms up, there will be some odd smells and smoke from parts getting hot and burning off oil deposits.
8 When the engine running temperature has been reached, adjust the idling speed, as described in Chapter 3. Check, and, if necessary, adjust the ignition timing using a stroboscope (see Chapter 4).
9 Stop the engine and wait a few minutes; check to see if there are any coolant or oil leaks.
10 Road test the car to check that the engine is running with the correct smoothness and power. If it does not, refer to the *Fault diagnosis* Section in the introduction of this manual. Do not race the engine. If new bearings and/or pistons and rings have been fitted, it should be treated as a new engine and run it at reduced speed for at least 800 km (500 miles).
11 After 800 km (500 miles) change the engine oil and filter.

46 Fault diagnosis – 1116 cc, 1298 cc and 1301 cc (OHC) engine

Symptom	Reason(s)
Engine fails to turn when starter operated	Battery discharged Battery terminals loose or corroded Battery earth to body defective Engine/transmission earth strap broken or loose Disconnected or broken wire in starter circuit Ignition/starter switch defective Starter pinion jammed in mesh with flywheel gear Starter motor or solenoid defective Major mechanical failure (seizure) or long disuse (piston rings rusted to bores)
Engine turns slowly and fails to start	Battery discharged Battery terminals loose or corroded Battery or engine earth strap loose Starter motor connections loose Oil in engine/transmission too thick Starter motor defective
Engine turns normally but will not start	Fuel tank empty Damp or dirty HT leads, distributor cap or plug bodies Broken, loose or disconnected LT leads Contact breaker points dirty or incorrectly gapped Other ignition fault (see Chapter 4) Other fuel system fault (see Chapter 3) Valve timing incorrect (after rebuild)
Engine fires but will not run	Insufficient choke (cold engine) Fuel starvation or tank empty Ignition fault (see Chapter 4) Other fuel system fault (see Chapter 3)
Difficult starting when cold	Insufficient choke Fouled or incorrectly gapped spark plugs Damp or dirty HT leads, distributor cap or spark plug bodies Dirty or maladjusted contact breaker points (where applicable) Other ignition fault or timing maladjustment (see Chapter 4) Fuel system or emission control fault (see Chapter 3) Poor compression (may be due to incorrect valve clearances, burnt or sticking valves, blown head gasket, worn or damaged pistons, rings or bores) Incorrect valve timing (after rebuild)
Difficult starting when hot	Incorrect use of manual choke Fuel line vapour lock (especially in hot weather or at high altitudes) Incorrect ignition timing Other fuel system or emission control fault (see Chapter 3) Poor compression (see above)
Engine slow to warm up	Choke linkage maladjusted Air cleaner temperature control unit defective Thermostat stuck open (see Chapter 2) Other fuel system fault (see Chapter 3)
Engine idles roughly	Carburettor incorrectly adjusted Other fuel system fault (see Chapter 3) Spark plugs fouled or incorrectly gapped. Ignition timing incorrect

Symptom	Reason(s)
Engine idles roughly (cont.)	Incorrect valve clearances Widely differing cylinder compressions Other ignition fault (see Chapter 4) Low battery voltage (charging fault)
Engine lacks power	Ignition timing incorrect Air cleaner choked Valve clearances incorrect Brake binding Poor compression Other fuel system fault (see Chapter 3) Other ignition system fault (see Chapter 4) Carbon build-up in cylinder head
Engine misfires throughout speed range	Defective or fouled spark plug Loose, cracked or defective HT lead Maladjusted, sticking or burnt valves Ignition timing incorrect Blown head gasket Fuel contaminated Other ignition fault (see Chapter 4) Other fuel system fault (see Chapter 3)
Poor engine braking	High idle speed Other fuel system fault (see Chapter 3) Low compression
Pre-ignition (pinking) during acceleration	Incorrect grade of fuel being used Ignition timing overadvanced Engine overheated Excessive carbon build-up Other ignition fault (see Chapter 4) Fuel system fault (see Chapter 3)
Engine runs on after switching off	Idle speed too high Incorrect type of spark plug Overheating Excessive carbon build-up Other emission control fault (see Chapter 3)
Low oil pressure (verify accuracy of sender before dismantling engine!)	Oil level low Engine overheating Incorrect grade of oil in use Oil filter clogged or bypass valve stuck Pressure relief valve stuck or defective Oil pick-up strainer clogged or loose Main or big-end bearings worn Oil pump worn or mountings loose
Excessive oil consumption	Overfilling Leaking gaskets or drain plug washer Valve stem oil seals worn, damaged or missing after rebuild Valve stems and/or guides worn Piston rings and/or bores worn Piston oil return holes clogged
Oil contaminated with water	Excessive cold running Leaking head gasket Cracked block or head
Oil contaminated with fuel	Excessive use of choke Worn piston rings and/or bores
Unusual mechanical noises	Unintentional mechanical contact (eg fan blade) Worn drivebelt Worn valvegear (tapping noises from top of engine) or incorrect clearance Peripheral component fault (generator, coolant pump) Worn big-end bearings (regular heavy knocking, perhaps less under load) Worn main bearings (rumbling and knocking, perhaps worsening under load) Small-end bushes or gudgeon pins worn (light metallic tapping) Piston slap (most noticeable when engine cold)

Chapter 2 Cooling and heating systems

Contents

Specifications

General

Type (all models)	Liquid cooled, with engine driven centrifugal pump. Radiator with expansion tank and thermally operated electric fan. Thermostatic opening of engine outlet to radiator

Cooling fan thermal switch

Switches fan on at	90 to 94°C (194 to 201°F)
Switches fan off at	85 to 89°C (185 to 192°F)

Thermostat

Opening temperature:	
OHV engine	85 to 89°C (185 to 192°F)
OHC engines	80 to 84°C (176 to 183°F)
Valve travel:	
OHV engine	7.5 mm (0.29 in)
OHC engines	8.0 mm (0.31 in)

Radiator cap

Opening pressure	0.8 bar (11.6 lbf/in²)

Coolant

Capacity	5.0 litres (8.8 pints)
Type	Ethylene glycol based antifreeze (Duckhams Universal Antifreeze and Summer Coolant)

Torque wrench settings

	Nm	lbf ft
Cooling fan	39	29
Water pump pulley	39	29
Radiator thermal switch	49	36
Temperature sender	49	36

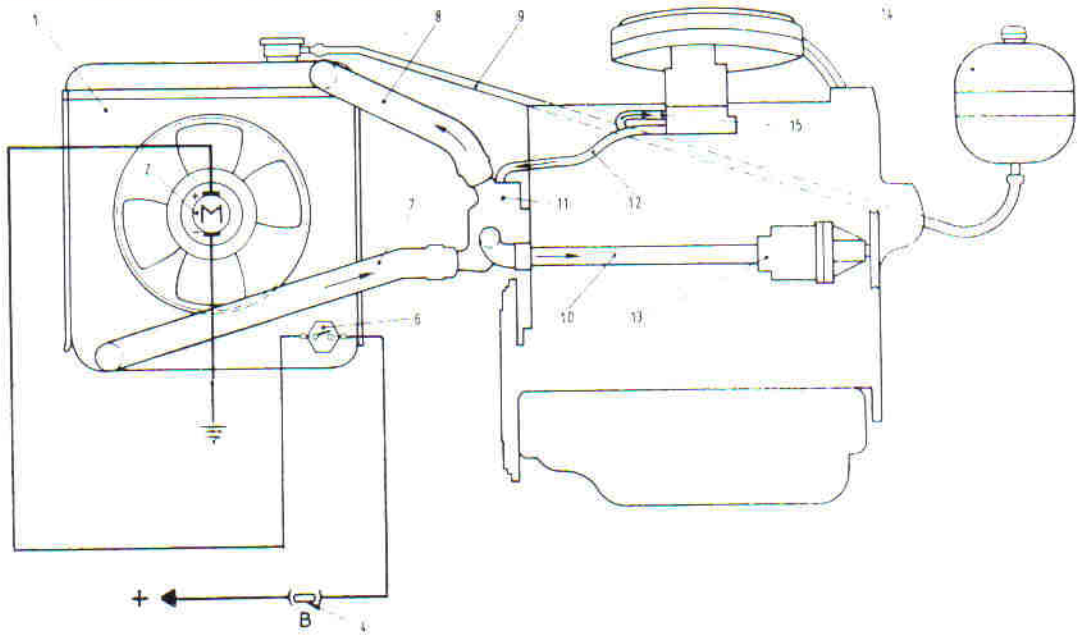


Fig. 2.1 Layout of typical cooling system (Sec 1)

1 *Radiator*
2 *Fan motor*
4 *Fan fuse (B)*
6 *Radiator fan thermal switch*
7 *Radiator bottom hose*
8 *Radiator top hose*
9 *Expansion tank hose*
10 *Coolant transfer pipe*
11 *Thermostat housing*
12 *Carburettor base heating hose*
13 *Water pump*
14 *Expansion tank*
15 *Carburettor base heating hose*

1 General description

The cooling system is very similar on all models and the procedures in this Chapter apply equally to all models. Where major differences occur, these are pointed out in the text.

The cooling system consists of a front-mounted radiator, a coolant pump driven by the alternator drivebelt, a thermostat and a heater, all connected by hoses.

Coolant circulates around the internal coolant passages of the engine where it picks up heat. The circulation is assisted by the pump.

As the temperature of the coolant reaches the operating temperature of the thermostat, the thermostat begins to open and allows coolant to flow to the radiator, which is air cooled due to the forward motion of the car.

A thermal switch fitted in the bottom of the radiator controls the electric cooling fan mounted on the back of the radiator. Should the temperature of the coolant rise above that of the operating temperature of the switch, the cooling fan is switched on, increasing the airflow through the radiator and thus the cooling effect. This is particularly useful when the vehicle is stationary in traffic with the engine running.

Coolant is also fed to the car interior heating system. The flow of warmed coolant through the heater is controlled by the water valve on the side of the heater unit, which is operated by the heating and ventilation controls.

An electrical temperature sender screwed into the cylinder head is connected to the water temperature gauge in the instrument panel.

On some models, the carburettor base is also heated to aid fuel atomisation.

2 Routine maintenance

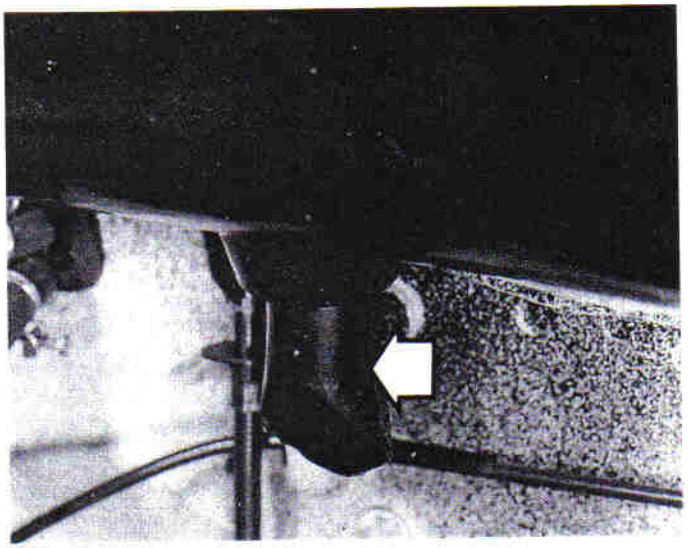
At the intervals given in the *'Routine maintenance'* Section at the beginning of this manual carry out the following:

Check and if necessary top up the level of antifreeze in the cooling system (Section 4)
Check the condition and tension of the alternator/water pump drivebelt (Chapter 12)
Renew the coolant in the system (Section 4)
Periodically clean the radiator fins of debris (leaves, dead insects etc)
Ensure that the drain tube at the base of the heater air inlet duct is not blocked (photo)
Check the condition of the radiator cap

3 Coolant mixtures

1 In cold climates, antifreeze is needed for two reasons. In extreme cases, if the coolant in the engine freezes solid it could crack the cylinder block or head. But also in cold weather, with the circulation restricted by the thermostat, and any warm water that *is* getting to the radiator being at the top, the bottom of the radiator could freeze, and so block circulation completely, making the coolant trapped in the engine boil.

2 The antifreeze should be mixed in the proportions advocated by the makers, according to the climate. The normal proportion in a temperate climate to provide maximum protection against freezing and corrosion



2.6 Air inlet duct drain tube (arrowed)

is 50% antifreeze and 50% water.
3 Use only ethylene glycol based antifreeze and preferably soft water.
4 Antifreeze should be left in through the summer. It has an important secondary function, to act as an inhibitor against corrosion. In the cooling system are many different metals. In contact with the coolant this sets up electrolytic corrosion, accentuated by any dirt in the system. This corrosion can occur catastrophically fast.
5 After about two years, the effectiveness of the antifreeze's inhibitor is used up. It must then be discarded, and the system refilled with new coolant.
6 In warm climates free from frost, an inhibitor should be used. Again, a reputable make giving full protection must be chosen and renewed every two years. Inhibitors with dyes are useful for finding leaks, and on some makes the dye shows when the inhibiting ability is finished.

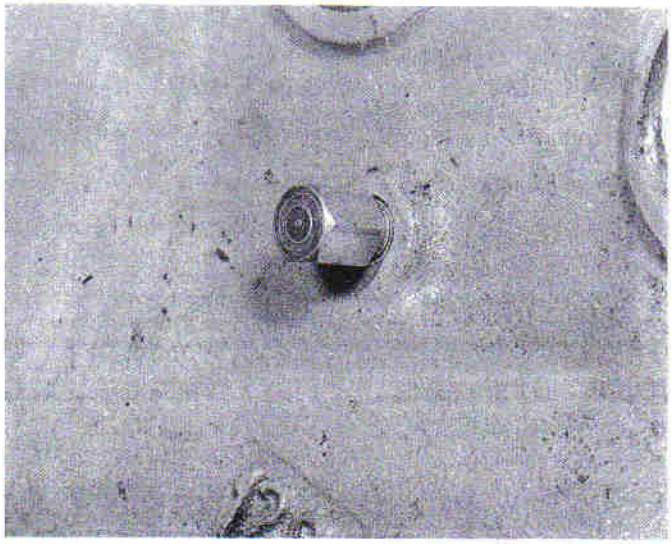
4 Cooling system – draining, flushing and refilling

1 The operation is best performed with the engine warm, but take precautions against scalding.
2 Set the heater temperature control lever to hot (Max).
3 Remove the expansion tank and radiator caps. If the engine is still hot, place a cloth over the radiator cap while undoing it to prevent scalding.
4 Disconnect the bottom radiator hose, and on OHC engines remove the cylinder block drain plug (photo). Some radiators also have a drain plug which can be undone to aid the draining and flushing process.
5 Allow the system to drain, collecting the coolant in a container if it is fit to be used again.
6 If the system has been neglected and the coolant is heavily contaminated with rust and sediment, flush the system through with a garden hose. Disconnection of the heater hoses and removal of the thermostat will enable a more thorough job of flushing to be carried out.
Warning: *Do not introduce cold water into a hot engine due to risk of cracking the cylinder head or block.*
7 If, after a reasonable period, the water still does not run clear, the radiator may be flushed with a good proprietary cleaning agent, such as Holts Radflush or Holts Speedflush. It is important that the manufacturer's instructions are followed carefully. The regular renewal of antifreeze should prevent further scaling and contamination of the system. On completion of flushing, remake all connections and refit the thermostat.
8 Fill the system with fresh antifreeze mixture through the radiator filler until the coolant reaches the bottom of the filler neck.
9 Fit the radiator cap.
10 Fill the expansion tank with the same antifreeze mixture to about 25 mm (1.0 in) above the 'MIN' mark, then fit the cap (photos).
11 Start and run the engine until it reaches normal operating temperature, and check for leaks.
12 After 10 to 15 minutes, switch off the engine and allow it to cool. If necessary, top up the system through the expansion tank so that the level is above the 'MIN' mark.

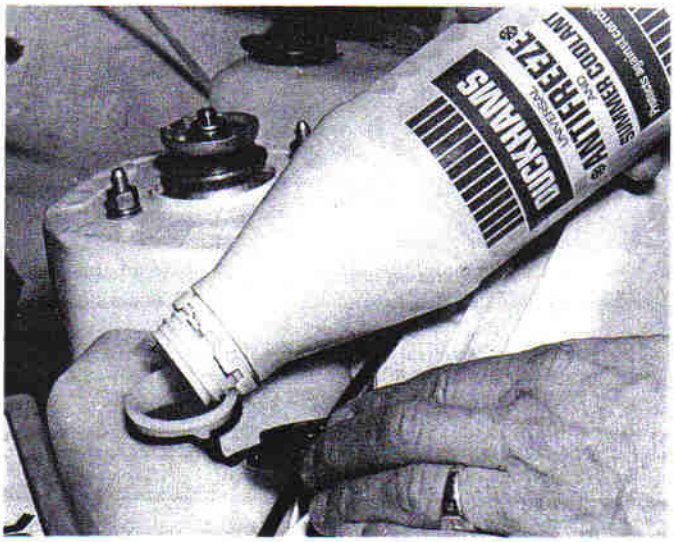
5 Radiator – removal and refitting

Note: *If the reason for removing the radiator is concern over coolant loss, note that minor leaks may be repaired by using a radiator sealant, such as Holts Radweld, with the radiator* in situ.

1 Disconnect the battery negative lead.
2 Drain the cooling system as described in Section 4.
3 Disconnect the electric cooling fan, noting the earth lead under the headlamp retaining nut.
4 Disconnect the cooling fan thermal switch.
5 Disconnect the top radiator hose (the bottom radiator hose will have been disconnected for draining).
6 Disconnect the expansion tank hose and unclip it from the clip on the side of the radiator (photos).
7 On 45/55/65 models remove the bolts from the top radiator mounting bracket and lift off the bracket (photo).
8 Where applicable, remove the bolt at each side of the radiator (photo).
9 Lift out the radiator. If the radiator has been leaking or is suspected of leaking, take it to a specialist repairer (with the radiator cap) for test and repair, or renew it.



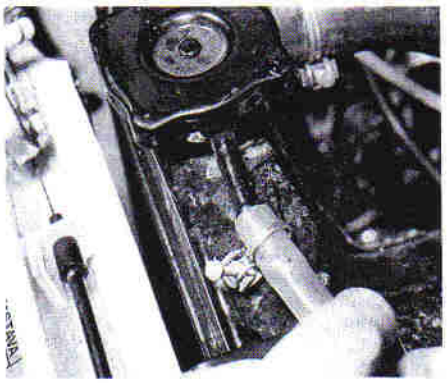
4.4 Cylinder block drain plug on OHC engines



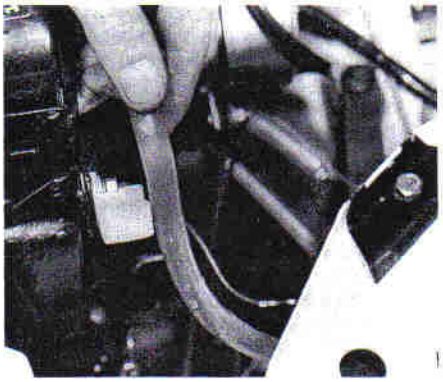
4.10A Filling the expansion tank with antifreeze

4.10B 'MIN' mark on 45/55/65 model expansion tank ...

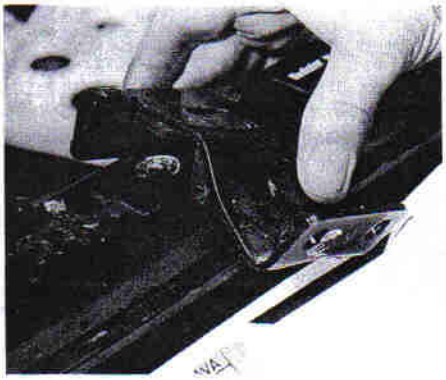
4.10C ...and on 3/4/5 series



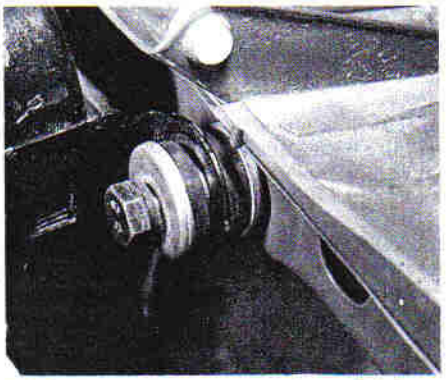
5.6A Disconnect the expansion tank hose ...



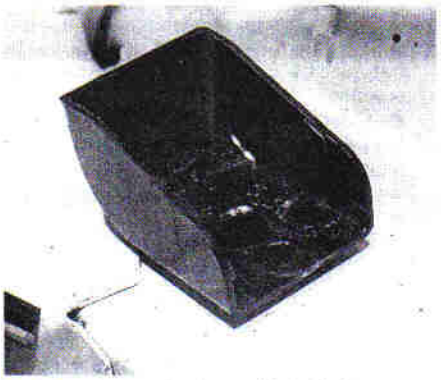
5.6B ... and unclip it from the radiator



5.7 Top radiator mounting bracket on 45/55/65 models



5.8 Radiator side mounting bolt on 3/4/5 series



5.10 Plastic bracket into which the bottom of the radiator fits

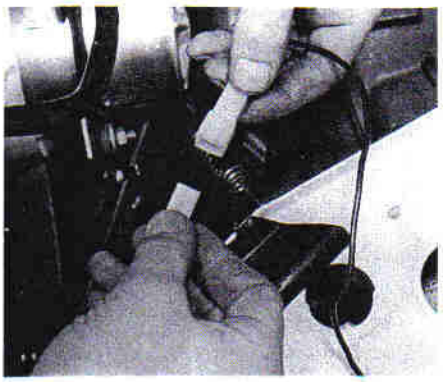
10 Refitting is a reversal of removal, ensuring the radiator fits into the plastic brackets at the bottom (photo).
11 Fill the cooling system as described in Section 4.

6 Radiator fan – removal and refitting

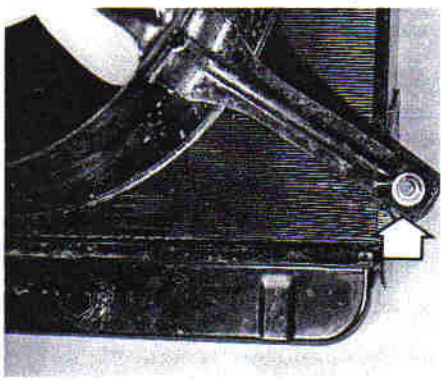
1 Disconnect the leads from the fan. Note that the earth lead is anchored under one of the headlamp securing nuts (photo).
2 Unbolt the fan support struts from the radiator and lift the fan away (photo).
3 To separate the motor from the support, remove the three nuts and bolts (photo).
4 Little can be done by way of repair to the motor, and if it is defective it must be renewed.
5 Refitting is a reversal of removal.

7 Radiator fan thermostatic switch – removal, checking and refitting

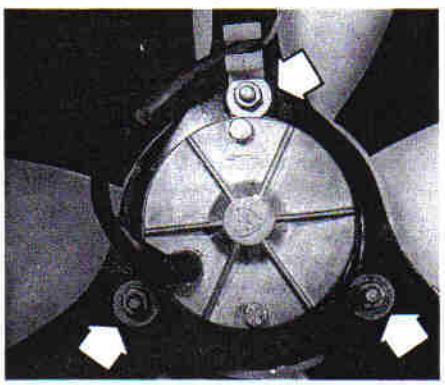
1 Drain the cooling system.
2 If the thermostatic switch is being removed because the fan is not operating and the switch is suspect, check the fan fuse first, before removing the switch.
3 To remove the switch, disconnect the leads from the terminals and unscrew the switch (photos).
4 Connect a test bulb and battery across the switch terminals and then immerse the sensing part of the switch in a container of water. Heat the water and, using a thermometer, check the temperature of the water when the bulb lights up, indicating the switch is functioning. The switch should operate at the specified temperature (see Specifications). Allow the water to cool and check that the switch cuts out at the specified temperature. Renew a faulty switch.



6.1 Disconnecting the fan leads



6.2 Fan support strut bolt (arrowed)



6.3 Fan is secured to support by bolts

5 Refitting of the switch is the reverse of the removal procedure, using a new seal.

8 Thermostat – removal and refitting

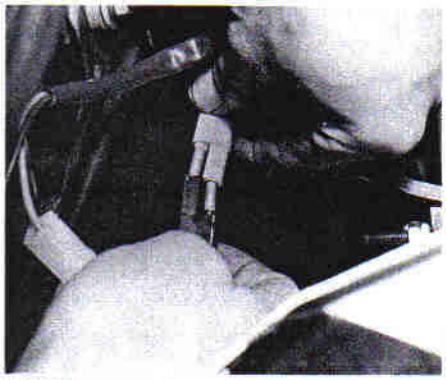
1 Drain the cooling system as described in Section 4.

OHV engine

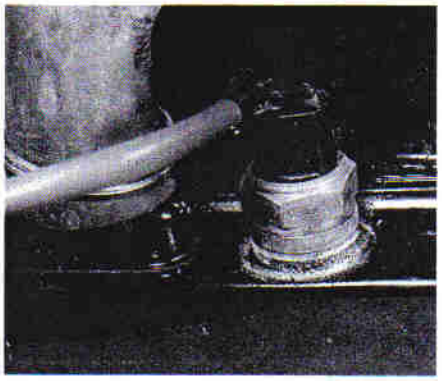
2 Disconnect the upper radiator hose at the thermostat (photo).
3 Remove the two nuts and one bolt securing the upper cover to the lower housing, noting the air cleaner bracket under the nuts (photo).
4 Lift off the upper cover (photo).
5 Lift out the thermostat (photo).
6 The lower housing can be removed after disconnecting the carburettor base heating pipe.
7 Refit in reverse order using new gaskets (photos).

OHC engines

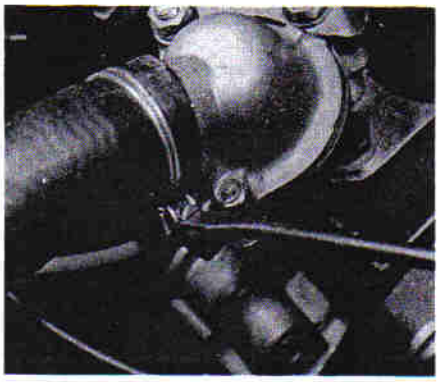
8 Disconnect the coolant transfer pipe from the thermostat housing (photo).
9 Disconnect the top and bottom radiator hoses at the thermostat housing.
10 Disconnect the carburettor base heating pipes either at the carburettor or the thermostat housing end.
11 Undo and remove the nuts securing the housing to the cylinder block (photo).
12 Lift off the housing (photo).
13 Undo the bolts securing the top cover and lift off the cover.
14 Remove the thermostat, noting the seal around the flange (photo).
15 Refit in reverse order using new gaskets (photos) and check that the seal around the thermostat flange is in good condition.



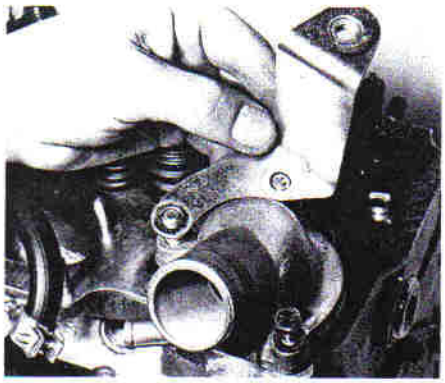
7.3A Disconnecting the thermostatic switch leads



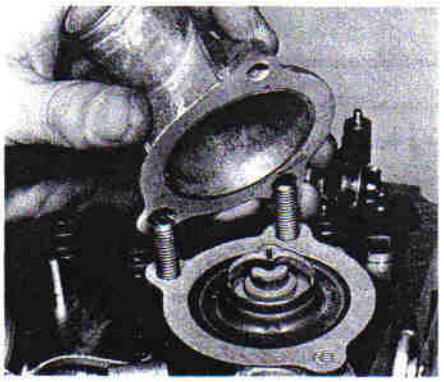
7.3B Thermostatic switch in bottom of radiator



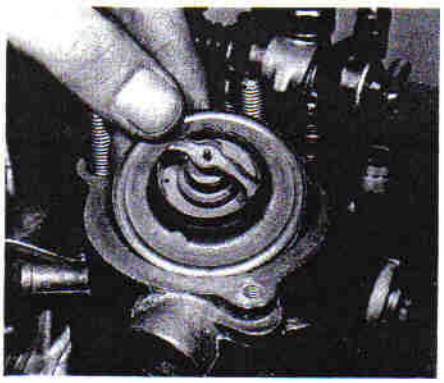
8.2 Disconnecting the upper radiator hose



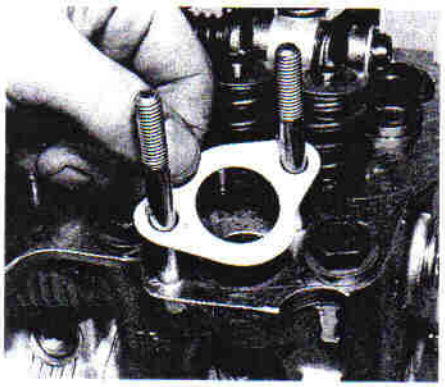
8.3 Lifting off the air cleaner bracket



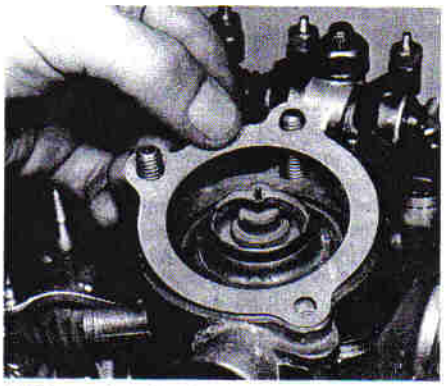
8.4 Lift off the upper cover ...



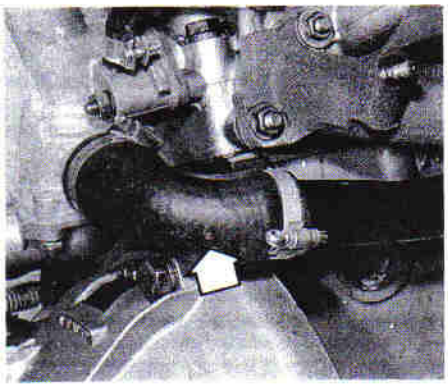
8.5 ... and lift out the thermostat



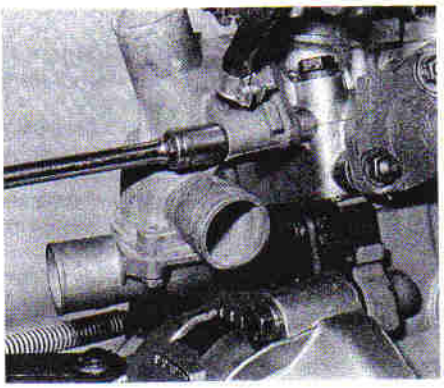
8.7A Fit a new gasket under the housing ...



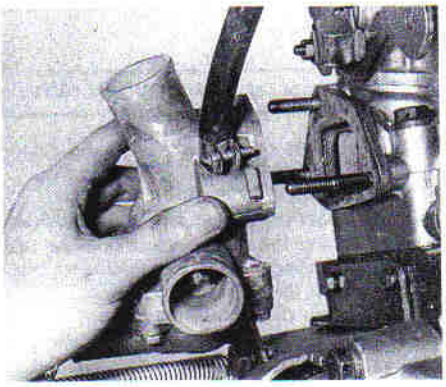
8.7B ... and under the upper cover



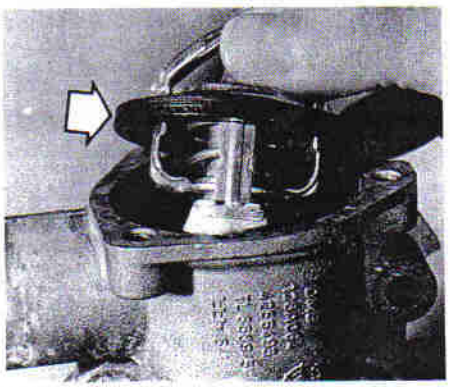
8.8 Coolant transfer pipe (arrowed)



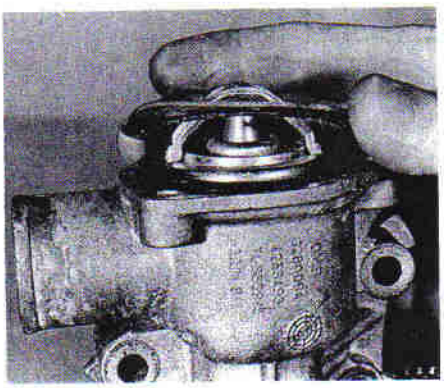
8.11 Undo and remove the nuts ...



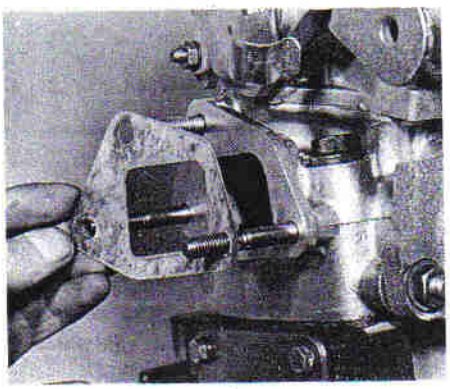
8.12 ... and lift off the housing



8.14 Thermostat seal (arrowed)



8.15A Use new gasket under the top cover ...



8.15B ... and the housing

9 Thermostat – testing

1 The thermostat can be tested as follows after it has been removed from the engine as described in Section 8.
2 Hook the thermostat onto a length of wire and lower it into a pan of water.
3 Bring the water to the boil.
4 As the water temperature approaches that of the operating temperature of the thermostat, the thermostat should begin to open and should move over its full length of travel (see Specifications).
5 On removal from the water, as the thermostat cools it should close.
6 If not, renew the thermostat.

10 Water pump – removal and refitting

OHV engine

1 Refer to Chapter 12, loosen the alternator drivebelt, and slip it off the pulleys.
2 Drain the cooling system as described in Section 4.
3 Disconnect and remove the alternator (Chapter 12).
4 Disconnect the inlet and outlet hoses at the pump (photo).
5 Remove the bolts securing the pump to the cylinder block and lift off the pump (photo).
6 Access to the pump impeller can be gained without removing the pump by removing the rear cover (photo).
7 If the clearance between the impeller and the rear cover is not as specified (see Fig. 2.2), the bearings are probably worn, and the pump must be renewed.
8 Refit in reverse order, using new gaskets (photos). Fill the cooling system as described in Section 4 and tension the drivebelt as described in Chapter 12.

OHC engines

9 Proceed as described in paragraphs 1 to 3.

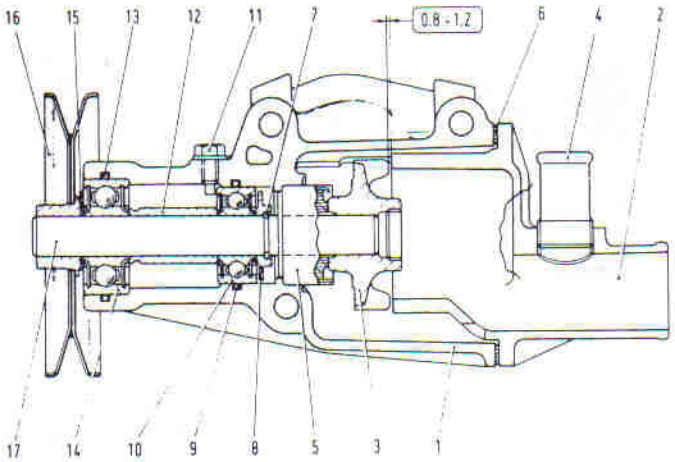


Fig. 2.2 Sectional view of coolant pump on OHV engines (Sec 10)

1 *Pump body*
2 *Pump rear cover*
3 *Impeller*
4 *Outlet connection*
5 *Shaft seal*
6 *Gasket*
7 *Circlip*
8 *Bearing shoulder washer*
9 *Inner seal*
10 *Inner bearing*
11 *Bearing location bolt*
12 *Bearing spacer*
13 *Outer seal*
14 *Outer bearing*
15 *Lock washer*
16 *Pulley*
17 *Pump shaft*

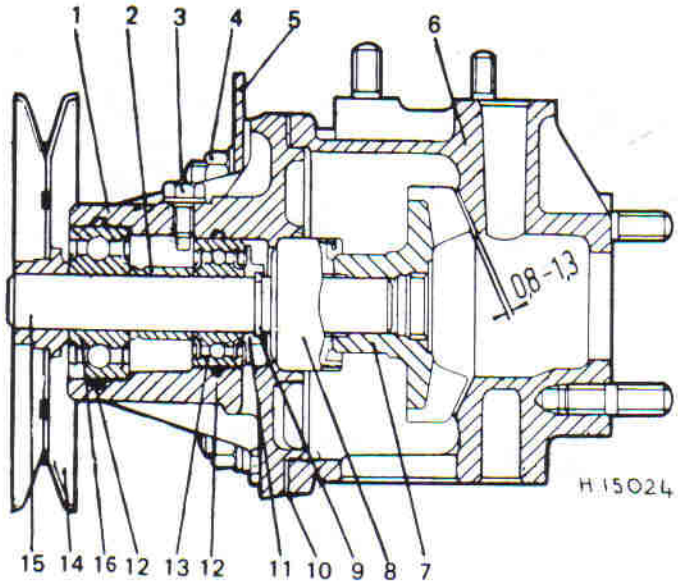
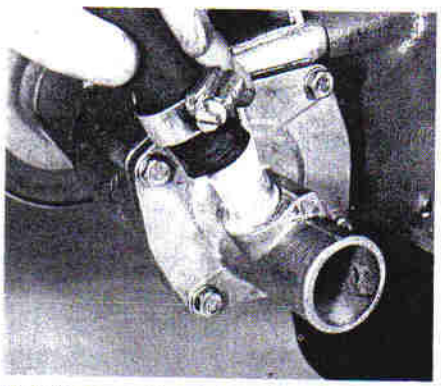


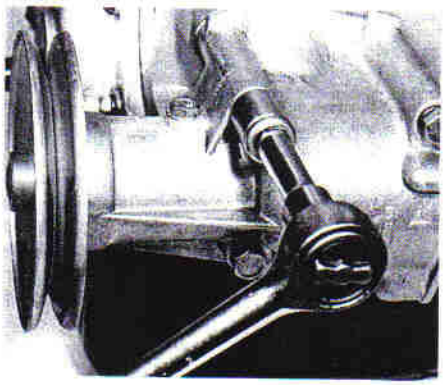
Fig. 2.3 Sectional view of coolant pump on OHC engines (Sec 10)

1 *Pump body*
2 *Bearing spacer*
3 *Bearing locating bolt*
4 *Retaining nuts*
5 *Bracket*
6 *End cover*
7 *Impeller*
8 *Shaft seal*
9 *Circlip*
10 *Gasket*
11 *Shoulder washer*
12 *Seal*
13 *Inner bearing*
14 *Pulley*
15 *Shaft*
16 *Outer bearing*

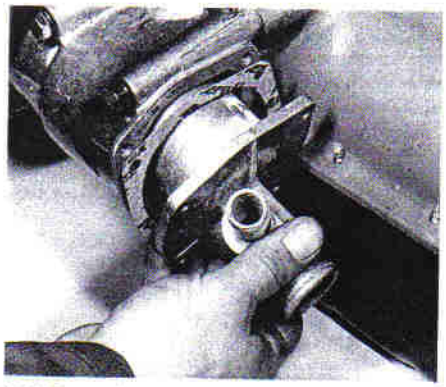
10 Disconnect the heater hose from the outlet pipe on the pump.
11 Remove the bolts and disconnect the coolant transfer pipe (photo).
12 Remove the bolts securing the pump to the cylinder block and lift off the pump. Note the alternator adjustment bracket under the bolts (photo).
13 The clearance between the impeller and the pump body can be measured using a feeler gauge (photo).
14 If it is not as specified, the pump should be renewed as the bearings are probably worn.
15 The pump halves can be separated by removing the bolts, noting the lifting eye under one of the bolts (photo).
16 Reassembly and refitting of the pump are a reversal of removal, using new gaskets (photos).
17 On completion fill the cooling system as described in Section 4 and tension the drivebelt as described in Chapter 12.



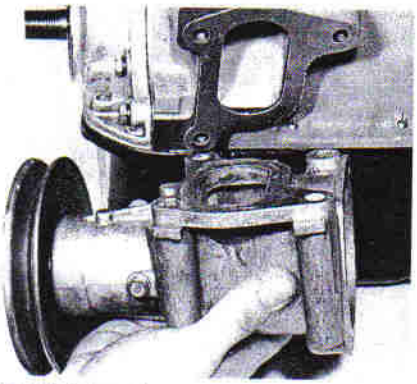
10.4 Disconnect the inlet and outlet hoses



10.5 Remove the bolts

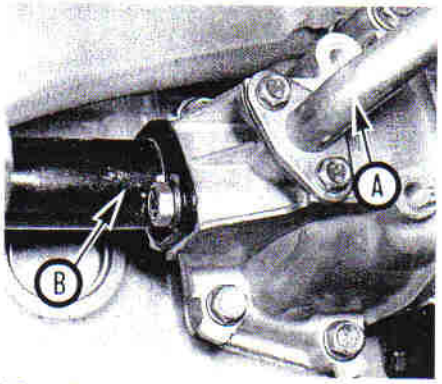


10.6 Removing the rear cover, pump in-situ

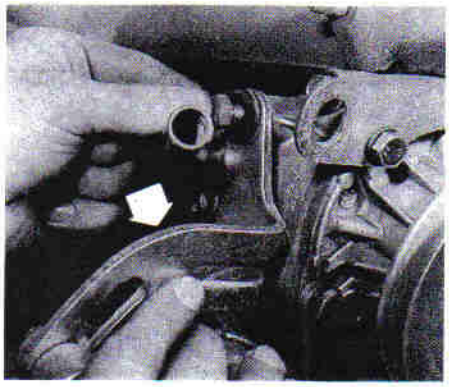


10.8A Refitting the pump using a new gasket

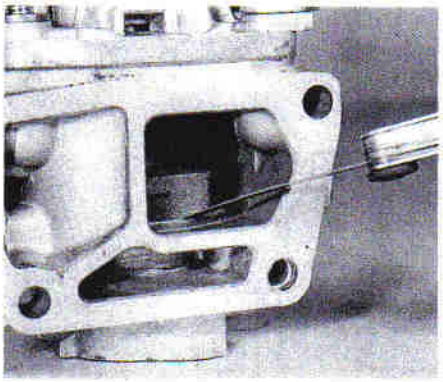
10.8B Rear cover gasket



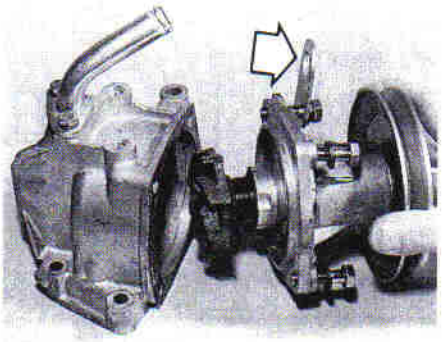
10.11 Coolant transfer pipe connection (B) and heater hose outlet (A)



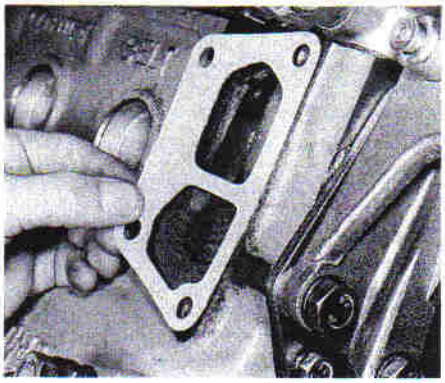
10.12 Removing the pump securing bolts (alternator bracket arrowed)



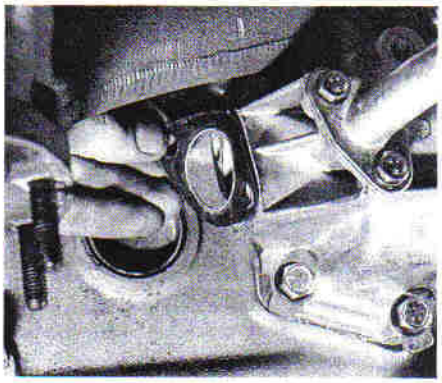
10.13 Measuring impeller-to-pump body clearance



10.15 Separating the pump halves (lifting eye arrowed)



10.16A Fitting the pump gasket



10.16B Transfer pipe gasket

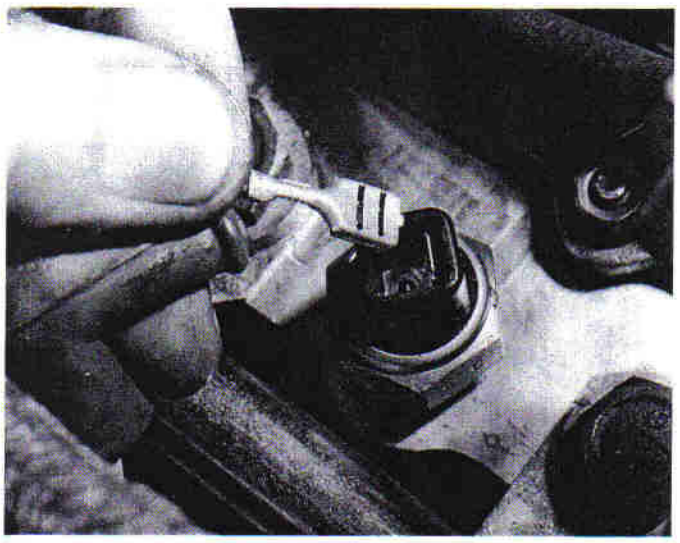
11 Coolant temperature sender – removal and refitting

1 A coolant temperature sender is fitted to all models and relays the coolant temperature to the gauge in the instrument panel.
2 The sender is screwed into the cylinder head above No 1 cylinder spark plug on OHV engines, and above No 2 cylinder spark plug on OHC engines (photos).
3 To remove the sender, pull back the rubber cover, disconnect the lead and unscrew the sender from the cylinder head.
4 Refit in reverse order, using sealant on the sender threads as a precaution against leakage.

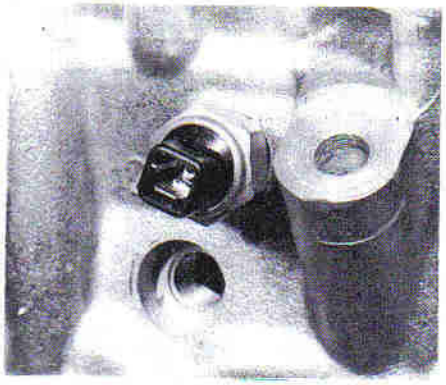
12 Heater – removal and refitting

Note: *The heater assembly is the same on all models, the only difference being in the heater hose connections to the engine. The procedure given here is applicable to all models. If it has been proven by fault diagnosis that the water valve is faulty, it can be removed without removing the heater matrix by disconnecting the valve and unbolting it from the side of the matrix.*

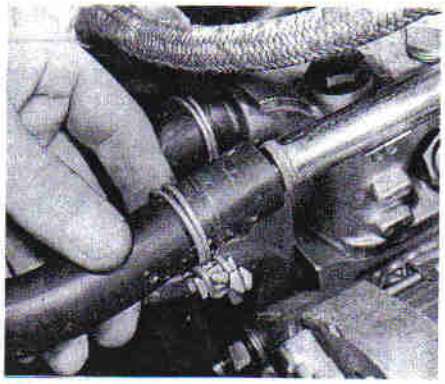
1 Drain the cooling system as described in Section 4.
2 Disconnect the heater hoses at the engine connections (photos).
3 Remove the nut and bolt from the heater water valve-to-flap control arm (photo).
4 Pull out the plastic plugs and remove the air inlet duct cover (photo).
5 Remove the bolt accessible from inside the duct (photo).
6 Disconnect the air inlet flap cable.
7 Prise open the spring clips and lift off the air inlet duct (photo).
8 Disconnect the control cable from the water valve on the side of the heater assembly.
9 Lift out the heater matrix and water valve (photos).
10 Feed the flap control cable through the fan housing (photo).
11 Disconnect the fan lead connections (photo).
12 Remove the nuts securing the fan casing to the bulkhead, noting the earth lead under the outboard nut (photos).
13 The fan can be removed from the casing by undoing the spring clips (photos).
14 The heater assembly is now stripped for cleaning, flushing or repair to the matrix or fan motor.
15 Refitting is a reversal of removal, adjusting the cables so that the flaps and water valve operate over their full range of movement and in the correct sense.
16 Fill the cooling system as described in Section 4.



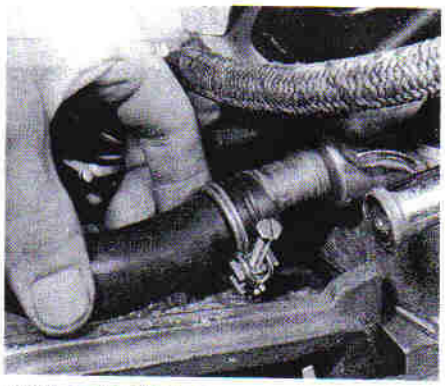
11.2A Temperature sender on OHV engine ...



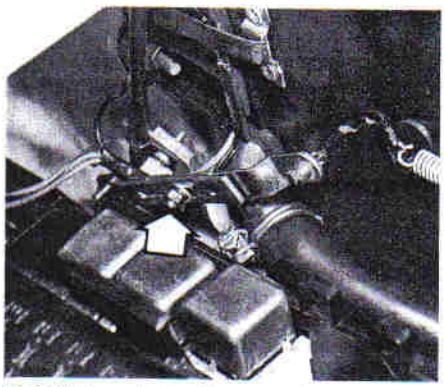
11.2B ... and on OHC engines



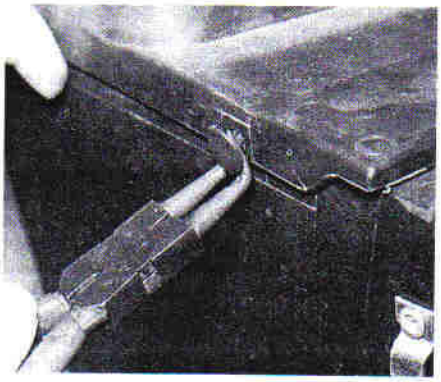
12.2A Disconnecting the heater inlet hose



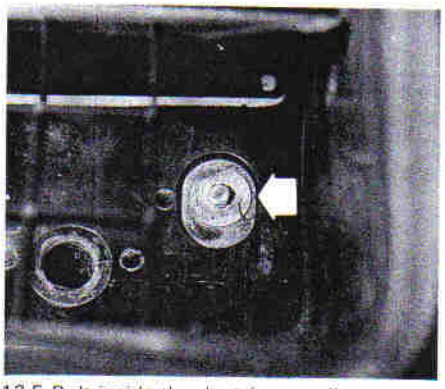
12.2B and outlet hose



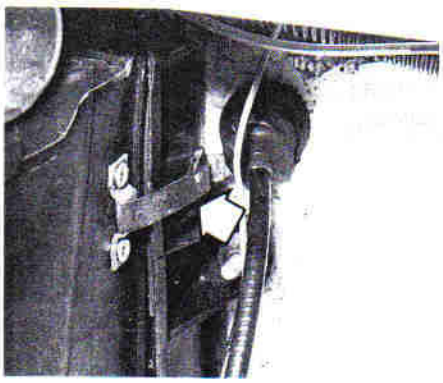
12.3 Water valve-to-flap control arm bolt (arrowed)



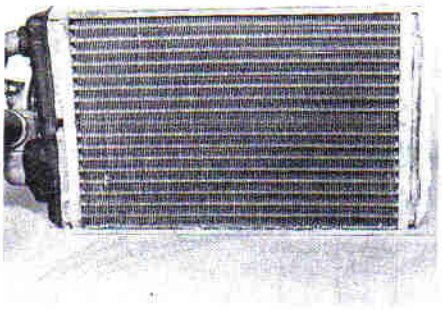
12.4 Removing a plastic plug from inlet duct cover



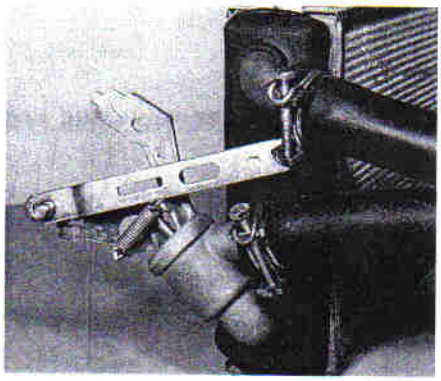
12.5 Bolt inside the duct (arrowed)



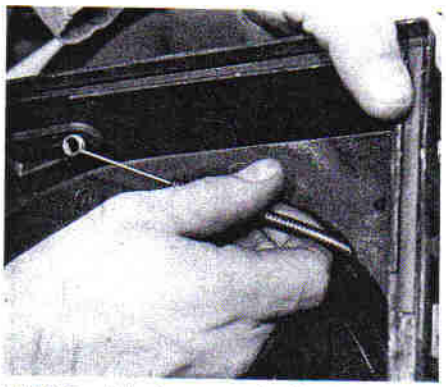
12.7 Air inlet duct spring clip (arrowed)



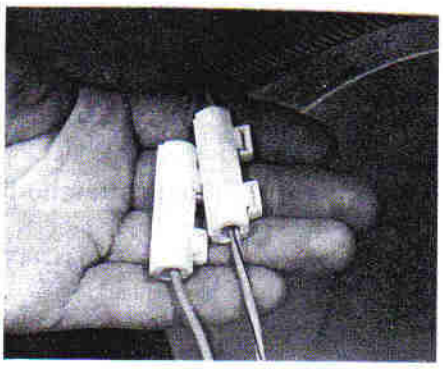
12.9A Heater matrix ...



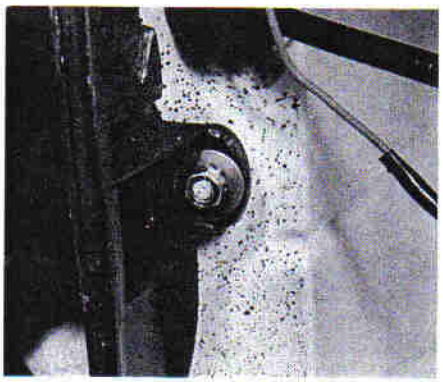
12.9B ... and water valve



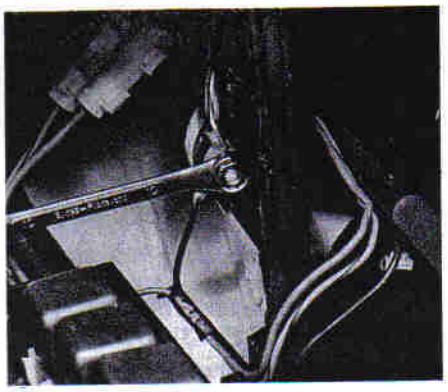
12.10 Feed the flap control cable through the fan housing



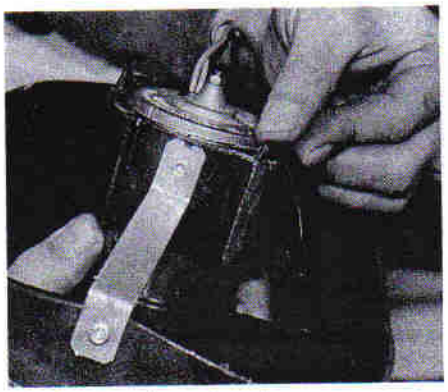
12.11 Fan lead connections



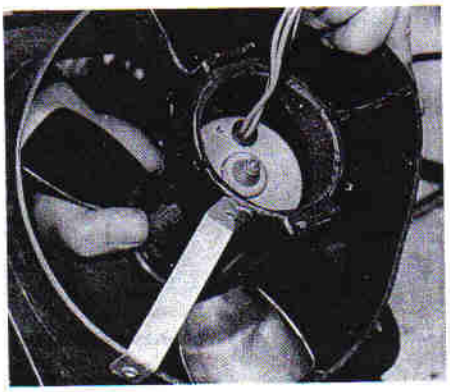
12.12A Fan casing securing nut



12.12B Note the earth lead under the outer nut



12.13A Undo the spring clips ...



12.13B ... and withdraw the fan

13 Heater controls and cables – removal, refitting and adjustment

1 The heater control functions are as follows:

Upper lever – fresh air entry (upper and lower flap)
Centre lever – water valve (heating)
Lower lever – air direction flap inside vehicle (up or down)

2 To renew the fresh air entry control cable, the heater assembly must be partially dismantled as described in Section 12 to disconnect the heater end of the cable.

3 To disconnect the control lever ends, first remove the centre console as described in Chapter 11.

4 Pull off the lever buttons (photo).

5 Remove the screws securing the heater console to the facia.

6 Pull the console forward as far as possible to gain access to the cables and levers.

7 Remove the screws securing the cable clamps to the lever frame, remove the clamps and unhook the cable ends from the levers (photo).

8 Refitting of the cables is a reverse of the removal procedure, adjusting the cable outer sheaths in the cable clamps so that the control flaps and levers operate over their full range of movement and in the correct sense.

9 To renew the heater illumination bulb, pull out the bulbholder. The bulb is a push fit (photo).

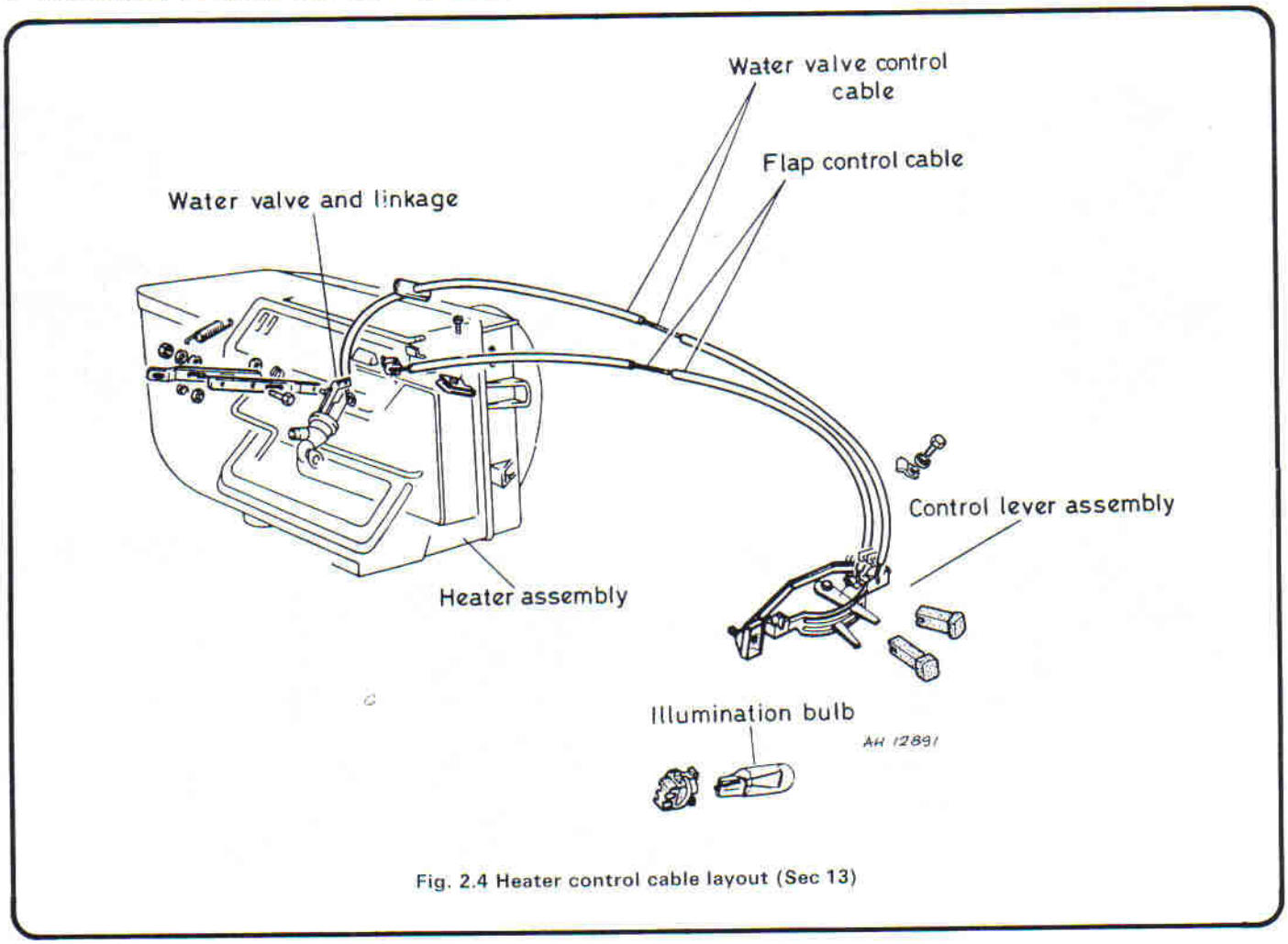
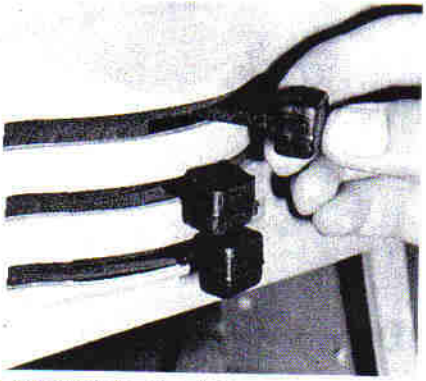
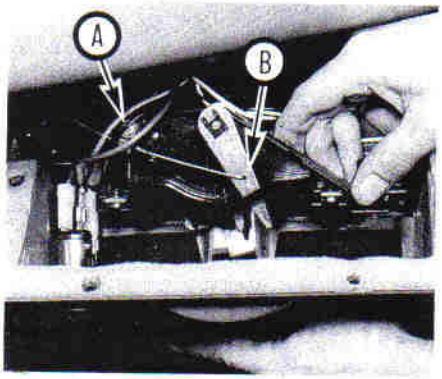


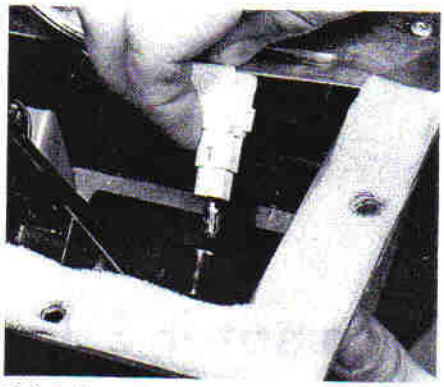
Fig. 2.4 Heater control cable layout (Sec 13)



13.4 Pull off the lever buttons



13.7 Cable clamp securing screw (A) and cable end (B)



13.9 Pull out the bulbholder

14 Fault diagnosis – cooling and heating

Symptom	Reason(s)
Overheating	Insufficient coolant in system Pump ineffective due to slack drivebelt Radiator blocked either internally or externally Kinked or collapsed hose causing coolant flow restriction Thermostat not working properly Engine out of tune Ignition timing retarded or auto advance malfunction Cylinder head gasket blown Engine not yet run-in Exhaust system partially blocked Engine oil level too low Brakes binding
Engine running too cool	Faulty, incorrect or missing thermostat
Loss of coolant	Loose hose clips Hoses perished or leaking Radiator leaking Filler/pressure cap defective Blown cylinder head gasket Cracked cylinder block or head
Heater gives insufficient output	Engine overcooled (see above) Heater matrix blocked Heater controls maladjusted or broken Water valve jammed or otherwise defective

Chapter 3 Fuel and exhaust systems

For modifications, and information applicable to later models, see Supplement at end of manual

Contents

Specifications

General

System type	Rear mounted fuel tank, mechanical pump, single or twin barrel downdraught carburettor with manual choke
Fuel octane rating	4-star (minimum 97 RON)*

**Unleaded fuel may be used following an adjustment to the ignition timing – see Chapter 13*

Engine idle speed (all models)

800 to 850 rpm

CO content at idle

Single barrel carburettors	0.1 to 2.0%
Twin barrel carburettors:	
With manual choke	1.0 to 2.0%
With automatic choke	0.5 to 1.5%

Fuel tank

Capacity:	
3/4/5 series models	38 litres (8.4 gal)
45/55/65 models	30 litres (6.6 gal)

Air cleaner element

Champion W107

Carburettor calibration (all dimensions in mm)

IPM 32 MGV 10

Application	311, 411 and 511 models
Venturi	21.00
Auxiliary venturi	3.50
Main jet	1.17
Idle jet	0.50
Main air correction jet	1.90
Idle air correction jet	1.60
Accelerator pump jet	0.40
Power jet	1.10
Power air correction jet	1.40
Power mixture orifice	2.00
Needle valve seat	1.50
Emulsion tube	F73
Recirculation hole	1.00

IPM 32 MGV 22

Application	413 and 513 models
Venturi	24.00
Auxiliary venturi	3.50
Main jet	1.22
Idle jet	0.50
Main air correction jet	1.55
Idle air correction jet	1.40
Accelerator pump jet	0.40
Power jet	1.50
Power air correction jet	1.40
Power mixture orifice	2.00
Needle valve seat	1.50
Emulsion tube	F73
Recirculation hole	1.00

IPM 32 MGV 31 (Weber 32 ICEV 31)

Application	45 models
Venturi	22.00
Auxiliary venturi	3.50
Main jet	1.12
Idle jet	0.47
Main air correction jet	1.60
Idle air correction jet	1.10
Accelerator pump jet	0.40
Power jet	1.30
Power air correction jet	1.40
Power mixture orifice	2.00
Needle valve seat	1.50
Emulsion tube	F86
Recirculation hole	1.00

IPM 32 MGV 21

Application	55 models
Venturi	21.00
Auxiliary venturi	3.50
Main jet	1.12
Idle jet	0.47
Main air correction jet	1.90
Idle air correction jet	1.30
Accelerator pump jet	0.40
Power jet	1.10
Power air correction jet	1.40
Power mixture orifice	2.50
Needle valve seat	1.50
Emulsion tube	F73
Recirculation hole	1.00

IPM 32 MGV 34 (Weber 32 ICEV 50/250)

Application	45A models
Venturi	22.00
Auxiliary venturi	3.50
Main jet	1.12
Idle jet	0.47
Main air correction jet	1.70
Idle air correction jet	1.60
Accelerator pump jet	0.40
Power jet	0.80
Power mixture orifice	2.50
Needle valve seat	1.50
Emulsion tube	F89
Recirculation hole	1.20

IPM 32 MGV 12 (Weber 32 ICEV 51/250)

Application	55A, 311 and 511 models
Venturi	22.00
Auxiliary venturi	3.50
Main jet	1.15
Idle jet	0.47
Main air correction jet	1.90
Idle air correction jet	1.55
Accelerator pump jet	0.40
Power jet	0.90
Power mixture orifice	2.50
Needle valve seat	1.50
Emulsion tube	F74
Recirculation hole	1.00

Weber 30/32 DMTR

	65A and 513 models	
Application	**1st barrel**	**2nd barrel**
Main jet	0.90	0.95
Main air correction jet	1.85	1.75
Emulsion tube	F43	F38
Idle jet	0.50	0.50
Auxiliary venturi	3.5	5.0
Accelerator pump injector	0.45	-
Float valve seat	1.50	-

Torque wrench settings

	Nm	lbf ft
Exhaust manifold nuts (OHV engine)	20	15
Exhaust and intake manifold nuts (OHC engines)	28	20
Fuel pump nuts	28	20
Carburettor mounting nuts	25	18

1 General description

The fuel system consists of a rear mounted fuel tank, mechanically operated fuel pump and a carburettor with an air cleaner assembly.

A single barrel, downdraught carburettor is fitted to all models except the 65A and 513 models produced from 1988 which have a twin barrel downdraught carburettor. Late 65A models use an automatic choke version; this is covered in Chapter 13 at the end of the manual.

On early models the carburettor incorporates a valve which controls the crankcase breather system, but on later models the system is 'open', and the valve is no longer fitted.

The single barrel carburettor fitted to all models is basically similar although there are minor differences between models. Among these differences are the crankcase breather valve already mentioned, a choke limiter which is either mechanically or vacuum operated, and a vacuum take-off port for the distributor advance. These differences mean that the carburettors have different identification numbers but are still basically the same carburettor.

An IPM carburettor is a Weber carburettor built under licence in Yugoslavia. However, in some instances a genuine Weber may be fitted and where the information was available the Weber equivalent carburettor model number is given in the Specifications. Note, however, that although the Specifications are the same for an IPM and Weber equivalent, when ordering spares it is important to identify which carburettor is fitted.

Carburettors can be identified from the markings on the float chamber bowl on the side of the carburettor.

Note: *Before starting work on any part of the fuel system, disconnect the battery negative terminal as described in Chapter 12.*

2 Routine maintenance

At the intervals given in the *'Routine maintenance'* Section at the beginning of this manual carry out the following:

Check and if necessary adjust the engine idle speed and CO mixture (Section 10 or 14 as applicable)
Renew the air cleaner element (Section 3)
Check and if necessary clean the positive crankcase ventilation system (Section 21)
Check the tightness of the inlet and exhaust manifold securing nuts (Section 22)
Additionally, check all fuel lines and hoses periodically for leaks and security
Periodically clean the fuel filters in the fuel pump, fuel tank and carburettor (Section 20)

3 Air cleaner element – renewal

1 The air cleaner element must be renewed at the intervals laid down in the *'Routine maintenance'* Section.

2 However, if during the course of other servicing work the element is removed for access it is beneficial to give it a blow through using compressed air, or put a vacuum cleaner hose over it.

OHV engine

3 Undo the wingnuts (photo).

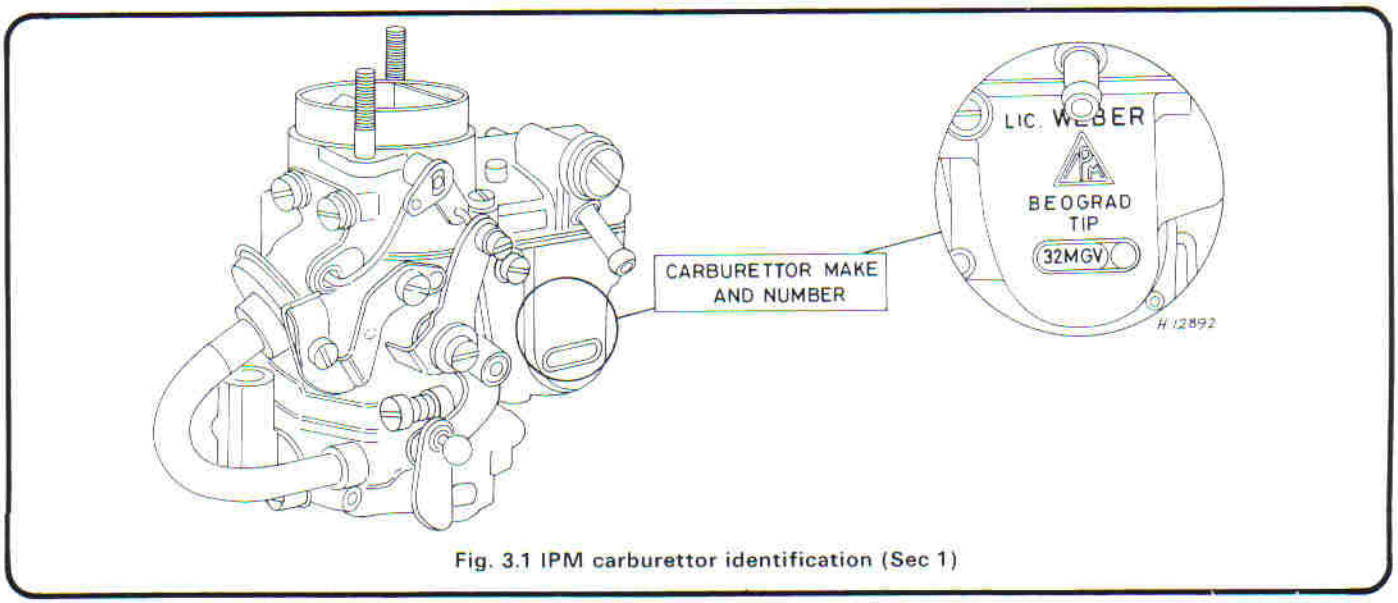
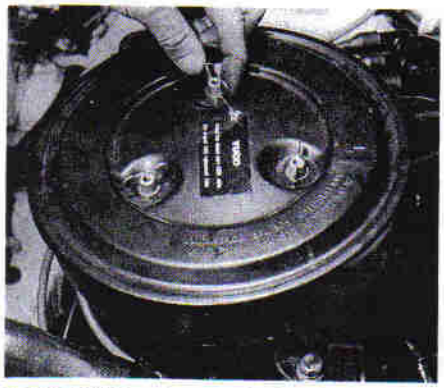
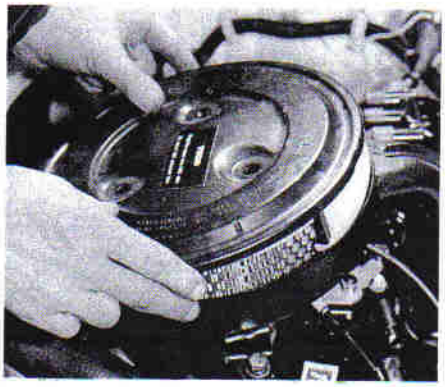


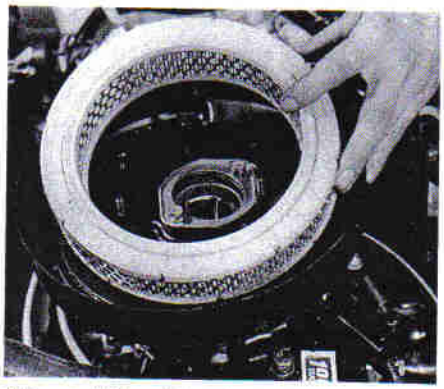
Fig. 3.1 IPM carburettor identification (Sec 1)



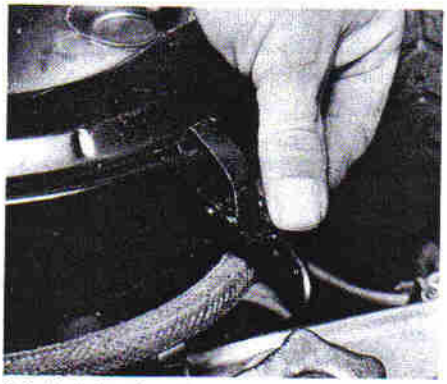
3.3 On OHV engines undo the wingnuts ...



3.4 ... lift off the top cover ...



3.5 ... and lift out the element



3.6 Undoing the clips on type A air cleaner – OHC engine

3.8 OHC engine type B air cleaner cover is secured by wingnuts – note the washers under them

4 Lift off the top cover (photo).
5 Lift out the element (photo).

OHC engines (type A)

6 Undo the clips on the side of the housing (photo).
7 Lift off the cover and lift out the element.

OHC engines (type B)

8 Undo the wingnuts on the top of the cover, noting the washers under them (photo).
9 Lift off the cover.
10 Lift out the element.

All engines

11 Refit in reverse order.

4 Air cleaner housing – removal and refitting

1 Remove the air cleaner element as described in Section 3.

OHV engine

2 Remove the nuts from the carburettor flange (photo).
3 Lift off the flange (photo).
4 Raise the housing from the carburettor and disconnect the crankcase and carburettor breather pipes underneath (photo).
5 Renew the flange seal if it is perished.

OHC engines (single barrel downdraught carburettor)

6 The procedure is similar to that for OHV engines, but also undo the nut on the support bracket on the valve cover (photo).

OHC engines (twin barrel downdraught carburettor)

7 The procedure is as described for single barrel carburettors, but the carburettor flange is held by four nuts (photo).

All engines

8 Refit in reverse order ensuring that the summer/winter lever is in the applicable position.

5 Choke cable – removal and refitting

OHV engine

1 Remove the air cleaner housing as described in Section 4.
2 Undo the lockbolt clamping the cable end to the choke lever on the carburettor (photo).
3 Withdraw the cable from the bracket on the carburettor and the choke lever.
4 Reach behind the lower steering wheel panel, depress the two clips on the back of the choke knob assembly and withdraw the cable into the vehicle (photo).

OHC engines

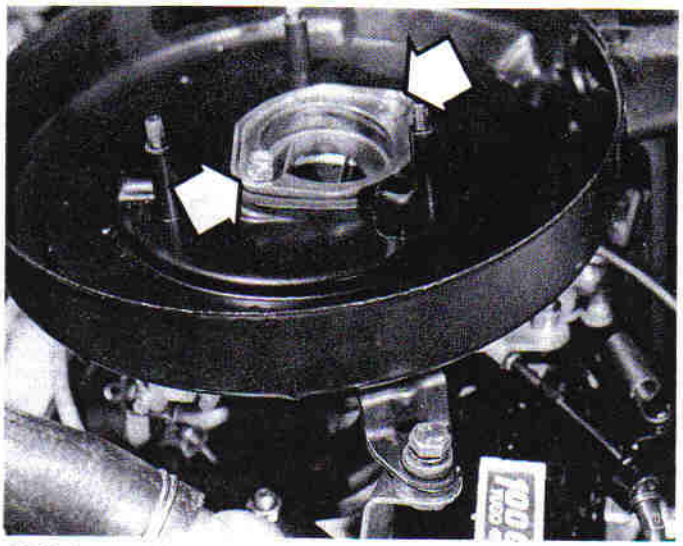
5 The procedure is as for OHV engines, but the inner cable is secured by a lockbolt, and the outer sheath is retained by a clamp (photo).
6 Note also that on some models the choke control knob is clipped into the heater control panel and not the steering column panel.

All engines

7 Refitting is a reversal of removal, but do not tighten the cable lockbolt on the choke lever until the choke control knob has been pulled out by 2 to 3 mm (0.08 to 0.12 in) and the choke valve is fully open. This will ensure that the choke valve is fully open when the choke knob is pushed in.

6 Accelerator pedal – removal and refitting

1 Disconnect the accelerator cable or link from the top of the accelerator pedal (photo).
2 Remove the two nuts from the pivot bracket on the engine bulkhead and lift off the pedal (photo).
3 Refit in the reverse order.

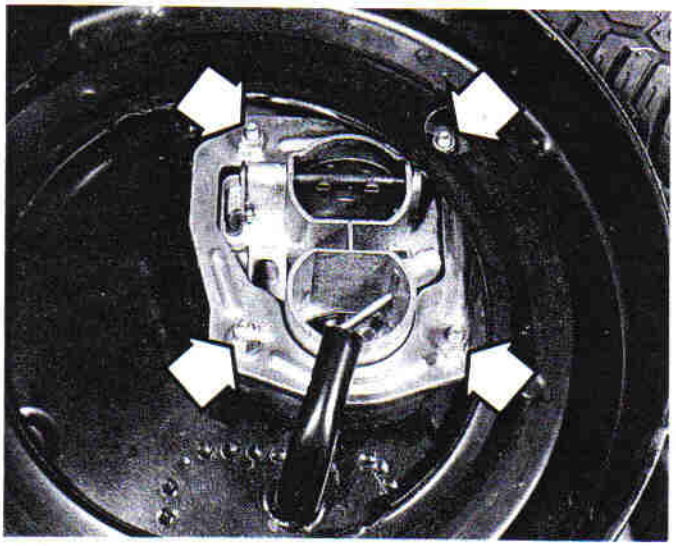


4.2 Carburettor flange nuts (arrowed) on OHV engine

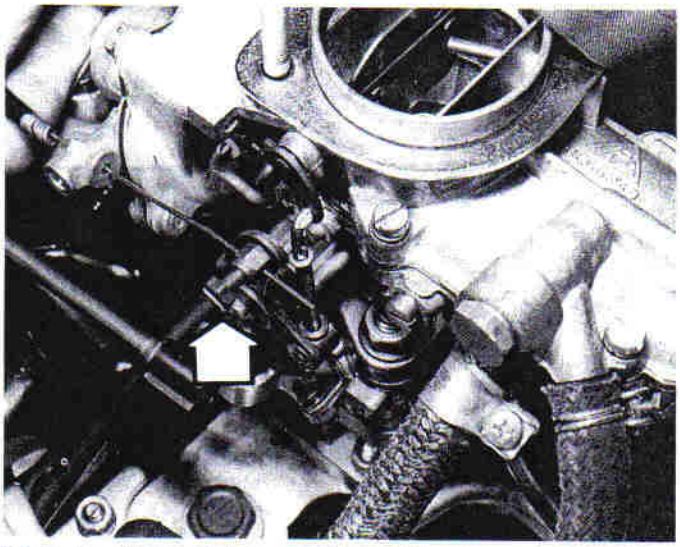
4.3 Lift off the flange ...

4.4 ... and disconnect the breather pipes

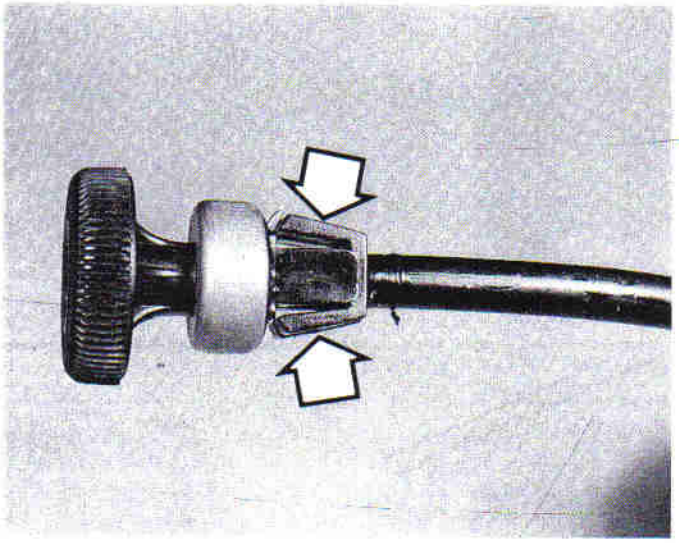
4.6 Support bracket nut (arrowed) on valve cover – OHC engines



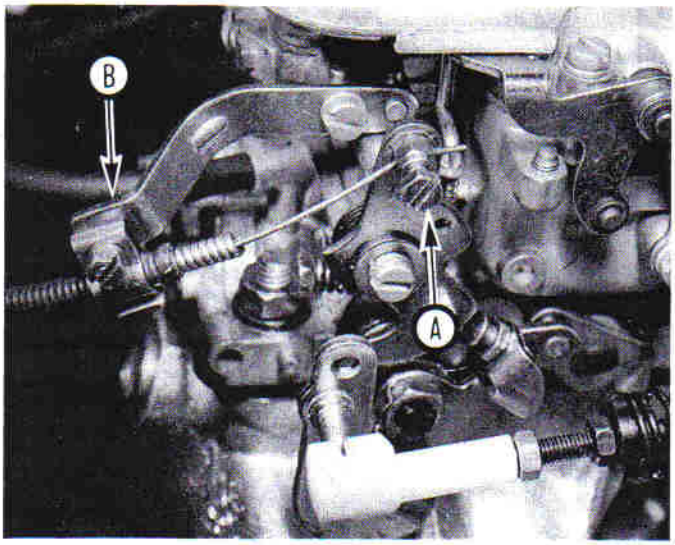
4.7 Carburettor flange nuts (arrowed) on twin barrel carburettor



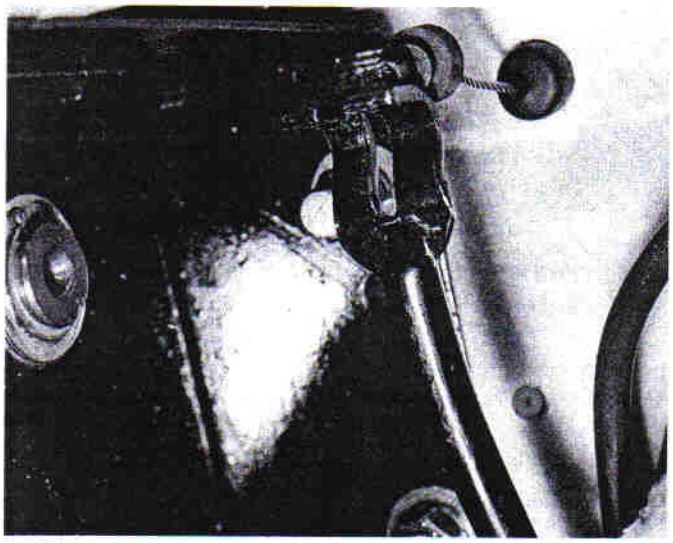
5.2 Choke cable lockbolt (arrowed) – OHV engine



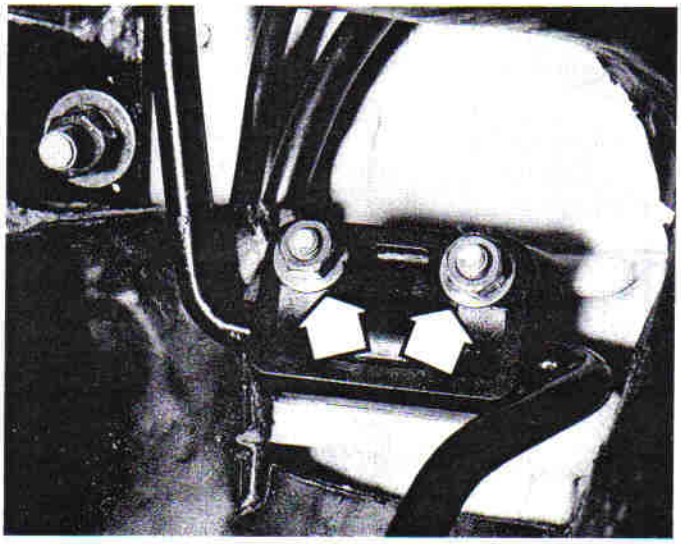
5.4 Choke cable removed showing the clips (arrowed) which must be depressed



5.5 Choke inner cable lockbolt (A) and outer sheath clamp (B) – OHC engines



6.1 Disconnecting the accelerator cable from the fork end at the top of the pedal



6.2 Pedal pivot bracket nuts (arrowed)

7 Accelerator cable and linkage – removal and refitting

OHV engine (cable type)

1 Remove the air cleaner housing as described in Section 4.
2 Pull the nylon end fitting off the balljoint on the bellcrank assembly (photo).
3 Release the cable from the bracket on the valve cover (photo).
4 Unhook the cable from the fork end at the top of the accelerator pedal.
5 Withdraw the cable into the engine bay.
6 Refit the cable in reverse order, ensuring the grommet fits correctly in the hole where the cable passes through the bulkhead.
7 To remove the bellcrank assembly from the valve cover, first remove the clip from the throttle lever end fitting and pull off the link rod (photo).
8 Unhook the return spring from the bellcrank (photo).
9 Disconnect the accelerator cable as previously described.
10 Prise off the circlip from the bellcrank pivot and lift off the bellcrank.
11 Refit in reverse order, lubricating all pivot points and balljoints with a drop of engine oil.
12 On completion, adjust the accelerator cable by releasing the locknut on the cable end fitting and tensioning the cable so that when the pedal is released the throttle valve is on its closed stop, and when the pedal is fully depressed the throttle valve is fully open.

OHC engines (linkage type – pre-1987)

13 A diagram of the linkage appears in Fig. 3.2. Remove the air cleaner housing as described in Section 4.
14 Removal of all or part of the linkage is achieved by removing the clips over the joint ends and disconnecting the joints.
15 Adjust the linkage by screwing the end fittings in or out so that the throttle lever remains on its stop with the accelerator pedal in its fully released position.

OHC engines (cable type 1987-on)

16 Remove the air cleaner housing as described in Section 4.
17 Prise the nylon end fitting from the balljoint on the throttle lever (photo).
18 Release the cable from the bracket on the valve cover (photo).
19 The remaining procedure is basically as described for OHV engines.

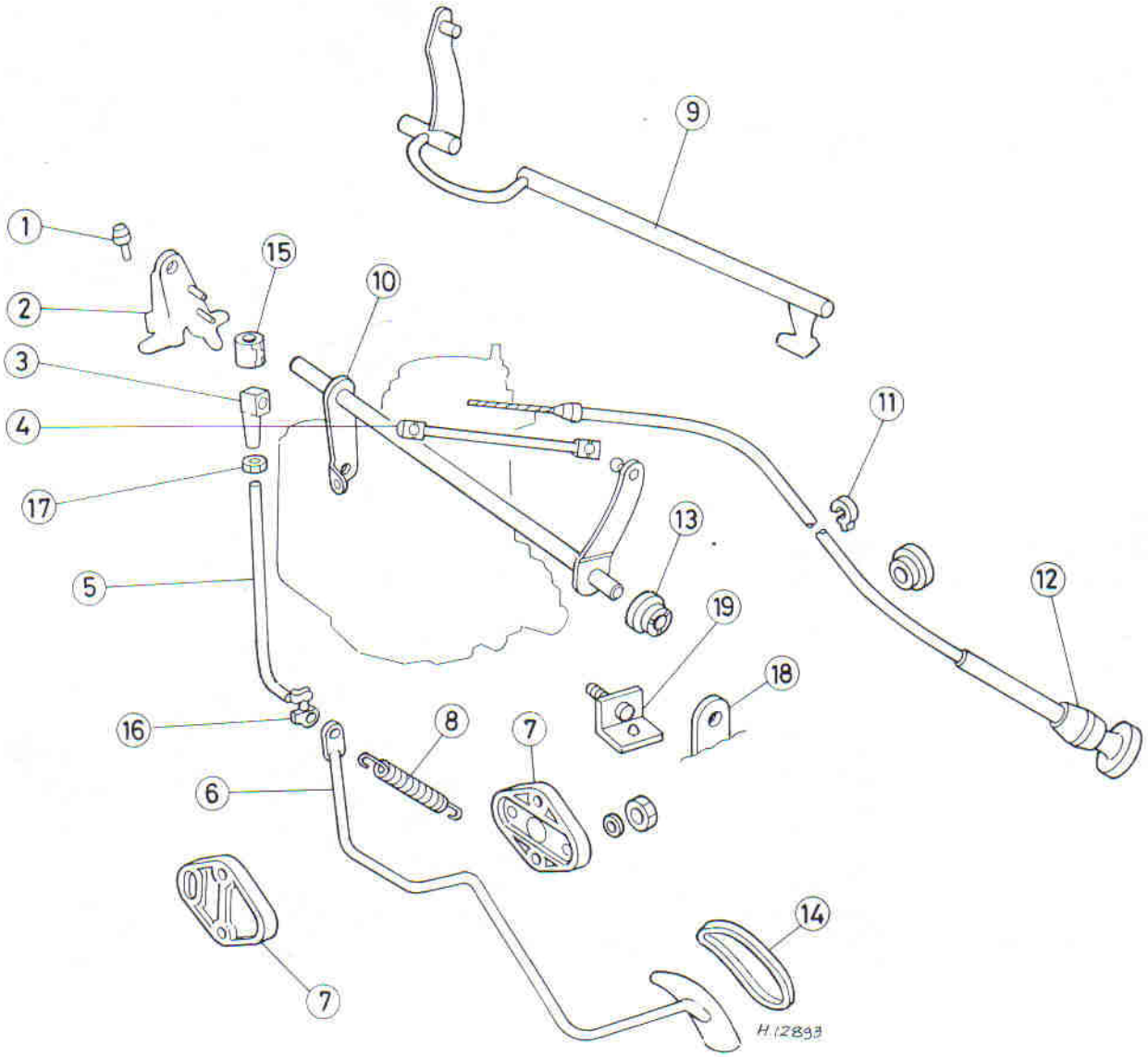
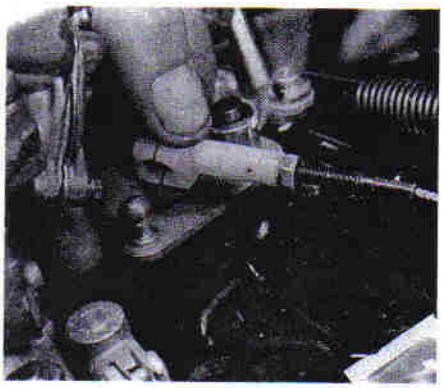


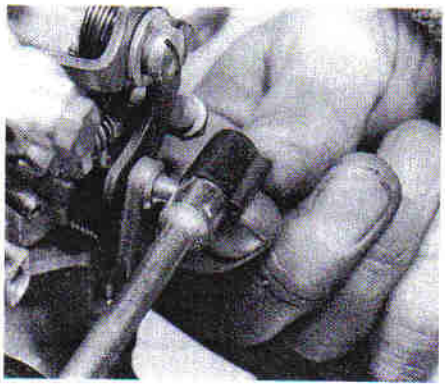
Fig. 3.2 Diagram of early type OHC engine accelerator pedal linkage and choke linkage (Sec 7)

1 Screw
2 Bracket
3 Clip
4 Link rod
5 Link rod
6 Accelerator pedal
7 Mounting brackets
8 Spring
9 Top link (1298 cc and 1301 cc engines)
10 Top link (1116 cc engine)
11 Clip
12 Choke cable
13 Bush
14 Pedal rubber
15 Accelerator link clip
16 Clip
17 Nut
18 Throttle link bracket (part of heat shield)
19 Angle plate

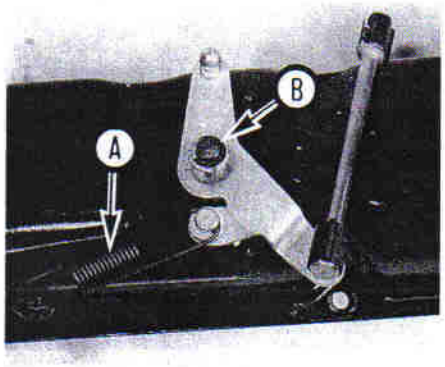


7.2 Pulling off the nylon balljoint end fitting – OHV engine

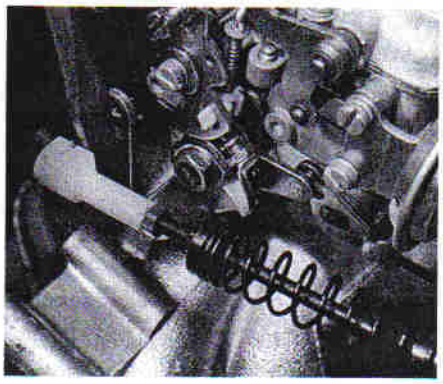
7.3 Releasing the cable from the bracket on the valve cover



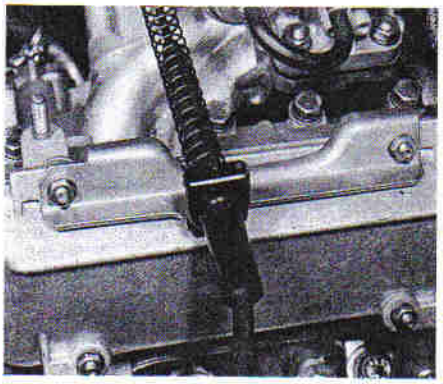
7.7 Removing the clip from the throttle lever end fitting



7.8 Bellcrank assembly showing return spring (A) and pivot post circlip (B)



7.17 Prising off the nylon end fitting from the balljoint on the throttle lever – OHC engines



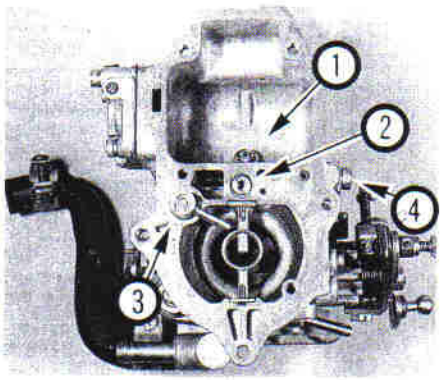
7.18 Cable bracket on valve cover – OHC engines

8 Carburettors – general

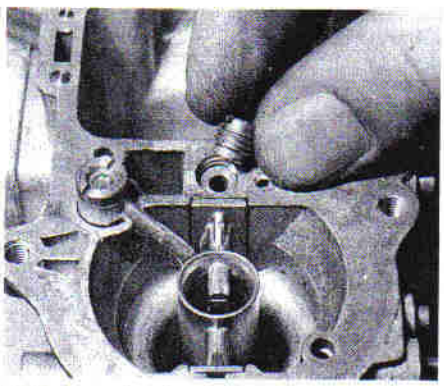
1 The need to completely overhaul a carburettor is rare. A carburettor can normally be kept in good working order if the top cover is removed and the fuel mopped out of the fuel bowl. Individual jets can be removed and blown through. *Never probe them with wire or their calibration will be ruined (photos).*
2 Take the opportunity to check the jet sizes and other components against those listed in the Specifications in case a previous owner has substituted some of incorrect calibration.
3 When the stage is reached where the valve plate spindle bushes have worn, then the carburettor should be renewed complete.
4 When reassembling the carburettor, use new gaskets which can be obtained in a repair pack.

9 Carburettor (IPM 32 MGV) – removal and refitting

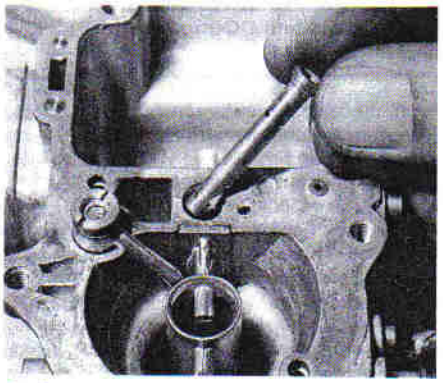
1 Remove the air cleaner housing as described in Section 4.
2 Disconnect the fuel inlet and outlet pipes being careful to avoid spillage and plug their ends (photos).
3 Disconnect the vacuum advance hose, where fitted (photo).
4 Disconnect the accelerator cable or linkage, as applicable, as described in Section 7.
5 Disconnect the choke cable as described in Section 5.
6 Disconnect the carburettor base heater pipes and tie their ends up to avoid coolant loss (photo).
7 Remove the four nuts securing the carburettor to the cylinder head or inlet manifold, as applicable, and lift off the carburettor (photo).
8 Refit in the reverse order, using a new gasket under the carburettor base (photo).



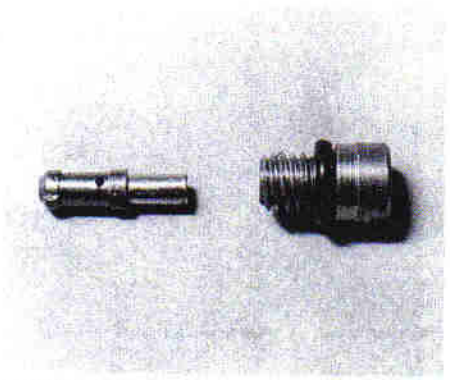
8.1A IPM 32 MGV carburettor jet locations
1 Main jet *3 Accelerator jet*
2 Air bleed jet *4 Idle jet*



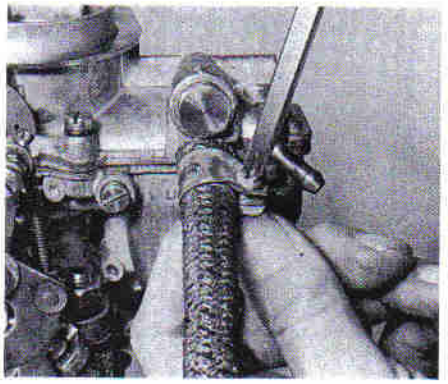
8.1B Removing the air bleed jet ...



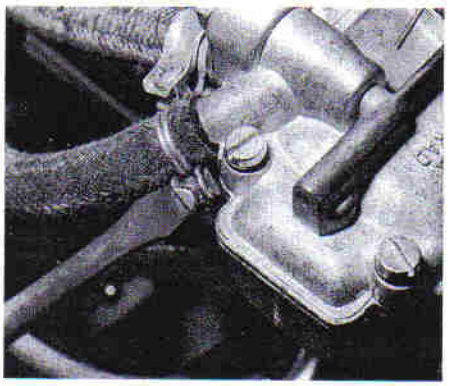
8.1C ... and emulsifier tube – IPM 32 MGV carburettor



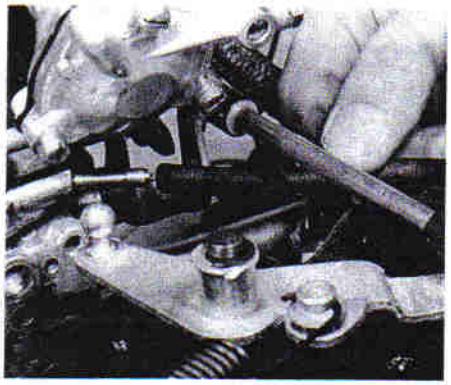
8.1D Idle jet



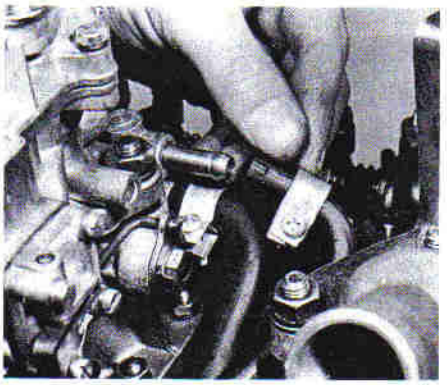
9.2A Disconnect the fuel inlet ...



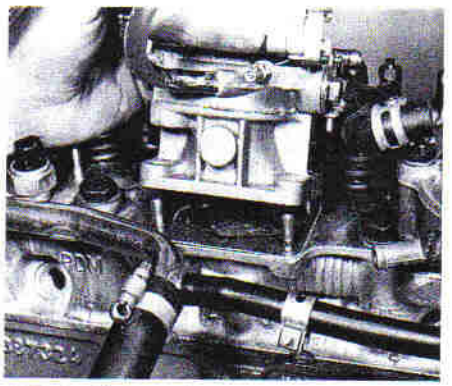
9.2B ... and outlet pipes



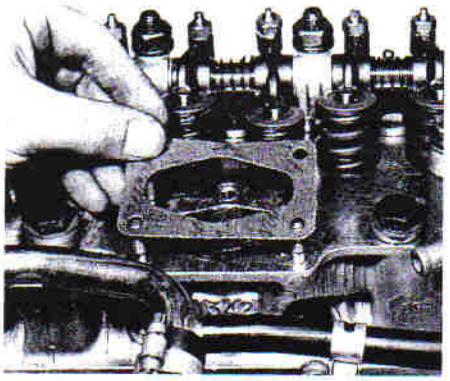
9.3 Disconnect the vacuum advance hose ...



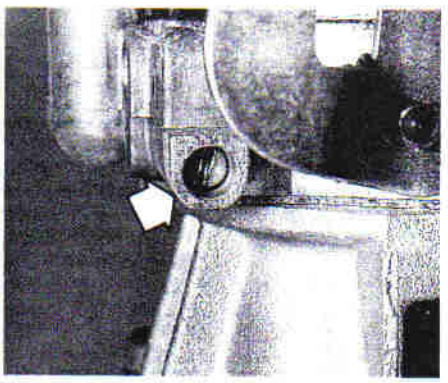
9.6 ... and carburettor base heater pipes



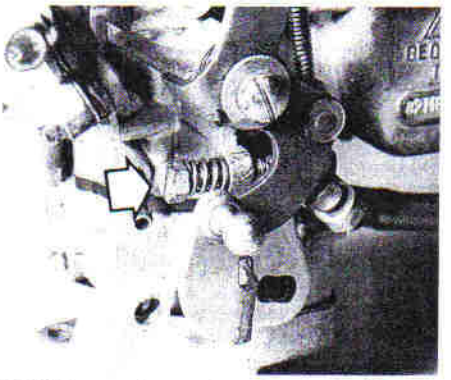
9.7 Lift off the carburettor



9.8 Use a new carburettor base gasket on refitting



10.3 CO mixture screw location on IPM 32 MGV carburettor



10.4 Idle speed screw location on IPM 32 MGV carburettor

10 Idle speed and CO mixture (IPM 32 MGV carburettor) – adjusting

1 All modern vehicles have the exhaust gas CO content set in production to comply with national (or local) anti-pollution laws. The mixture screw is then sealed with a tamperproof plug.
2 Under normal circumstances, only the idle speed need be adjusted to obtain the specified setting.
3 Should it become necessary to adjust the mixture setting, the plug can be prised out and a new plug fitted on completion, but this should only really be done by a dealer who has the necessary exhaust gas analyser equipment to reset the mixture accurately. A rough setting can be achieved by running the engine to normal operating temperature and screwing the mixture screw in to weaken or out to enrich the mixture to the point where the engine runs smoothly without 'hunting' (photo).
4 On completion adjust the idle speed by screwing the idle speed screw in to increase or out to decrease the idle speed (photo).

11 Carburettor (IPM 32 MGV) – overhaul and adjustment

1 The carburettor top cover can be removed for float adjustment without removing the carburettor from the engine. The remaining operations will require its removal.
2 Remove the carburettor top cover securing screws.
3 Lift the top cover and float from the carburettor, twisting the cover to release the choke linkage.

Float adjustment

4 Remove the float by pulling out the float hinge pin and lifting the float and needle valve out (photos).
5 Lift the needle valve from the float and check that it is free to move in its seat. Renew the valve if it sticks.
6 Shake the float and check that there is no fuel inside it, indicating a punctured float. Renew if necessary.
7 Use a socket to unscrew the needle valve seat from the top cover (photo).

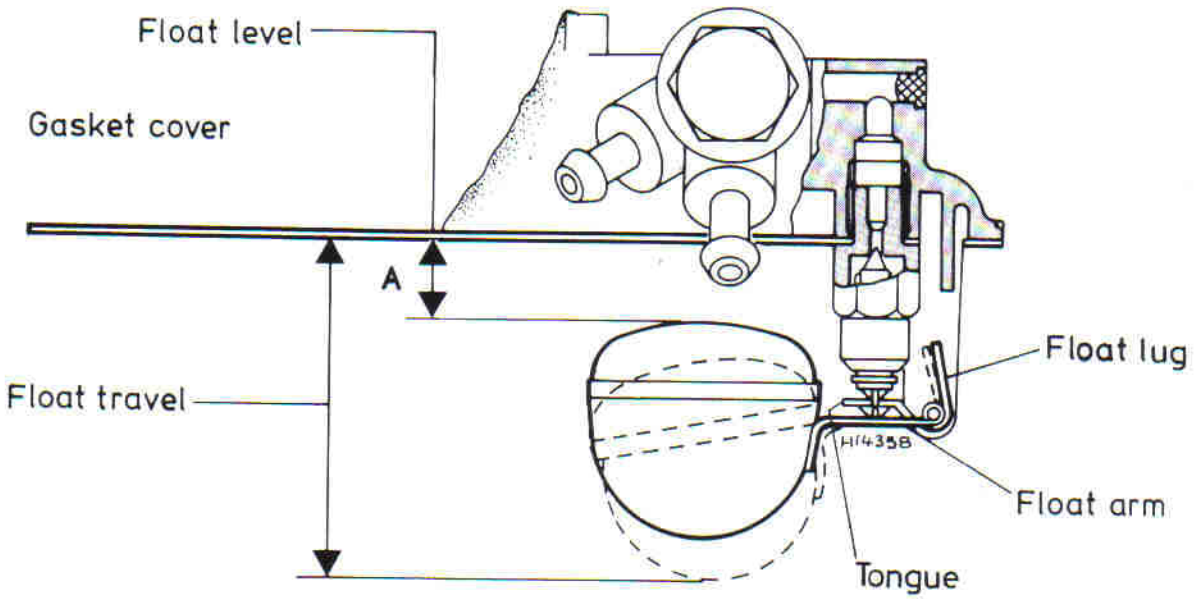


Fig. 3.3 Float setting diagram for IPM 32 MGV carburettor (Sec 11)

Float height A = 10.5 to 11.0 mm (0.41 to 0.44 in) *Float travel = 44.5 to 45.5 mm (1.75 to 1.79 in)*

8 Blow through the inlet orifice and valve seat, then refit using a new seal under the valve seat.
9 Refit the float, ensuring that the needle valve is hooked onto the float (photo).
10 Turn the cover on its side so that the float hangs down and is lightly contacting the needle valve, but not enough to depress the needle valve ball.
11 Measure the float height which should be as specified (see Fig. 3.3).
12 Adjust by bending the float tongue.
13 Now hold the cover horizontally allowing the float to hang down, and measure the float travel which should be as specified.
14 Adjust by bending the lug.

Accelerator pump

15 Remove the nut from the end of the control rod (photo).
16 Undo the screws securing the accelerator pump cover to the carburettor and lift off the cover, diaphragm and spring.
17 Inspect the diagphragm for splitting or cracks and renew as necessary.
18 Remove the accelerator jet and blow through the delivery orifice. Refit the jet.
19 Refit the diaphragm and cover.
20 Open the throttle valve through 3.5 mm (0.14 in) using a twist drill as a gauge.
21 Turn the nut on the end of the control rod until the lever just contacts the diaphragm operating rod.

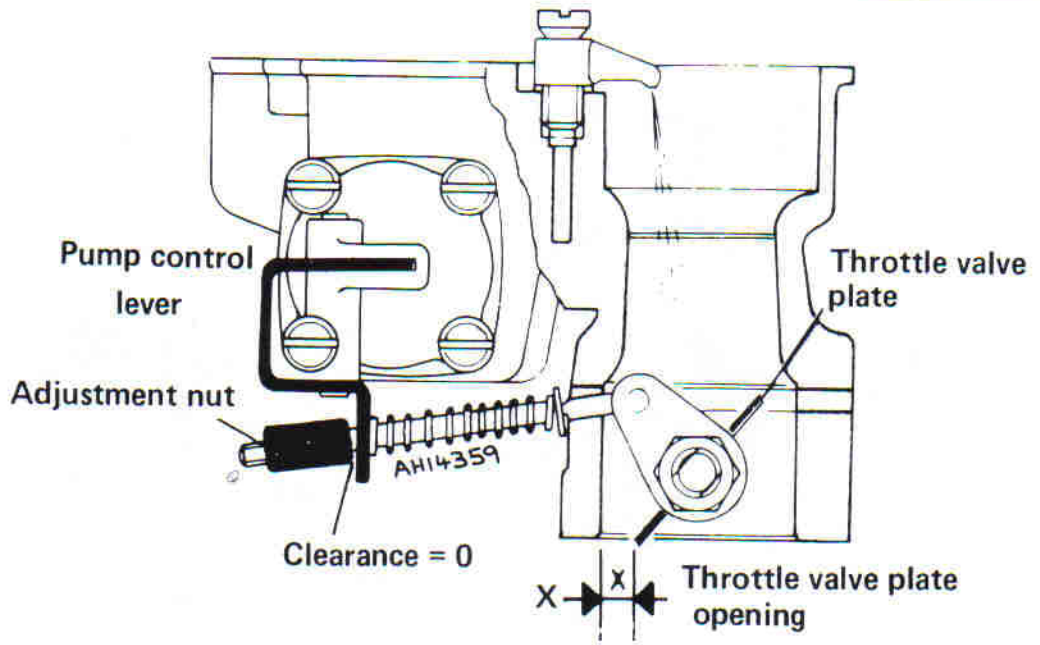


Fig. 3.4 Accelerator pump setting diagram for IPM 32 MGV carburettor (Sec 11)

X = 3.5 mm (0.14 in)

Fast idle adjustment

22 Close the choke valve by means of the choke lever.
23 In this position the throttle valve should be open by the specified amount (see Fig. 3.5). Use a twist drill of suitable size to measure the gap.
24 Adjust by screwing the fast idle screw in or out as necessary (photo).

Choke limiter

25 The choke limiter may be either vacuum or mechanically controlled.
26 Its purpose is to prevent the choke valve closing completely and causing flooding of the engine.
27 To inspect the diaphragm for splits, remove the screws from the cover and lift off the cover and diaphragm.
28 To adjust the choke valve gap, close the choke valve by means of the choke lever.
29 Push the vacuum device operating rod outwards to simulate vacuum.
30 In this position the gap between the choke valve edge and the carburettor wall should be as specified – see Fig. 3.6 (photo).
31 Adjust by bending the link rod between the choke and valve lever and the vacuum device operating rod (photo).

Jets

32 The jets are accessible after removing the carburettor top cover.
33 Refer to Section 8 for removal and cleaning.

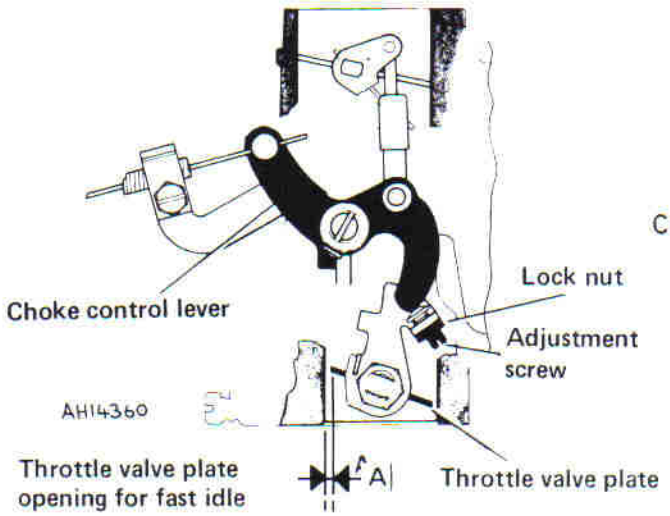


Fig. 3.5 Fast idle setting diagram for IPM 32 MGV carburettor (Sec 11)

A = 0.75 to 0.80 mm (0.030 to 0.032 in)

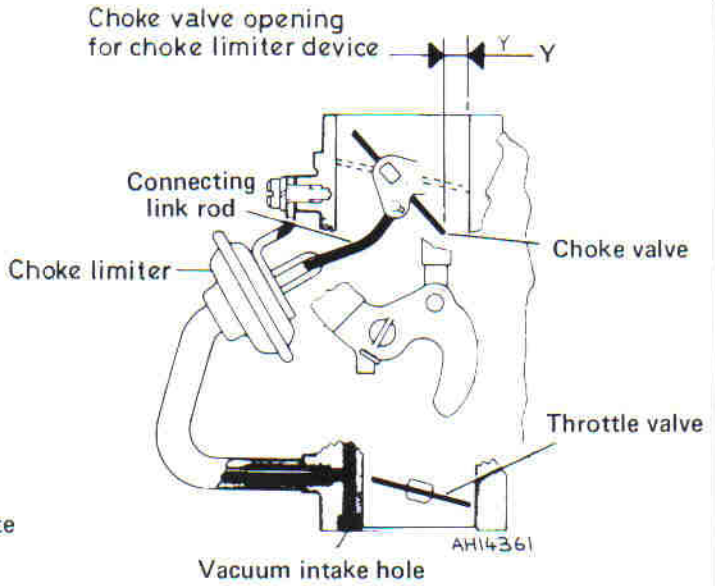
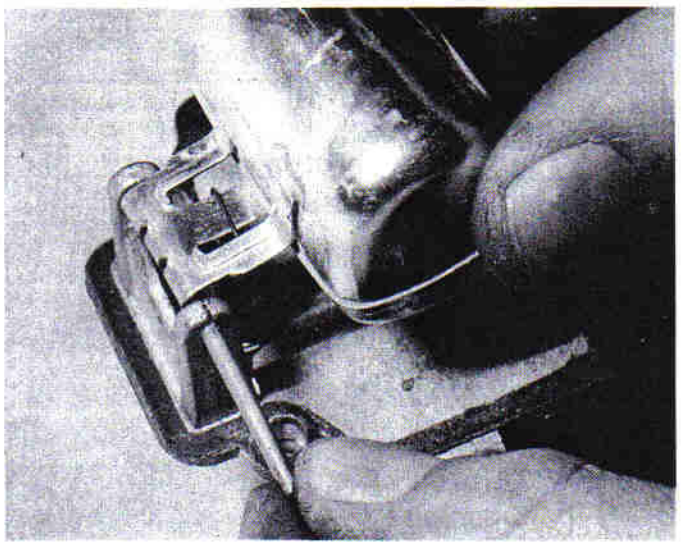
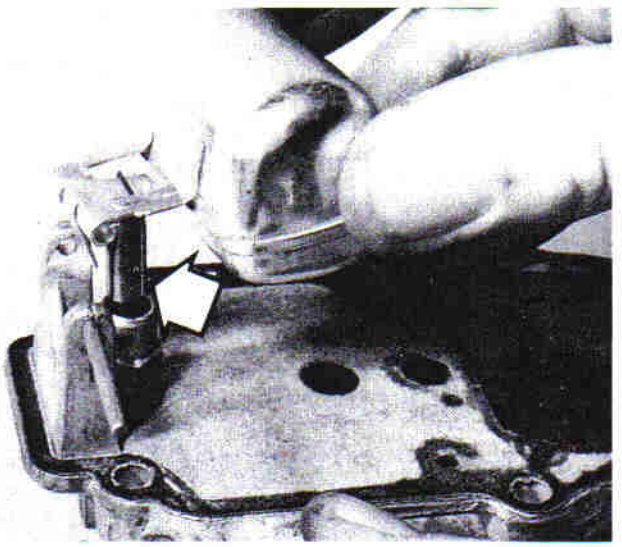


Fig. 3.6 Choke limiter setting diagram for IPM 32 MGV carburettor (Sec 11)

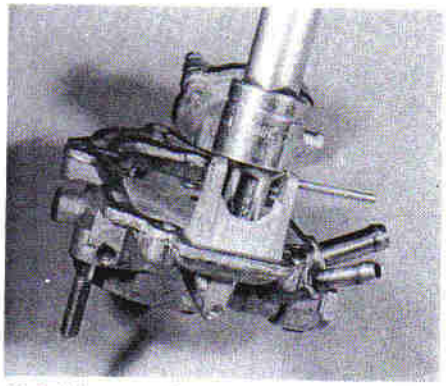
Y = 3.75 to 4.25 mm (0.148 to 0.167 in)



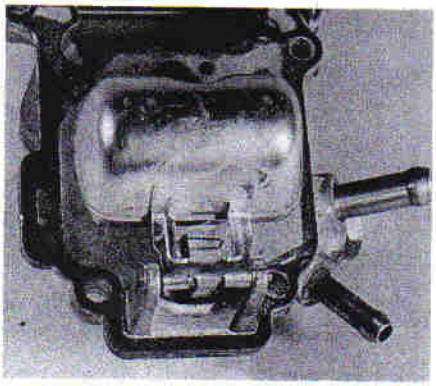
11.4A Pull out the hinge pin ...



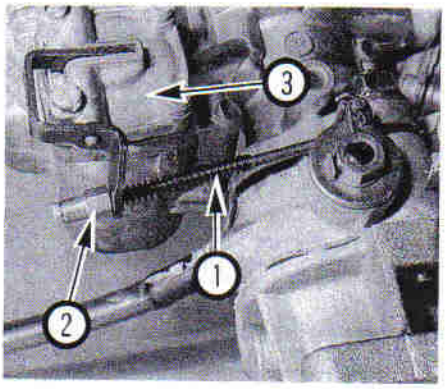
11.4B ... and remove the float and needle valve (arrowed)



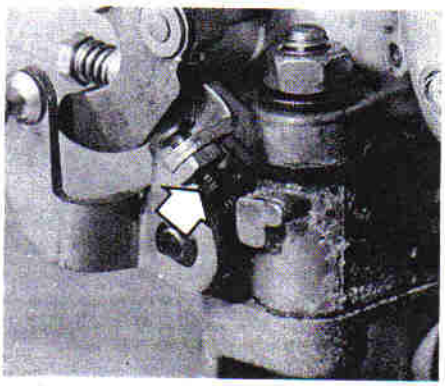
11.7 Using a socket to unscrew the needle valve seat



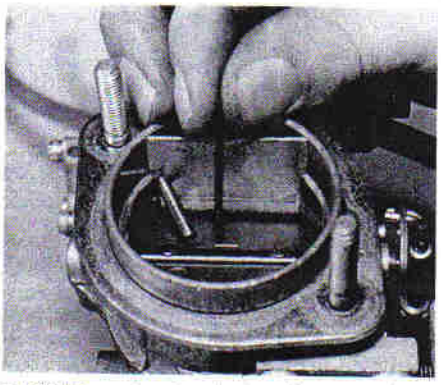
11.9 Ensure that the needle valve is hooked onto the float



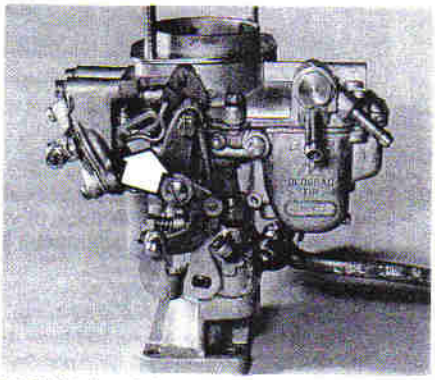
11.15 Accelerator pump on IPM 32 MGV
1 Control rod 2 Adjustment nut
3 Accelerator pump cover



11.24 Fast idle screw (arrowed) on IPM 32 MGV carburettor



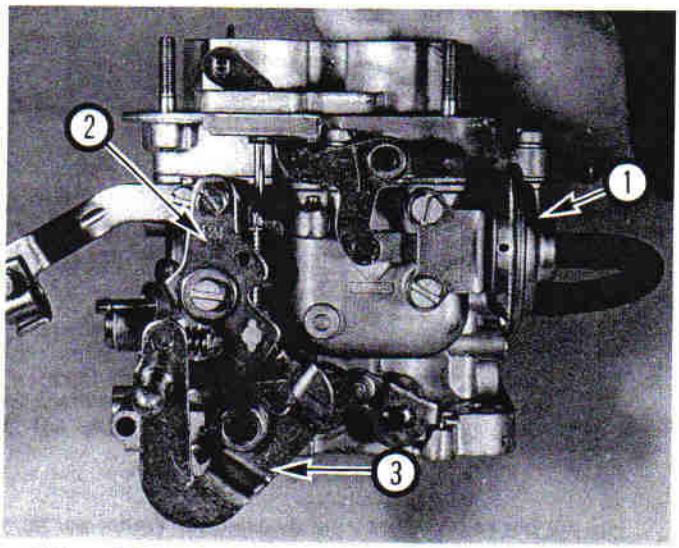
11.30 Measuring the choke valve gap using a twist drill as a gauge



11.31 Link rod (arrowed) between choke valve lever and vacuum device operating rod

12 Carburettor (Weber 30/32 DMTR) – description

1 The Weber 30/32 DMTR carburettor is a twin choke downdraught type, the second stage being operated mechanically by a linkage from the first stage (photo).
2 The choke is manually operated and is fitted to the primary (first stage) barrel.
3 A vacuum operated choke limiter device prevents flooding of the engine by preventing the choke valve from closing completely.



12.1 View of Weber 30/32 DMTR carburettor
1 Vacuum device for choke limiter
2 Choke lever 3 Throttle lever

13 Carburettor (Weber 30/32 DMTR) – removal and refitting

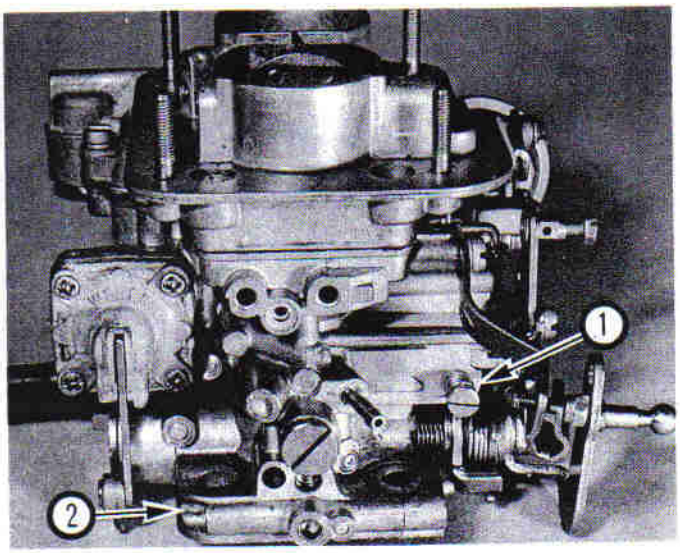
Removal and refitting of the Weber 30/32 DMTR carburettor is as described in Section 9.

14 Idle speed and CO mixture (Weber 30/32 DMTR carburettor) – adjustment

1 Refer to Section 10 for general comments on idle speed and mixture setting.
2 The idle speed and CO mixture screws on the Weber 30/32 DMTR carburettor are shown in the accompanying photograph.

15 Carburettor (Weber 30/32 DMTR) – overhaul and adjustment

1 The carburettor top cover can be removed for float adjustment without removing the carburettor from the manifold. The remainder of the operations require its removal.
2 Remove the air cleaner housing as described in Section 4.
3 Remove the carburettor top cover securing screws (photo).
4 Remove the two screws securing the choke limiter vacuum unit to the carburettor (photo).
5 Disconnect the choke link rod from the choke lever by lifting the collar against the spring and releasing the nylon bush.
6 Prise the circlip from the choke limiter lever pivot and remove the vacuum unit and lever (photo).
7 Lift off the top cover complete with float.



14.2 Idle speed screw (1) and CO mixture screw (2) on Weber 30/32 DMTR carburettor

Float adjustment

8 The procedure for removal of the float and needle valve assembly is as described in Section 11 (photo).

9 Float level checking and adjustment is also as described in Section 11, but refer to Fig. 3.7.

First stage throttle valve opening

10 With the throttle valve control lever in contact with its stop, the first stage throttle valve should be open by between 6.45 and 6.95 mm (0.25 and 0.27 in) (photo).

11 Adjust by carefully bending the lever stop.

Second stage throttle valve synchronisation

12 With the first stage throttle valve set as described above, the second stage throttle valve should be fully closed.

13 Open the first stage throttle valve fully, using the throttle lever, and check that both throttle valves are fully open.

Fast idle

14 Open the choke fully using the choke lever.

15 Check that the gap between the throttle valve and carburettor wall is as specified in Fig. 3.8.

16 Adjust by turning the fast idle screw as necessary.

Choke limiter

17 Open the choke valve fully.

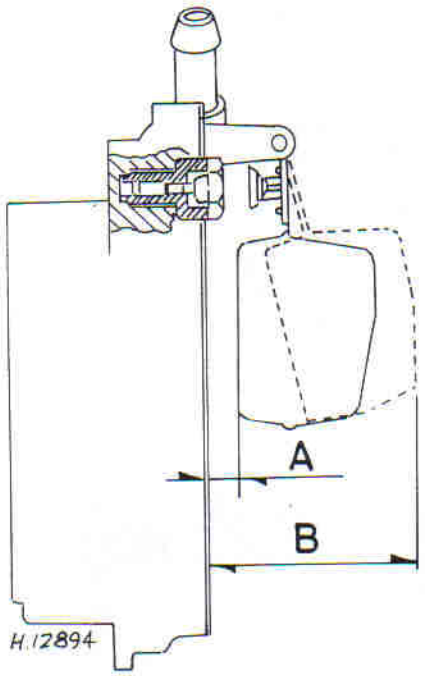


Fig. 3.7 Float setting diagram for Weber 30/32 DMTR carburettor (Sec 15)

Float height A = 6.75 to 7.25 mm (0.265 to 0.285 in)
Float travel B = 42.5 to 43.5 mm (1.67 to 1.71 in)

18 Push the control lever on the choke limiter outwards to simulate vacuum.

19 The choke valve should open by the specified amount given in Fig. 3.9 (photo).

20 Adjust by turning the screw as necessary.

Accelerator pump

21 The accelerator pump is operated by a cam from the throttle linkage (photo).

22 Refer to Section 11 for removal of the diaphragm unit. No adjustment is possible.

Jets

23 The jets are accessible after removing the carburettor cover (photo).

24 Refer to Section 8 for removal and cleaning.

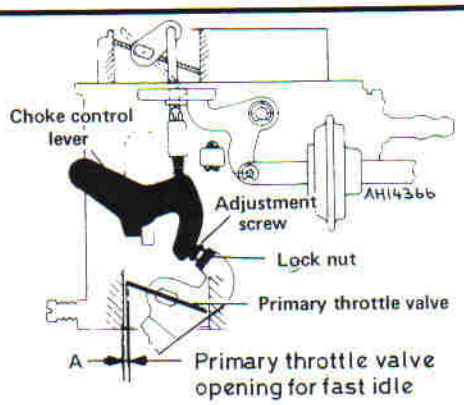


Fig. 3.8 Fast idle setting diagram for Weber 30/32 DMTR carburettor (Sec 15)

A = 0.90 to 0.95 mm (0.035 to 0.037 in)

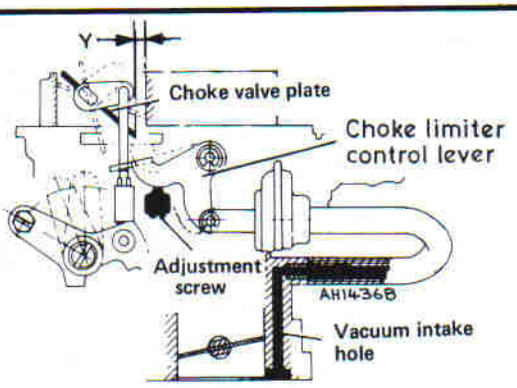
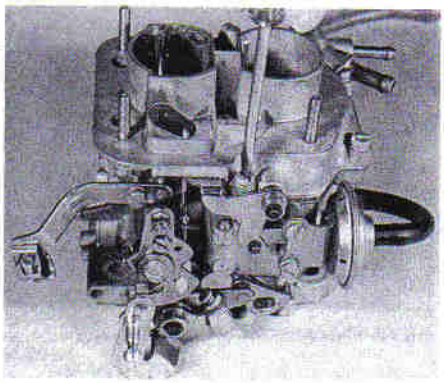
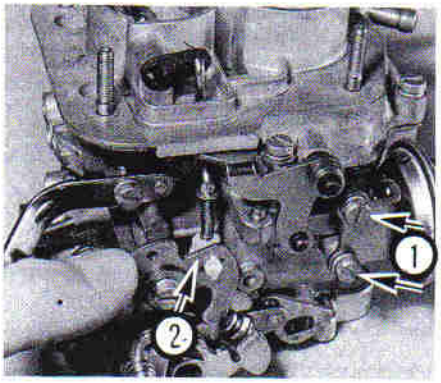


Fig. 3.9 Choke limiter setting diagram for Weber 30/32 DMTR carburettor (Sec 15)

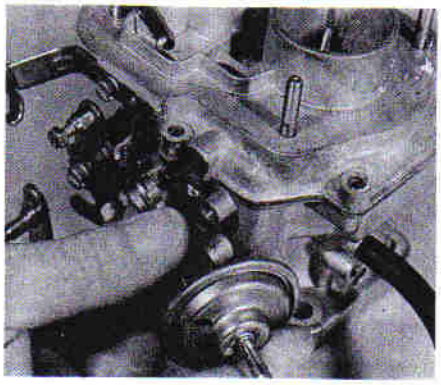
Y = 4.25 to 4.75 mm (0.167 to 0.187 in)



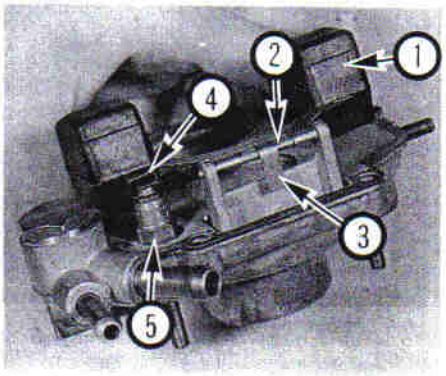
15.3 Removing a screw from the top cover



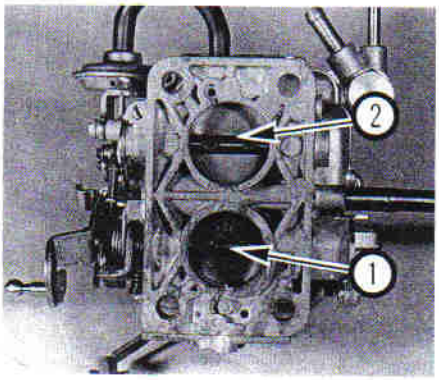
15.4 Choke limiter vacuum unit securing screws (1) and choke link rod (2)



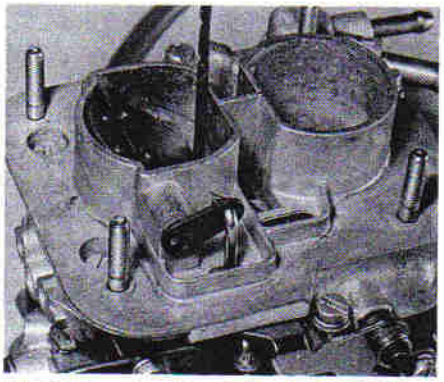
15.6 Removing the choke limiter vacuum unit



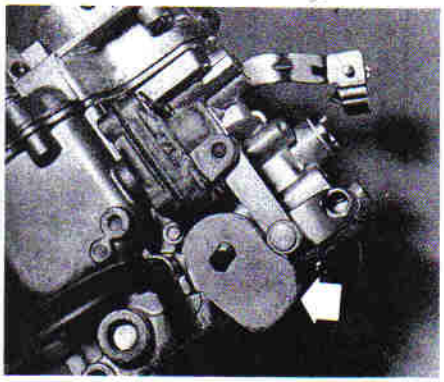
15.8 Float assembly on Weber 30/32 DMTR
1 Float 2 Hinge pin 3 Lug
4 Tongue 5 Needle valve



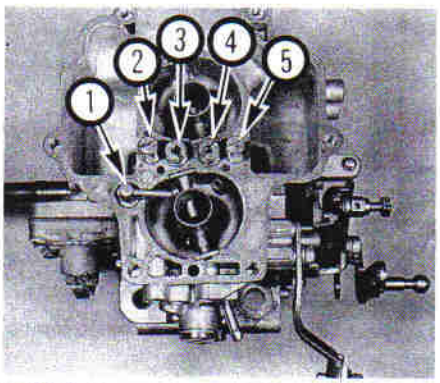
15.10 Weber 30/32 DMTR carburettor first stage throttle valve (1) and second stage throttle valve (2)



15.19 Measuring the choke valve opening on Weber 30/32 DMTR carburettor



15.21 Accelerator pump operating cam (arrowed) on Weber 30/32 DMTR carburettor



15.23 Carburettor jets on Weber 30/32 DMTR carburettor (top cover removed)

1 Accelerator jet
2 First stage idle jet
3 First stage main and air jet
4 Second stage main and air jet
5 Second stage idle jet

16 Fuel pump – removal and refitting

1 On OHV engines the fuel pump is mounted by the timing chain cover and is driven from the camshaft by an eccentric cam.
2 On OHC engines the fuel pump is mounted on the cylinder block and is driven from the auxiliary shaft by an eccentric cam.
3 The procedure for removal of both types of pump follows the same pattern.
4 Disconnect the inlet and outlet hoses (photos).
5 Remove the nuts securing the pump to the engine and lift it off the studs (photo).
6 Lift out the plunger (photo).
7 Note the number of gaskets under the pump then lift off the insulator block (photo).
8 It is better to renew a worn pump, but the top cover can be removed to renew the valve assembly and to clean the filter fitted in the top cover (photos).
9 Inspect the diaphragm for perishing and renew it as necessary (photo).
10 Reassembly and refitting of the pump is a reversal of removal, noting the following.
11 The pump stroke is set by the thickness of the gaskets fitted between the pump and the insulator block. This also controls the output pressure of the pump.
12 Gaskets are available in 0.3, 0.7 and 1.2 mm (0.01, 0.03 and 0.05 in) thicknesses.
13 Always fit a 0.3 mm (0.01 in) gasket between the insulator block and the engine (photo).
14 The length of the plunger protruding into the engine must now be set by selecting suitable gaskets from the thicknesses available so that the plunger dimension 'A' in Fig. 3.10 is as specified.

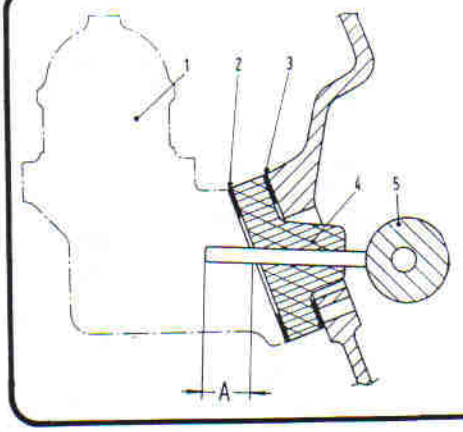
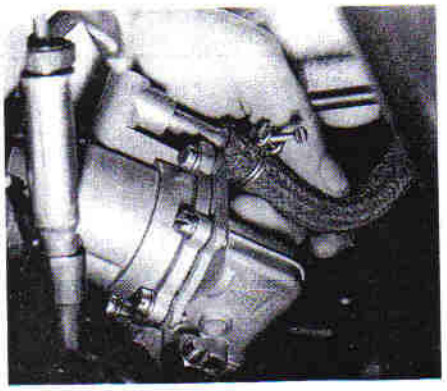
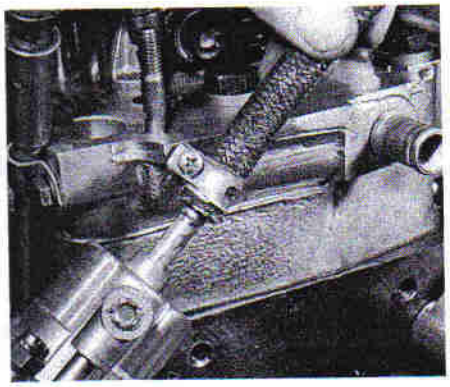


Fig. 3.10 Adjustment of fuel pump and plunger (Sec 16)

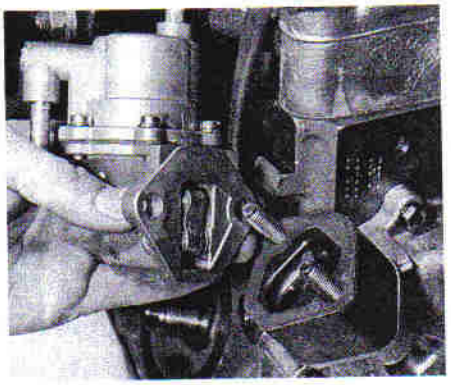
1 Fuel pump
2 Gasket
3 Insulator block
4 Plunger
5 Cam
A = 15.0 to 15.5 mm (0.59 to 0.61 in) for OHC engines
A = 2.4 mm (0.09 in) for OHV engines
Both measurements taken with plunger at bottom of its stroke



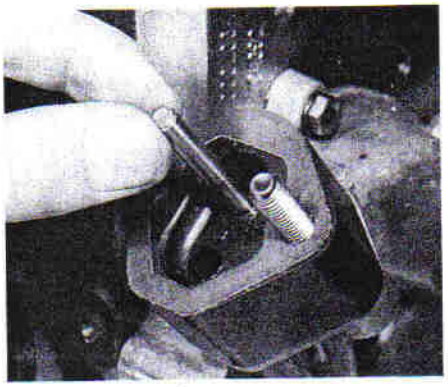
16.4A Disconnect the inlet ...



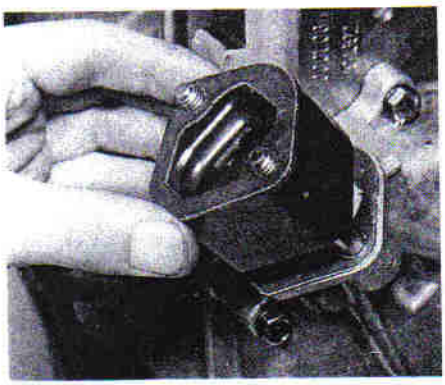
16.4B ... and outlet hoses



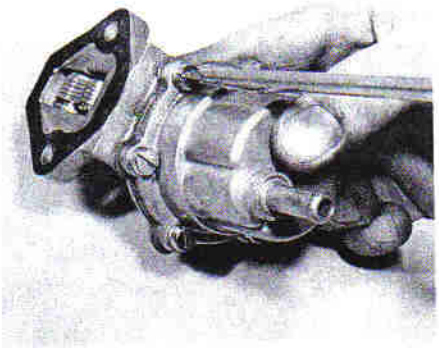
16.5 Removing the fuel pump



16.6 Lift out the plunger ...

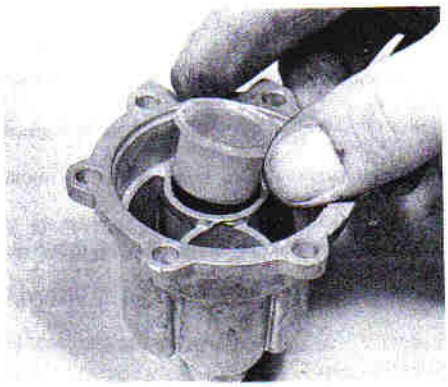


16.7 ... and remove the insulator block

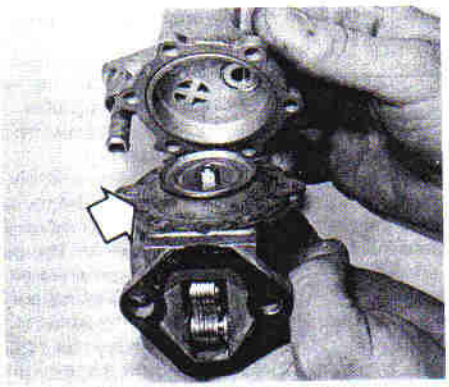


16.8A Removing a fuel pump top cover securing screw

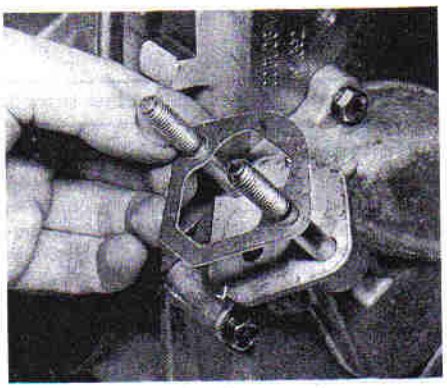
16.8B Lift out the valve assembly ...



16.8C ... and the fuel filter



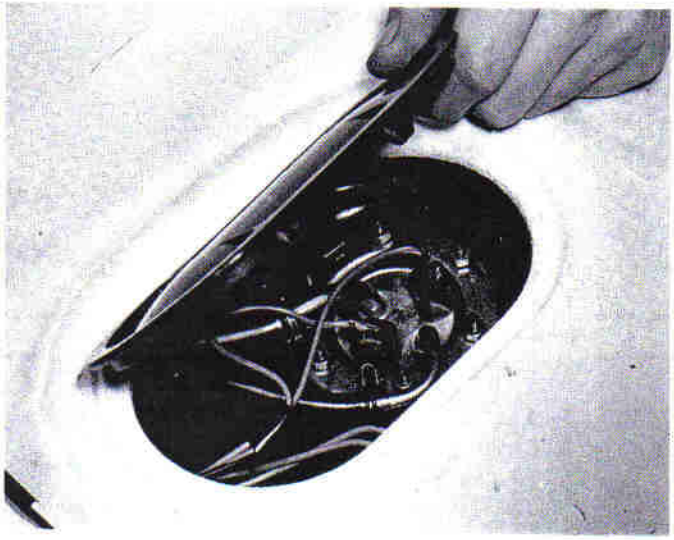
16.9 Diaphragm assembly (arrowed)



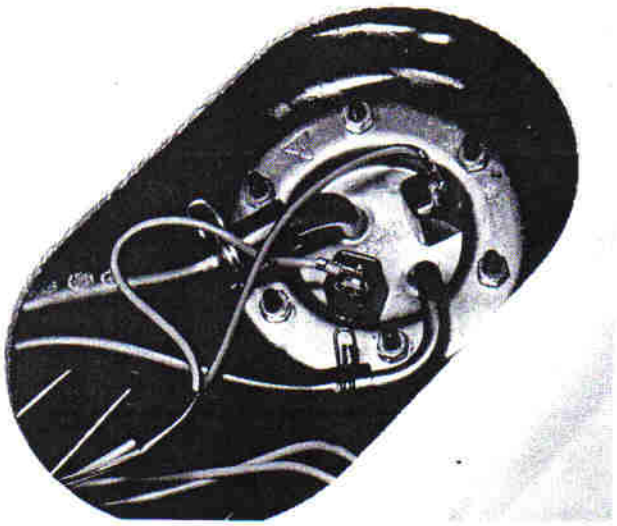
16.13 Fitting a gasket between the insulator block and engine

17 Fuel tank level sender unit – removal and refitting

1 The fuel tank level sender unit is mounted in the top of the fuel tank and consists of a float attached to a float arm which operates an electrical sender working on the resistance principle. This sender transmits the fuel level to the fuel gauge in the instrument panel.
2 To remove the unit, on 45/55/65 models fold the rear seats forward and take up the carpeting in the luggage area.
3 On 3/4/5 series models just take up the carpet.
4 Prise out the plastic panel from the luggage area floor (photo).
5 Disconnect the fuel pipes and the electrical leads (photo).
6 Undo the ring of nuts on the sender flange and lift out the sender unit and float. The float is on the end of a cranked arm, so take care when removing it.
7 Note that there is a filter on the end of the fuel supply pipe and if a problem has been encountered with fuel supply to the carburettor it is worth removing the sender unit and cleaning the filter, although there is no requirement to do this on a regular basis.
8 If the sender unit is proved to be unserviceable through fault diagnosis it should be renewed.
9 Refitting is a reversal of removal, using a new gasket under the sender unit flange if the old one is at all perished.



17.4 Removing the plastic panel from the luggage area floor



17.5 Fuel tank sender unit fuel pipe and electrical connections

18 Fuel filler pipe – removal and refitting

1 On 45/55/65 models fold forward the rear seat and remove the side trim panels from the right-hand side of the passenger compartment.
2 On 3/4/5 series models remove the trim panels from the left-hand side of the luggage area.
3 On all models release the clip securing the filler pipe to the tank (photo).
4 Disconnect the overflow and breather pipes.
5 From outside the vehicle remove the filler cap.
6 Undo the bolt securing the filler bracket to the inner skin.
7 Pull the filler pipe into the vehicle and release it from the lower rubber connecting pipe.
8 Refit in reverse order.

19 Fuel tank – removal and refitting

1 During the following procedure it will be helpful to refer to the underbody photographs at the beginning of this manual.

45/55/65 models

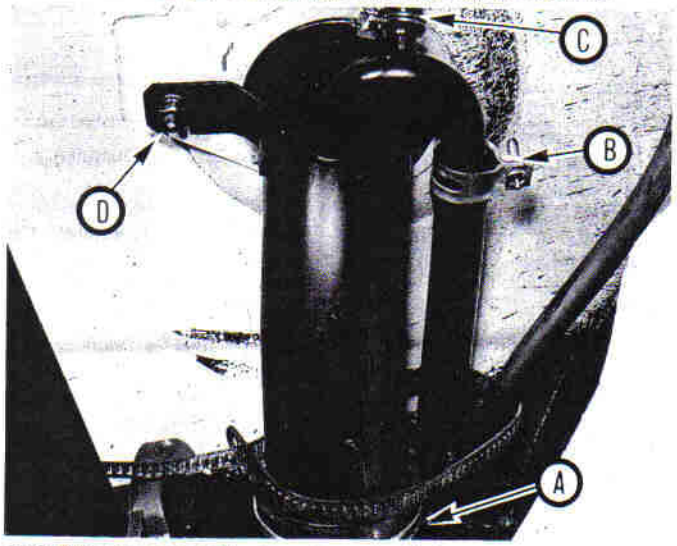
2 The fuel tank is mounted under the rear of the vehicle, in front of the rear suspension leaf spring.
3 Drain as much fuel as possible from the tank by removing the drain plug if one is fitted, or siphon the fuel out.
4 Fold the rear seat forward.
5 Disconnect the fuel pipes and electrical leads to the fuel tank level sender unit as described in Section 18.
6 To give better access, raise the rear of the vehicle on axle stands.
7 Release the handbrake cables from their supporting brackets and tie them back out of the way.
8 Loosen the filler neck clip at the bottom end of the filler neck.
9 Position a trolley jack under the tank and just take the weight of the tank on the jack.
10 Remove the retaining nuts securing the tank to the underbody.
11 Lower the jack sufficiently to allow the breather pipe on top of the tank to be disconnected.
12 Remove the tank from under the vehicle.

3/4/5 Series models

13 The tank is mounted on the underside of the vehicle behind the rear suspension leaf spring.
14 The procedure for its removal is basically as described for 3/4/5 models but there is no need to fold the rear seats.
15 To gain access to the lower clip on the filler neck remove the plastic cover on the left-hand side of the tank.

All models

16 The fuel tank can be flushed out using clean petrol. This operation



18.3 Filler pipe assembly viewed from inside luggage area
A Lower pipe clip
B Overflow pipe
C Breather pipe
D Bracket

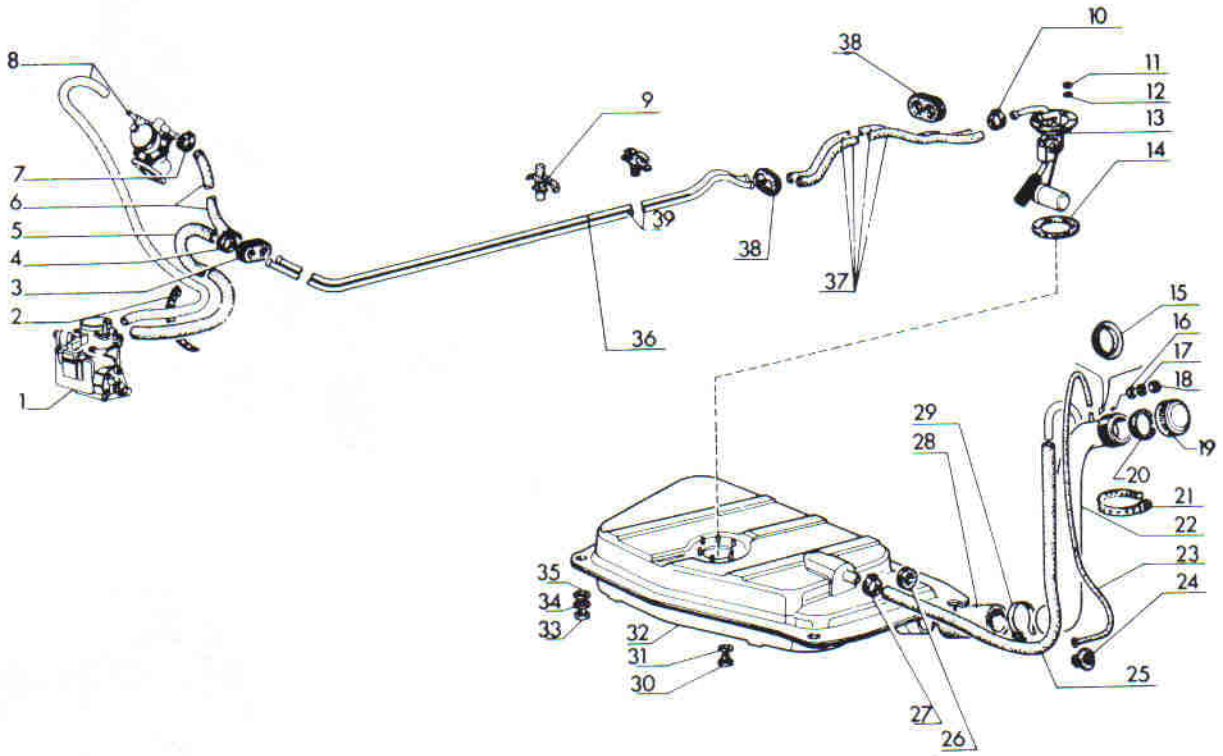


Fig. 3.11 Typical fuel system layout – 45, 55 and 65 Series models (Sec 19)

1 *Carburettor*
2 *Tie-strap*
3 *Spacer*
4 *Clip*
5 *Return pipe - flexible end*
6 *Feed pipe - flexible end*
7 *Clip*
8 *Pump to carburettor pipe*
9 *Clip supports*
10 *Hose clip*
11 *Nut*
12 *Washer*
13 *Tank sender unit*
14 *Sender unit gasket*
15 *Sealing ring*
16 *Washer*
17 *Washer*
18 *Nut*
19 *Filler cap*
20 *Sealing ring*
21 *Tie-strap*
22 *Filler pipe*
23 *Ventilation/breather pipe*
24 *Clip*
25 *Ventilation/breather pipe*
26 *Grommet*
27 *Clip*
28 *Hose*
29 *Clip*
30 *Drain plug*
31 *Washer*
32 *Fuel tank*
33 *Nut*
34 *Washer*
35 *Washer*
36 *Feed pipe*
37 *Flexible pipes*
38 *Spacers*
39 *Return pipe*

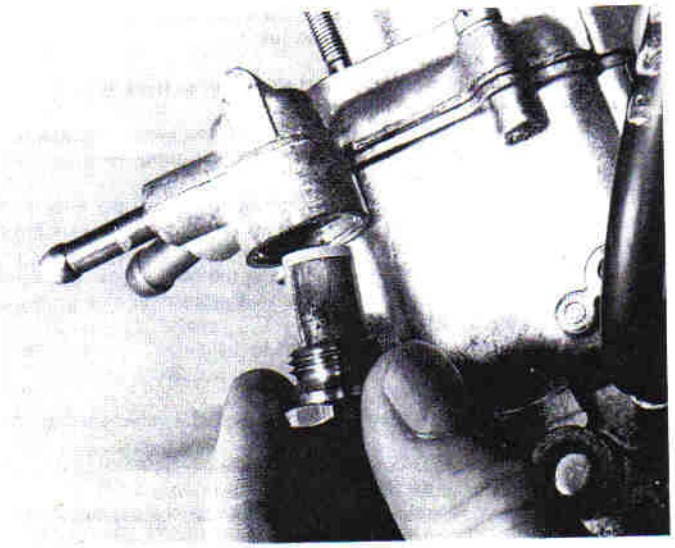
is aided by the removal of the sender unit.
17 If water ingress has been a problem, the tank should be blown dry using compressed air. Never attempt to heat the tank to dry it out.
18 Refitting is a reversal of removal.

20 Fuel filters – general

1 Periodic maintenance of the fuel filtration system is dependent on the types of filters fitted.
2 Models with the automatic choke carburettor utilise an in-line filter, located in the fuel line before the fuel pump. This filter must be renewed every 12 000 miles or 12 months.
3 All models are fitted with filter screens in the fuel pump and in the fuel tank level sender unit. These screens should be cleaned if the pump or sender unit is removed.
4 On all manual choke models, a fuel inlet filter is fitted to the carburettor. Although not specified as a service item, it is recommended that the filter be removed for cleaning periodically (photo). Wash the filter in clean petrol, then refit and tighten it.

21 Positive crankcase ventilation (PCV) system – description and servicing

1 All models have a positive crankcase ventilation (PCV) system.
2 On pre-1986 models the system incorporates a control valve housed on the side of the carburettor and operated by an extension of the throttle spindle.
3 The purpose of the system is to return crankcase fumes to the inlet side of the manifold for re-burning.



20.4 Removing the fuel inlet filter from the carburettor

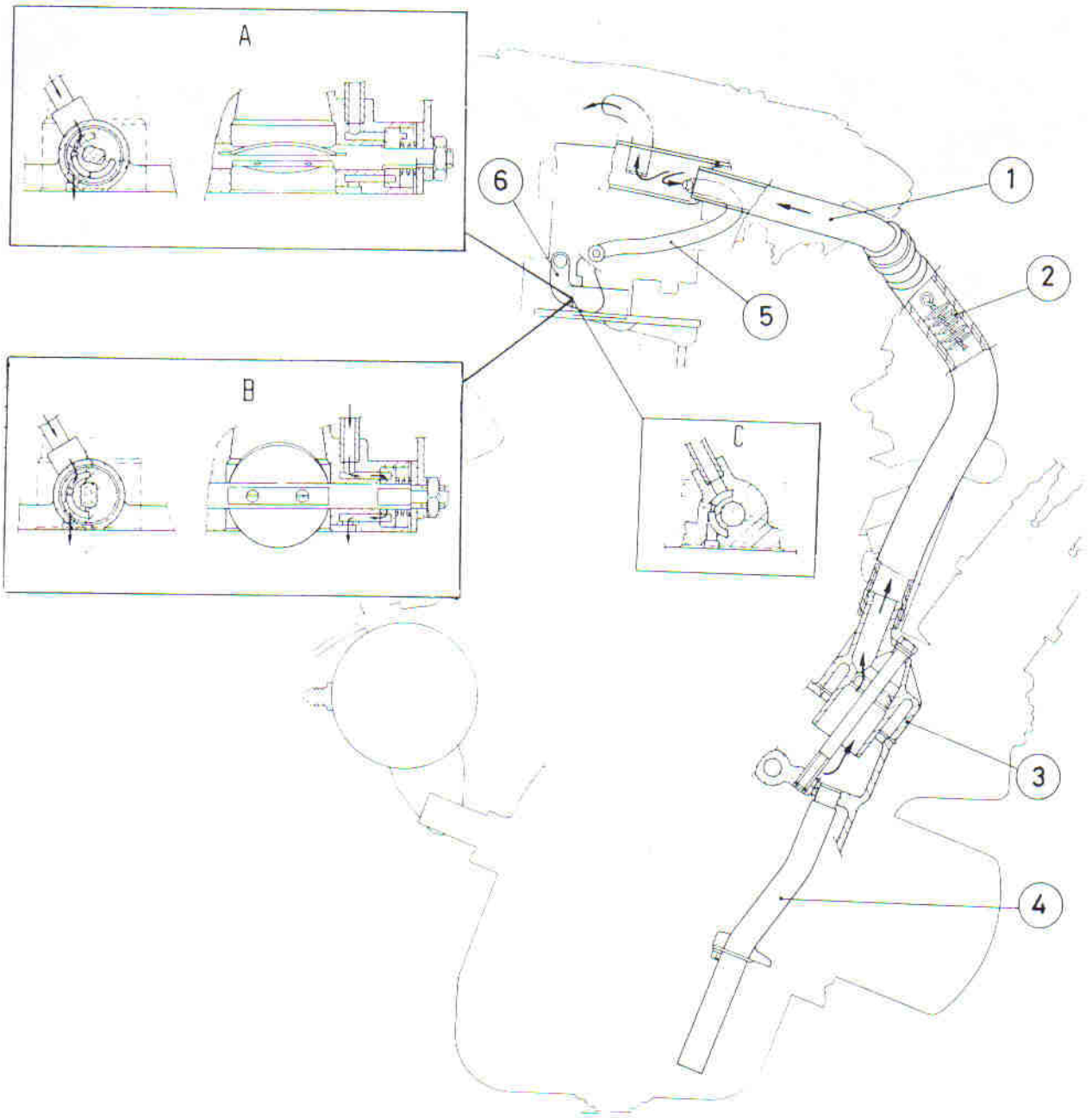
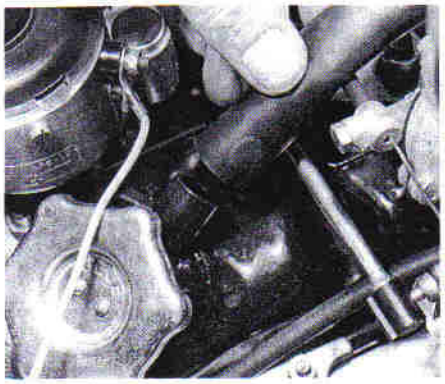


Fig. 3.12 Positive crankcase ventilation system (Sec 21)

1 Engine-to-air cleaner hose
2 Flame trap
3 Oil trap
4 Drain tube
5 Air cleaner-to-carburettor hose
6 Control valve

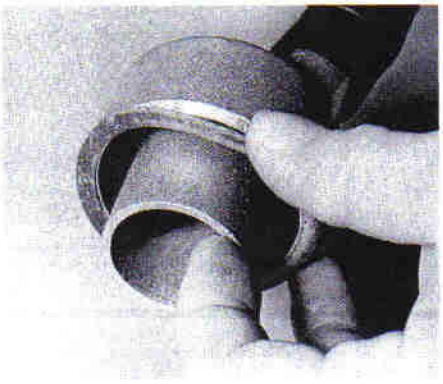
A – Throttle closed: blow-by gases are drawn into the inlet manifold through the calibrated orifice.
B – Throttle open: part of the blow-by gases is passed into the inlet manifold; the remainder enters the air cleaner downstream from the filter element.
C = Section through idling blow-by gas calibrated pick-up orifice.

4 On later models the fumes are drawn from the crankcase via an oil trap on the side of the crankcase and into the air cleaner housing.
5 On early models with a control valve, the amount of gases drawn in is proportional to throttle opening, although there is always some flow through the calibrated orifice in the valve.
6 The PCV system must be cleaned at the intervals given in the *'Routine maintenance'* section as follows.
7 Remove the air cleaner housing as described in Section 4.
8 Take note of their fitted positions, then disconnect all hoses in the system. Note the hose to the valve cover on OHV engine models.
9 Remove the flame trap from the end of the crankcase breather hose (photo).
10 Undo the bolt in the centre of the oil trap on the side of the crankcase and lift off the top cover (photo).
11 Clean all parts in solvent, blow dry and refit, which is a reversal of removal.
12 On models with a control valve, undo the nut on the end of the throttle spindle and remove the valve assembly.
13 Separate the plates and clean them in solvent.
14 Reassemble in the reverse order.



21.8 Disconnecting the breather pipe from the valve cover – OHV engine

21.9 Removing the flame trap from crankcase breather hose



21.10 Removing the oil trap top cover

22 Manifolds and exhaust system – general

1 The intake manifold on OHV engines is integral with the cylinder head.
2 On the OHC engines, the intake and exhaust manifolds are mounted on the same side of the cylinder head.
3 A hot air collector plate is fitted over the exhaust manifold from where the air cleaner draws air when in the winter setting.
4 When fitting a manifold, thoroughly clean the cylinder head and manifold mating surfaces, use a new gasket and tighten nuts to the specified torque (photos).
5 The exhaust system on OHV models is of single downpipe, single silencer, two section type (photo).
6 On OHC engine models, the exhaust system is of dual downpipe, two silencer, two section type.
7 The exhaust system is flexibly mounted (photos).
8 If the exhaust is leaking, it may be possible to use a good proprietary repair kit to seal it. Holts Flexiwrap and Holts Gun Gum exhaust repair systems can be used for effective repairs to exhaust pipes and silencer boxes, including ends and bends. Holts Flexiwrap is an MOT-approved permanent exhaust repair. If the leak is large, or if serious damage is evident, it may be better to renew the relevant exhaust section. Check the rubber mountings for deterioration, and renew if necessary.
9 Do not attempt to separate the sections of the exhaust system, while in position on the car. Unbolt the pipe from the manifold and remove the flexible mountings. Provided the car is then raised on jacks, ramps or placed over an inspection pit, the complete exhaust system can be withdrawn from under the car. If only one section is to be renewed, it is far easier to separate once the complete system is removed from the car.
10 Before assembly, smear all joints with a good proprietary exhaust sealing compound, such as Holts Firegum. Fit the clamps loosely until the flexible mountings are connected and the downpipe bolted up (use a new copper gasket where applicable). Check the alignment of the sections to each other, and with regard to the adjacent parts of the underbody. Fully tighten the clamps and downpipe flange nuts, remembering to bend up the lockplate tabs on OHC engine models (photos).
11 Note that on OHC engines produced after August 1986 there is no gasket fitted between the machined faces of the manifold-to-exhaust downpipe flange.
12 Prior to that date a gasket was used, and this must be renewed whenever the flange is disconnected.

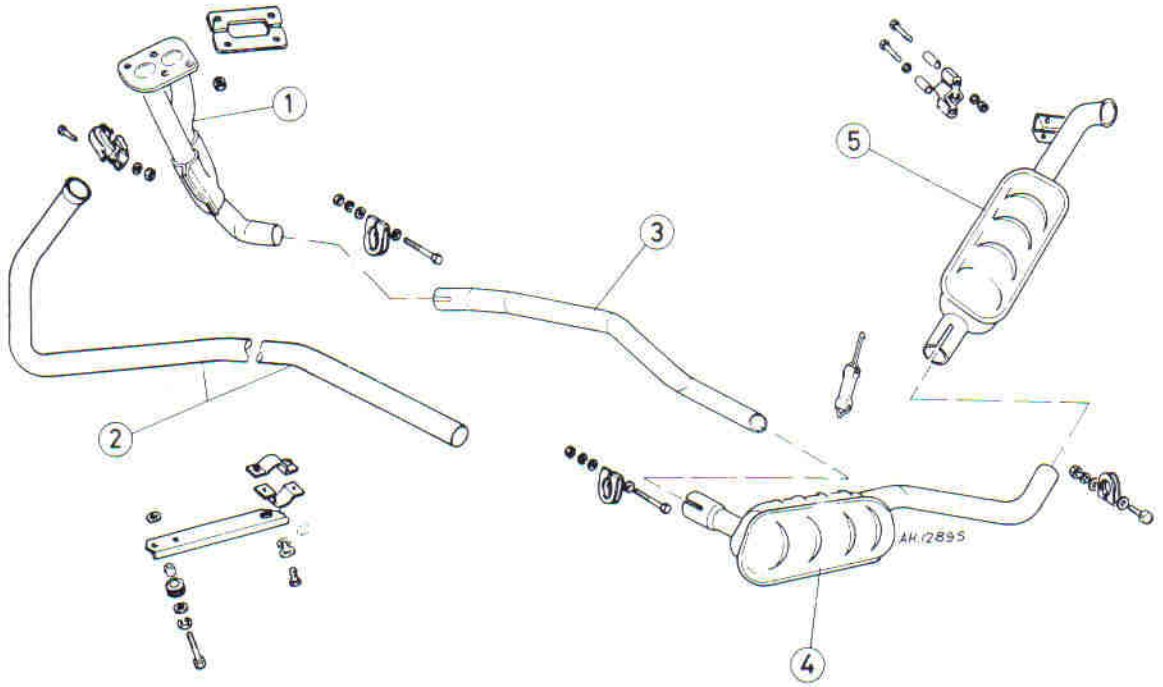
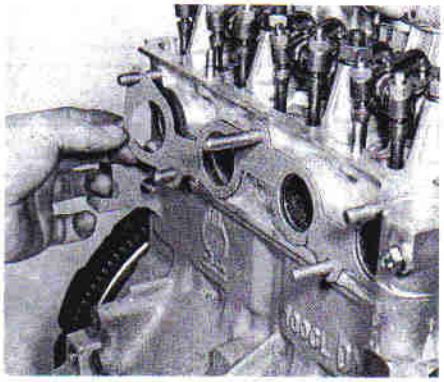
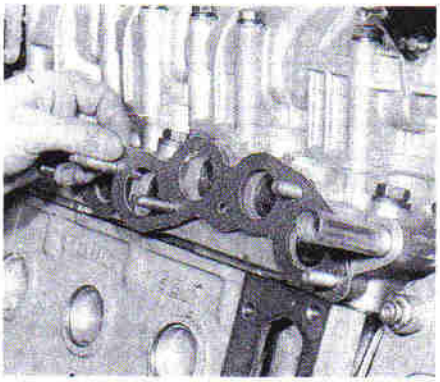


Fig. 3.13 Exploded view of typical exhaust system (Sec 22)

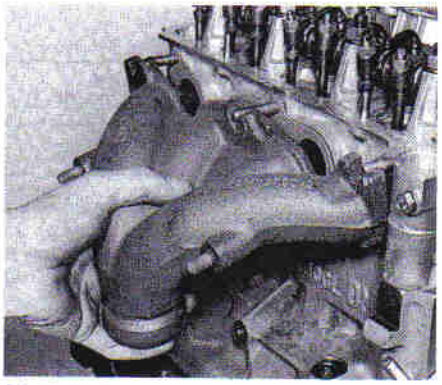
1 Twin downpipe
2 Single downpipe
3 Intermediate pipe
4 Intermediate silencer
5 Rear silencer



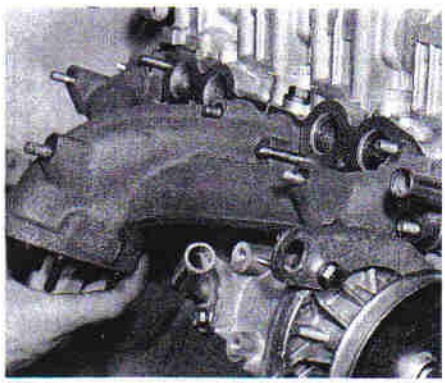
22.4A Fitting a new manifold gasket on an OHV engine ...



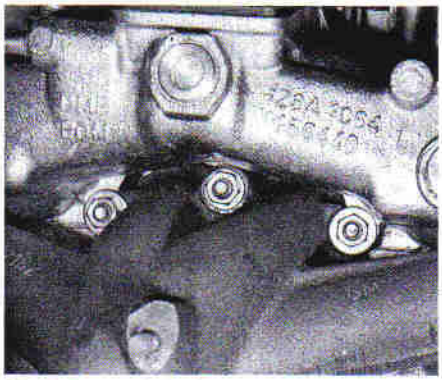
22.4B ... and on an OHC engine



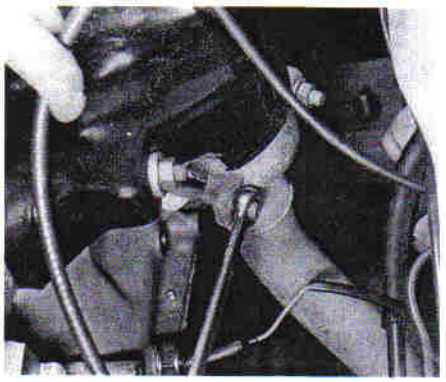
22.4C Fitting the exhaust manifold to an OHV engine ...



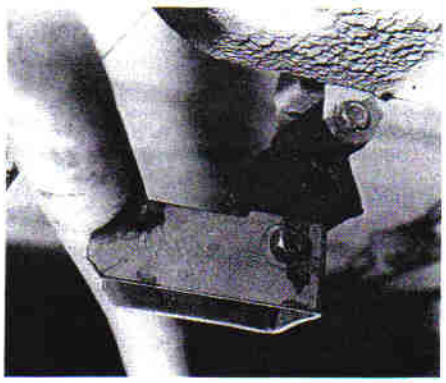
22.4D ... and to an OHC engine



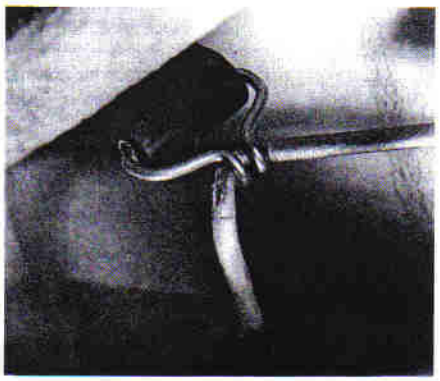
22.4E Some of the inlet and exhaust manifold nuts on an OHC engine



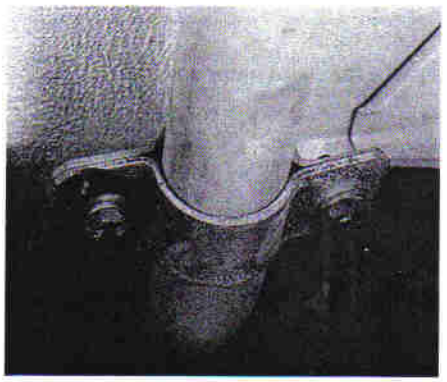
22.5 Exhaust manifold-to-downpipe clamp on OHV engine



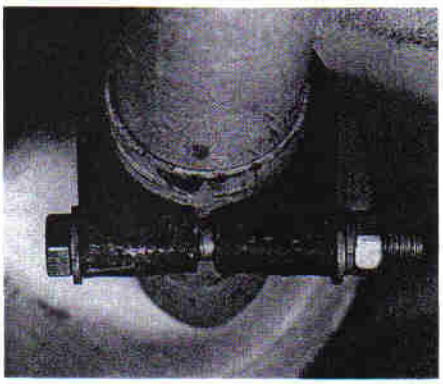
22.7A Typical flexible mountings ...



22.7B ... supporting the exhaust



22.10A Exhaust front mounting clamp



22.10B Pipe joint clamp

23 Fault diagnosis – fuel system

Symptom	Reason(s)
Unsatisfactory engine performance and excessive fuel consumption are not necessarily the fault of the fuel system or carburettor. In fact they more commonly occur as a result of ignition and timing faults. Before acting on the following it is necessary to check the ignition system first. Even though a fault may lie in the fuel system it will be difficult to trace unless the ignition is correct. The faults below, therefore, assume that this has been attended to first (where appropriate).	
Smell of petrol when engine is stopped	Leaking fuel lines or unions Leaking fuel tank
Smell of petrol when engine is idling	Leaking fuel line unions between pump and carburettor Overflow of fuel from float chamber due to wrong level setting Ineffective needle valve or punctured float
Excessive fuel consumption for reasons not covered by leaks or float chamber faults	Worn jets Over-rich setting Sticking mechanism Dirty air cleaner element
Difficult starting, uneven running, lack of power, cutting out	One or more jets blocked or restricted Float chamber fuel level too low or needle valve sticking Fuel pump not delivering sufficient fuel Induction leak
Difficult starting when cold	Choke control wrongly adjusted Insufficient use of manual choke Weak mixture
Difficult starting when hot	Excessive use of manual choke Accelerator pedal pumped before starting Vapour lock (especially in hot weather or at high altitude) Rich mixture
Engine does not respond properly to throttle	Faulty accelerator pump Blocked jet(s) Slack in accelerator cable
Engine idle speed drops when hot	Incorrect air cleaner intake setting Overheated fuel pump
Engine runs on	Idle speed too high

Chapter 4 Ignition system

For modifications, and information applicable to later models, see Supplement at end of manual

Contents

Specifications

General

System type:	
All models up to 1986 except 55 GLS	Mechanical with contact breaker
55 GLS from 1984 to 1986	Lucas 'Hall effect' electronic ignition
45A, 311 and 511 and Van from 1986	Mechanical with contact breaker
55A, 65A, 513 and 513 GL from 1986	Bosch/Rudi Cajevac electronic ignition
Firing order (all models)	1-3-4-2 (No 1 cylinder at timing gear end)

Mechanical (contact breaker) system

Distributor type	Rudi Cajevac, Marelli or Ducellier
Direction of rotor rotation	Clockwise
Contact breaker gap	0.37 to 0.43 mm (0.014 to 0.017 in)
Dwell angle	55° ± 3°
Condenser capacity:	
45 and 45 GL	0.22 to 0.23 microfarad
All other models	0.22 to 0.27 microfarad
Ignition timing (static and dynamic)*:	
45 (all models)	5°BTDC at idle
55 (all models)	10°BTDC at idle
1100, 311, 411, 511 and Van (all models)	10°BTDC at idle
1300, 313, 413 and 513 (with single barrel carburettor)	5°BTDC at idle
**See Chapter 13 for ignition timing with unleaded fuel*	
Centrifugal advance (begins at 1200 rpm for all models):	
All models up to 1986	28° ± 2°
45 (all models) from 1986	32° ± 2°
55 (all models) from 1986	24° ± 2°
311, 511 and Van (all models) from 1986	24° ± 2°
313 and 513 (all models) from 1986	28° ± 2°
Ignition coil:	
Type	Marelli, Iskra or Bosch
Primary resistance (approximate) at 20°C (68°F):	
Marelli	3.0 to 4.0 ohms
Iskra	3.0 to 4.0 ohms
Bosch	2.5 to 3.5 ohms
Secondary resistance (approximate) at 20°C (68°F):	
Marelli	9000 to 10 000 ohms
Iskra	6000 to 8000 ohms
Bosch	10 000 to 11 000 ohms

Lucas electronic ignition

Type	Distributor with 'Hall effect' rotor and sensor and separate switching unit/amplifier
Direction of rotor rotation	Clockwise
Ignition timing (static and dynamic)*	10°BTDC
Centrifugal advance	24° ± 2°

**See Chapter 13 for ignition timing with unleaded fuel*

Bosch/Rudi Cajevac electronic ignition

Type	Distributor with magnetic pulse generator and separate control unit/amplifier
Direction of rotor rotation	Clockwise
Ignition timing (static and dynamic)*	10°BTDC (manual choke), 5°BTDC (automatic choke)
Centrifugal advance	24° ± 2° (manual choke), 19° ± 2° (automatic choke)
Air gap (between rotor and pick-up poles)	0.3 to 0.5 mm (0.011 to 0.019 in)
Coil primary resistance at 20°C (68°F)	0.7 ohm
Coil secondary resistance at 20°C (68°F)	9500 ohms

**See Chapter 13 for ignition timing with unleaded fuel*

Spark plugs

Make and type	Champion RN9YCC or RN9YC
Electrode gap:	
Champion RN9YCC	0.8 mm (0.032 in)
Champion RN9YC	0.6 mm (0.024 in)

HT leads

45, 55 and 65 models	Champion CLS5 (boxed set)
All other models	Champion CLS8 (boxed set)

Torque wrench settings

	Nm	lbf ft
Spark plugs:		
OHV engine	33	24
OHC engines	38	28

1 General description

Prior to 1986, all models except the 55 GLS have a mechanical distributor incorporating contact breakers. The 55 GLS model has a Lucas 'Hall effect' electronic system with a breakerless distributor.

On all models prior to 1986 ignition advance is controlled by mechanical bobweights in the distributor, there being no vacuum advance.

From 1986, base models retain the contact breaker system with the addition of a vacuum advance unit, and models with a higher specification are fitted with a Bosch fully electronic system.

Mechanical contact breaker system

For the engine to run correctly, it is necessary for an electrical spark to ignite the fuel/air mixture in the combustion chamber at exactly the right moment in relation to engine speed and load. The ignition system is based on feeding low tension voltage from the battery to the coil where it is converted to high tension voltage. The high tension voltage is powerful enough to jump the spark plug gap in the cylinders under high compression pressures, providing that the system is in good condition and that all adjustments are correct.

The ignition system is divided into two circuits, the low tension (LT) circuit and the high tension (HT) circuit.

The low tension (sometimes known as the primary) circuit consists of the battery, the lead to the ignition switch, the lead from the ignition switch to the low tension or primary coil windings, and the lead from the low tension coil windings to the contact breaker points and condenser in the distributor.

The high tension circuit consists of the high tension or secondary coil windings, the heavy ignition lead from the centre of the coil to the centre of the distributor cap, the rotor arm, and the spark plug leads and spark plugs.

The system functions in the following manner. High tension

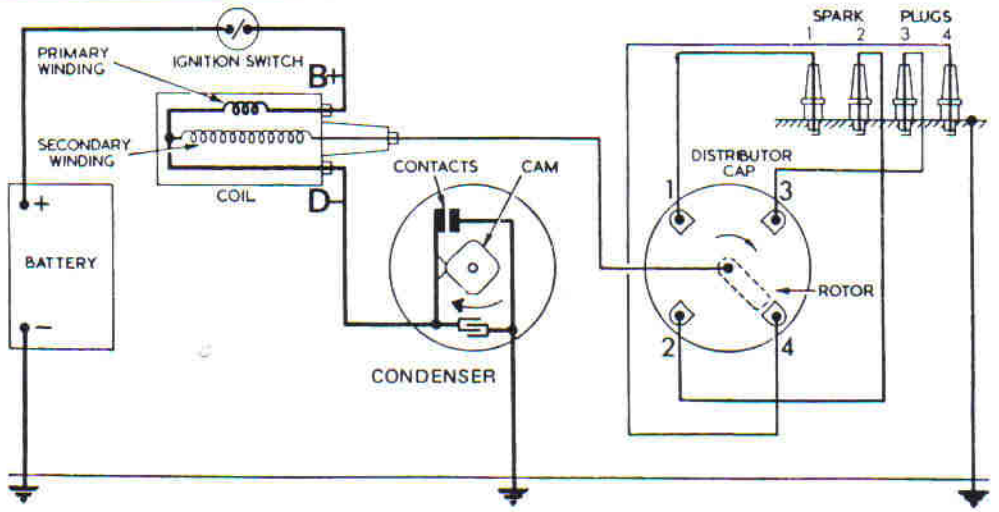


Fig. 4.1 Schematic diagram of typical contact breaker ignition system (Sec 1)

voltage is generated in the coil by the interruption of the low tension circuit. The interruption is effected by the opening of the contact breaker points in this low tension circuit. High tension voltage is fed from the centre of the coil via the carbon brush in the centre of the distributor cap to the rotor arm of the distributor.

The rotor arm revolves at half engine speed inside the distributor cap, and each time it comes in line with one of the four metal segments in the cap, which are connected to the spark plug leads, the opening of the contact breaker points causes the high tension voltage to build up, jump the gap from the rotor arm to the appropriate metal segment, and so via the spark plug lead to the spark plug, where it finally jumps the spark plug gap before going to earth.

The ignition timing is advanced and retarded automatically, to ensure the spark occurs at just the right instant for the particular load at the prevailing engine speed.

The ignition advance is controlled mechanically, and on later models by vacuum. The mechanical governor mechanism consists of two weights, which move out from the distributor shaft as the engine speed rises, due to centrifugal force. As they move outwards, they rotate the cam relative to the distributor shaft, and so advance the spark. The weights are held in position by two springs and it is the tension of the springs which is largely responsible for correct spark advancement.

The vacuum advance is controlled by a diaphragm capsule connected to the carburettor venturi. The vacuum pressure varies according to the throttle valve plate opening and so adjusts the ignition advance in accordance with the engine requirements.

Electronic ignition systems

The basic principles of the contact breaker system previously described apply to the electronic systems which are described in Section 16 (Lucas) and Section 20 (Bosch) of this Chapter.

2 Routine maintenance

At the intervals specified in the *Routine maintenance* Section at the beginning of this manual, carry out the following:

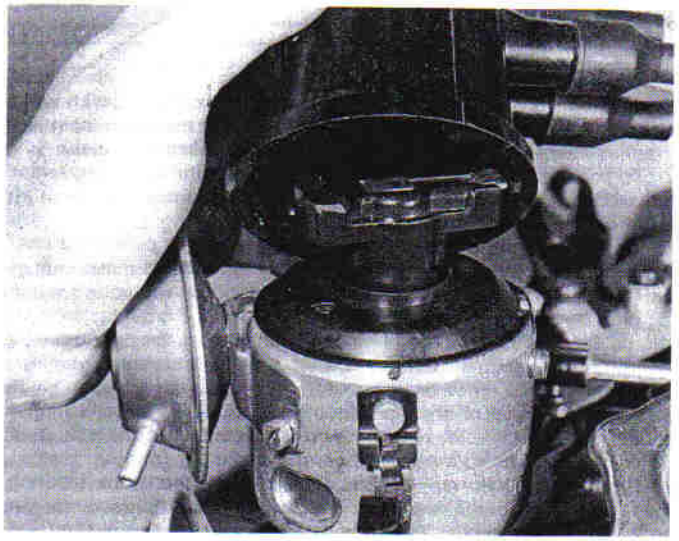
Check and if necessary adjust the contact breaker gap on mechanical systems (Section 6)
Check and adjust or renew as necessary the spark plugs (Section 14)
Check and if necessary adjust the dwell angle on mechanical systems (Section 13)
Check and if necessary adjust ignition timing (Section 12)
Renew the contact breaker assembly, where applicable (Section 7)

3 Distributor cap (all models) – removal, inspection and refitting

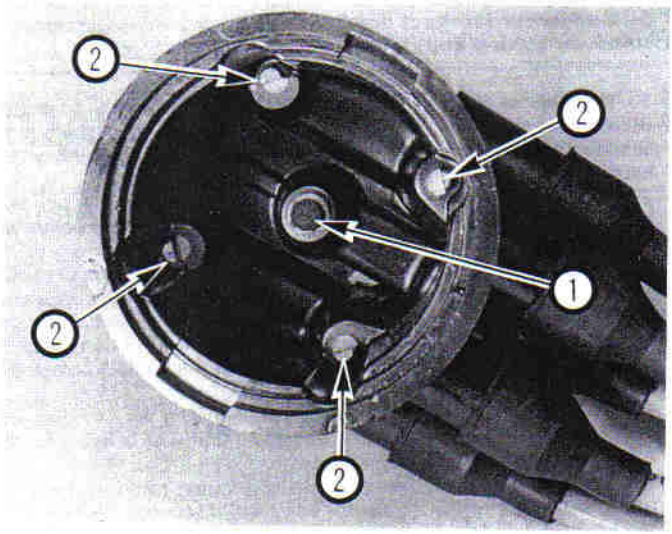
1 Prise open the spring clips on the side of the distributor body which secure the cap to the body, using a screwdriver if necessary, and lift off the cap (photo).
2 There is no need to disconnect the HT leads unless the cap needs renewal.
3 Clean the inside and outside of the cap and inspect the casing for cracks.
4 Look for signs of tracking on the inside of the cap. This shows up as fine lines running between the terminals and is caused by current jumping between them.
5 Use a fine file to clean off any hard deposit which may have formed on the four HT terminals. If the terminals are heavily corroded or worn, the cap must be renewed (photo).
6 Inspect the central carbon brush which must be free to move on its spring-loaded base. If the brush does not protrude far enough to make good contact with the rotor arm when the cap is fitted, the brush or the spring is worn and the cap must be renewed.
7 If the cap is to be renewed, or the HT leads disconnected for some other reason, then take careful note of the HT lead fitted positions. Number the leads one to four, so that they can be refitted in the same positions in order to maintain the correct firing order.
8 Some distributor caps are marked with the number of the cylinder which each connection serves (photo).
9 Refit the cap to the distributor, ensuring that it locates in the cut-outs in the distributor rim, and snap the spring clips back in place (photo).

4 Rotor arm (contact breaker distributor) – removal, inspection and refitting

1 Remove the distributor cap as described in Section 3.
2 Pull the rotor arm from the distributor shaft (photo).
3 Inspect the brass rotor tip for build up of a hard deposit and if necessary remove it with fine emery cloth. Similarly clean the central terminal with which the spring-loaded brush in the distributor cap makes contact (photo).
4 If the rotor tip is severely corroded or worn, or there are cracks in the rotor arm, it must be renewed.
5 Refit the rotor by pushing it down onto the distributor shaft, ensuring that it engages with the slot in the shaft.
6 Refit the distributor cap.

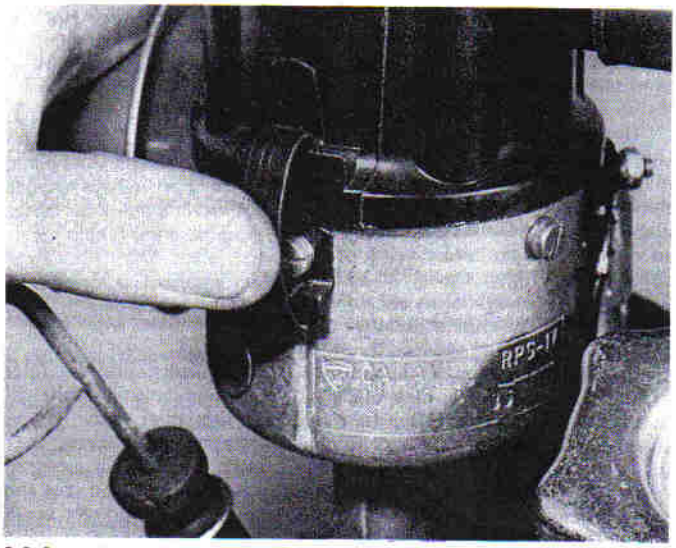


3.1 Lifting off the distributor cap (contact breaker distributor)

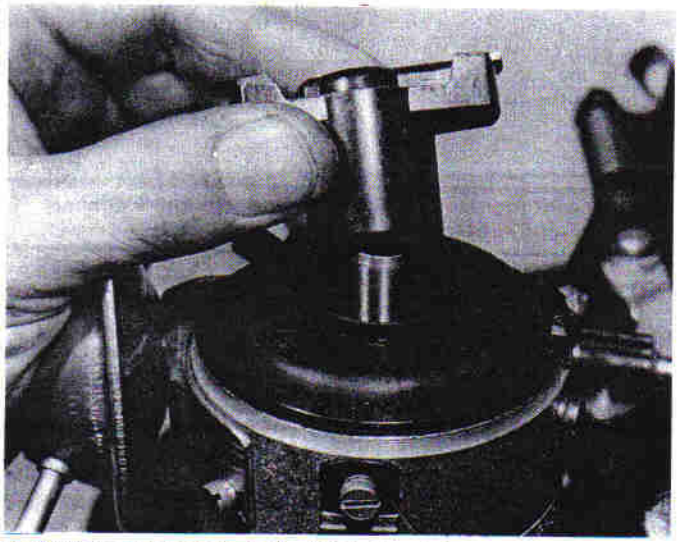


3.5 View inside the distributor cap showing the carbon brush (1) and the four HT terminals (2)

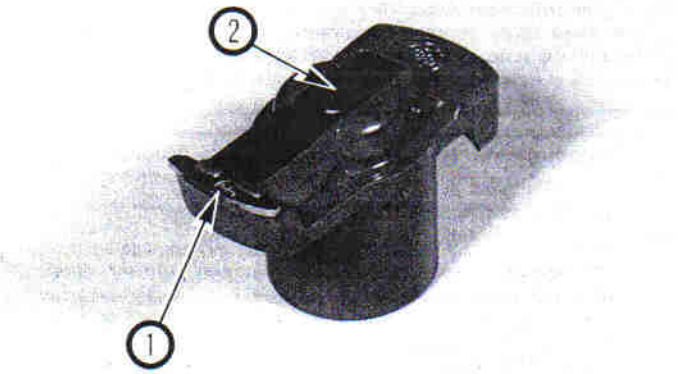
3.8 Distributor cap terminal markings



3.9 Snapping the spring clips back in place



4.2 Pull the rotor arm from the distributor shaft



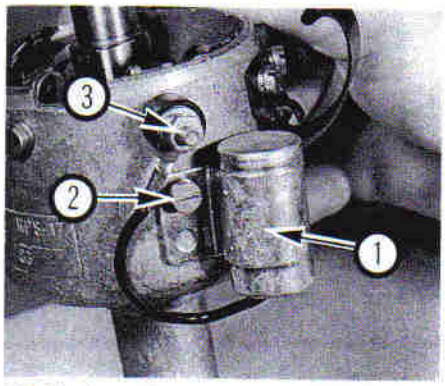
4.3 Rotor arm tip (1) and carbon brush contact area (2)

5 Condenser (contact breaker distributor) – description, removal, testing and refitting

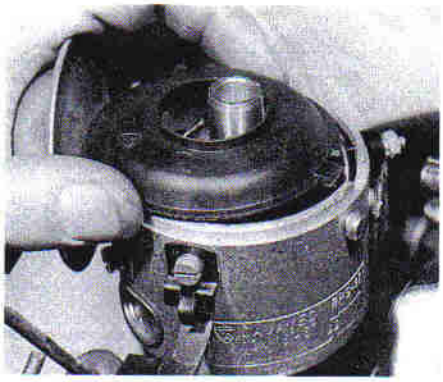
1 The purpose of the condenser (sometimes known as the capacitor) is to ensure that when the contact breaker points open there is no sparking across them which would weaken the spark at the plugs and cause rapid deterioration of the points.
2 The condenser is fitted in parallel with the contact breaker points. If it develops a short circuit, it will cause ignition failure as the points will be prevented from interrupting the low tension circuit.
3 If the engine becomes very difficult to start (or begins to misfire whilst running) and the breaker points show signs of excessive burning, suspect the condenser has failed with open circuit. A test can be made by separating the points by hand with the ignition switched on. If this is accompanied by a bright spark at the contact points, it is indicative that the condenser has failed.
4 Without special test equipment, the only sure way to diagnose condenser trouble is to replace a suspected unit with a new one and note if there is any improvement.
5 To remove the condenser from the distributor, take out the screw which secures it to the distributor body and disconnect its lead from the terminal (photo).
6 When fitting the condenser, it is vital to ensure that the fixing screw is secure. The lead must be secure on the terminal with no chance of short circuiting.

6 Contact breaker points – adjustment

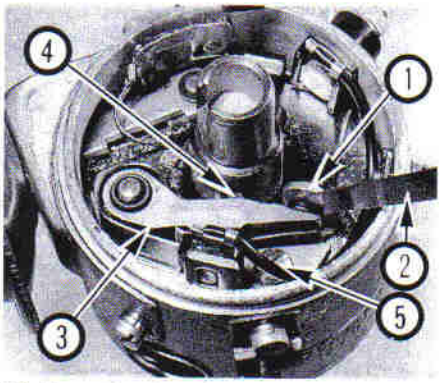
1 The gap between the contact breaker points reduces with wear of the heel on the spring-loaded contact, and the gap must be checked and adjusted, or the points renewed, at the intervals given in the *'Routine maintenance'* Section at the beginning of this manual.
2 To adjust the points gap, first remove the distributor cap and rotor arm as described in Sections 3 and 4.
3 Lift off the plastic shield (photo).
4 Turn the engine using a socket on the crankshaft pulley nut until the heel of the spring-loaded contact is resting on the highest point of one of the lobes on the distributor shaft.
5 Prise the points apart to inspect the surfaces of the contacts which should be a uniform greyish colour, and both surfaces should be smooth. If the contacts are burnt or pitted, the contact breaker assembly must be renewed.
6 A feeler blade of the specified thickness (see Specifications) should slide easily between the two contacts, with just a hint of resistance from the spring-loaded contact being felt (photo).
7 If the points gap requires adjustment, loosen the screw securing the fixed contact to the baseplate, and lever the fixed contact in or out as necessary to achieve the correct gap. There is a slot in the fixed contact arm and a raised 'pimple' on the baseplate enabling adjustments to be made with a screwdriver blade.
8 Once the gap is correct, tighten the fixed contact screw, turn the



5.5 Condenser location showing the condenser (1), securing screw (2) and terminal (3)



6.3 Lifting off the plastic shield



6.6 Measuring the points gap
1 Fixed contact
2 Feeler gauge blade
3 Spring-loaded contact arm
4 Heel
5 Fixed contact adjusting screw

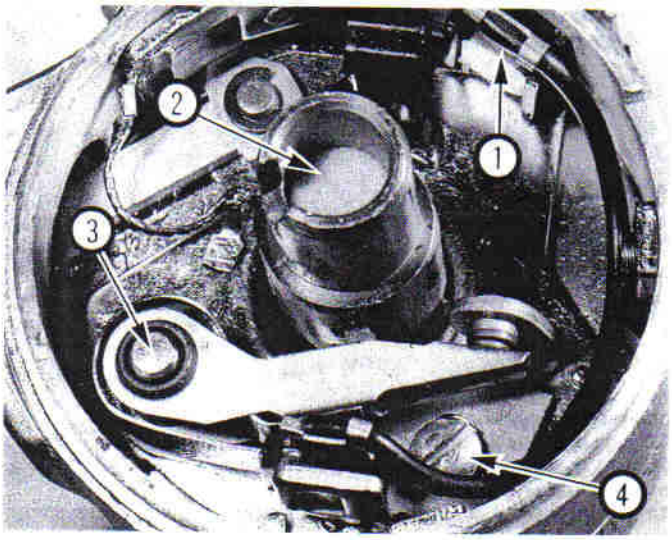
engine through one complete revolution and recheck the gap.
9 Refit the plastic shield, rotor arm and distributor cap.

7 Contact breaker points – renewal

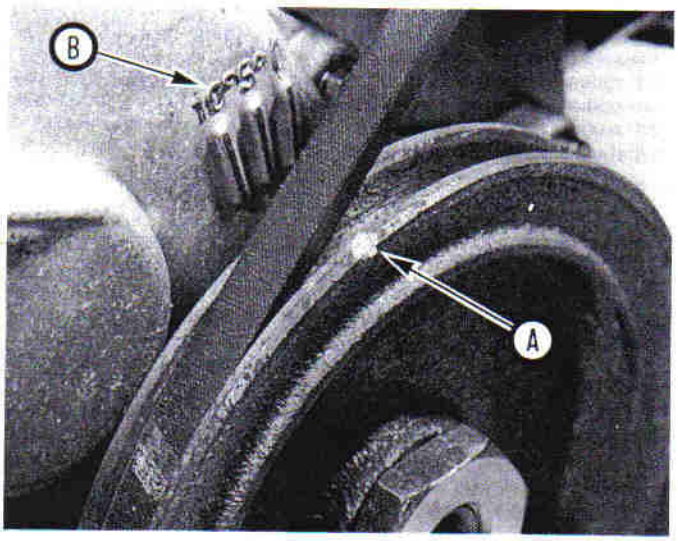
1 Remove the distributor cap, rotor arm and plastic shield as previously described.
2 Remove the screw from the fixed contact.
3 Loosen the LT connection on the side of the distributor.
4 Pull the contact breaker assembly from the pivot post, disconnect the LT connection and then remove the assembly from the distributor (photo).
5 Fitting the new contact breaker assembly is a reversal of removal. Apply a dab of high melting point grease to the pivot post and the heel of the contact arm.
6 Adjust the points gap as described in Section 6.
7 Apply a drop of engine oil to the felt pad in the top of the distributor shaft before refitting the rotor arm.
8 Check and if necessary adjust the ignition timing as described in Section 12.

8 Distributor (contact breaker type) – removal and refitting

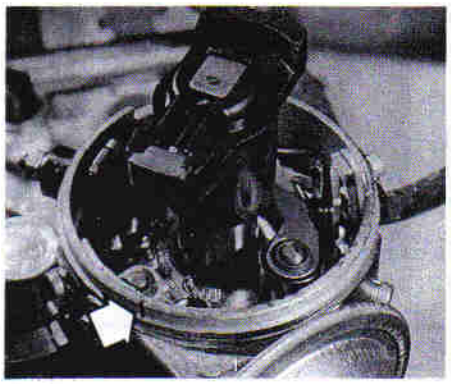
1 Remove the distributor cap, the rotor arm and the plastic shield, then temporarily refit the rotor arm.
2 Turn the engine using a socket on the crankshaft pulley nut until No 1 cylinder (nearest the crankshaft pulley) is at top dead centre (TDC) on its compression stroke. This can be checked by removing No 1 cylinder spark plug and placing a thumb over its hole as the engine is turned. Once both valves on No 1 cylinder are closed and the piston is rising on its compression stroke, the compression pressure will be felt. Alternatively, remove the valve cover and physically check that both valves are closed.
3 With No 1 piston at TDC, the timing marks on the crankshaft pulley should be in alignment with the TDC mark on the timing gear cover (photo).
4 On some distributors there is an index mark on the distributor rim, and the rotor arm should be pointing directly at the mark (photo). This mark corresponds to the No 1 cylinder HT lead terminal in the distributor cap. If there is no index mark, make a suitable mark with a marker or quick drying paint, so that the rotor arm can be positioned correctly when the distributor is refitted.
5 If the same distributor is to be refitted, then make an alignment mark across the distributor base and the cylinder head or block as applicable.
6 Disconnect the LT lead from the distributor and, where fitted, the vacuum hose (photo).
7 Undo the nut and remove the washer from the clamp plate, then remove the clamp plate (photo).
8 Lift out the distributor (photo).
9 Before refitting the distributor check that the timing marks on the



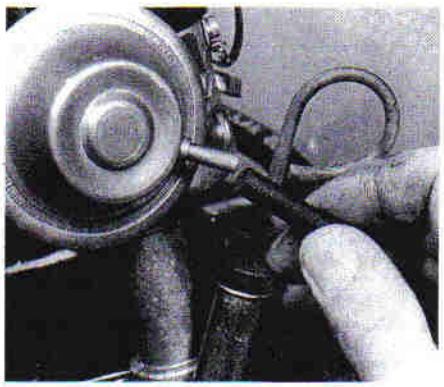
7.4 View of the contact breaker assembly
1 LT terminal
2 Felt pad
3 Pivot post
4 Fixed contact adjusting/securing screw



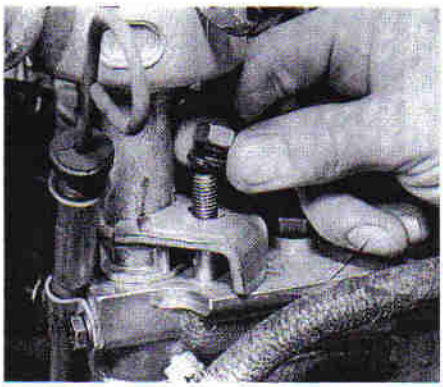
8.3 Timing marks on the crankshaft pulley (A) and timing gear cover (B) – 903 cc engine shown



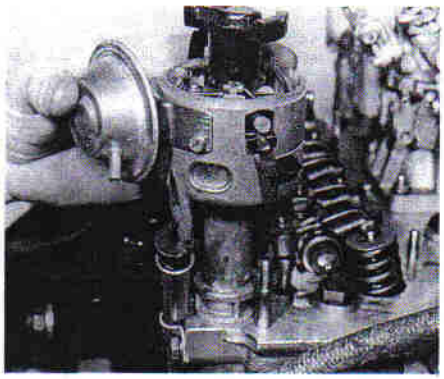
8.4 Rotor arm lined up with index mark on distributor rim (arrowed)



8.6 Disconnecting the vacuum hose

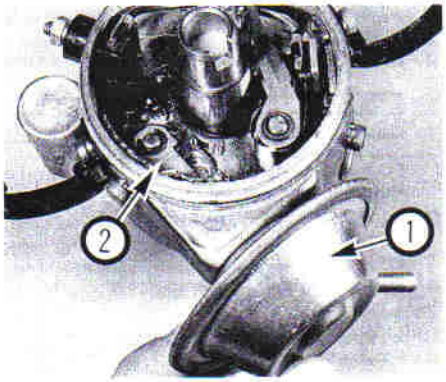


8.7 Undo the nut and remove the washer from the damp plate



8.8 Lifting out the distributor on a 903 cc engine

8.13 Splined distributor driveshaft



9.2 Vacuum unit (1) and control arm (2)

crankshaft pulley and timing gear cover are still in alignment.
10 Line up the rotor arm with the index mark on the distributor rim and fit the distributor to the splined driveshaft in the cylinder head or block as applicable.
11 Turn the distributor body until the previously made marks across the distributor base and the cylinder head or block (as applicable) line up. Refit the clamp plate and its washer and nut, and lightly tighten the nut.
12 Check that the rotor arm is still pointing towards the index mark on the distributor rim.
13 If the rotor arm does not line up with the mark, loosen the clamp plate nut, lift the distributor and turn it one spline to the left or right as necessary (photo). Tighten the clamp nut when the marks are aligned.
14 Check and if necessary adjust the points gap and ignition timing as described in Sections 6 and 12 respectively.
15 Reconnect the LT lead and the vacuum hose where applicable.
16 Refit the plastic shield, rotor arm and distributor cap.

9 Vacuum unit – testing, removal and refitting

1 The vacuum unit can be tested by disconnecting the pipe to the carburettor and applying a vacuum to its end.
2 The control arm in the distributor should move the distributor baseplate as the vacuum builds up (photo).
3 If the baseplate does not move, check that the pipe itself is not at fault before renewing the vacuum unit. To renew the vacuum unit proceed as follows.
4 Remove the screws securing the unit to the side of the distributor.
5 Remove the circlip securing the operating arm to the post on the baseplate.
6 Disengage the operating arm from the baseplate and withdraw the unit.
7 Refit in reverse order.

10 Distributor (contact breaker type) – overhaul

1 A distributor which has seen considerable service and in which the bushes have become worn, indicated by sloppiness of the distributor shaft in the body, can cause problems with the ignition system generally and can make accurate setting of the ignition timing difficult. Where this is the case it is better to renew the complete distributor.
2 If required, the distributor can be dismantled as follows.
3 Remove the distributor and then remove the rotor arm and contact breaker assembly.
4 Where fitted, remove the vacuum advance unit.
5 Unscrew and remove the LT terminal block from the side of the distributor.
6 Remove the two screws securing the baseplate to the distributor body and lift out the baseplate.
7 Prise out the felt pad from the top of the distributor shaft and remove the screw and washer located under it.
8 Unhook the bobweight springs and retrieve them from inside the distributor.
9 Remove the circlips from the bobweight pivot posts and lift out the bobweights.
10 Lift the cam and bobweight carrier from the shaft.
11 Reassembly is a reversal of removal. Renew any worn components, and apply high melting point grease to all pivot points, and a drop of engine oil to the felt pad in the top of the shaft.

11 Ignition coil (contact breaker system) – testing and renewal

1 Disconnect the coil primary (LT) connections and the secondary (HT) connection (photo).
2 Using an ohmmeter, check the resistance between the two LT connections, then between one of the LT connections and the HT

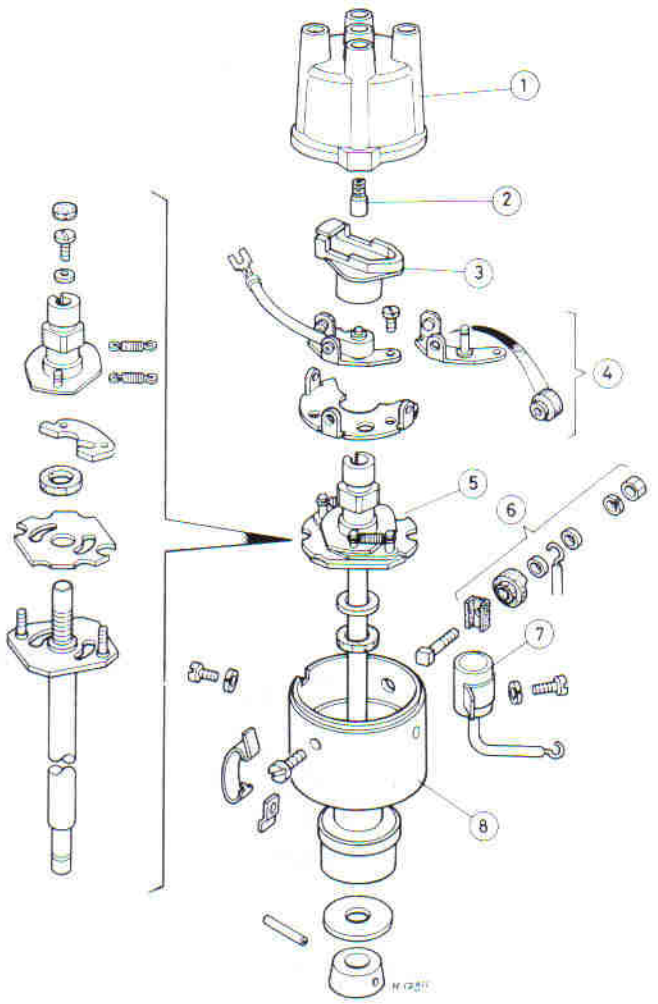
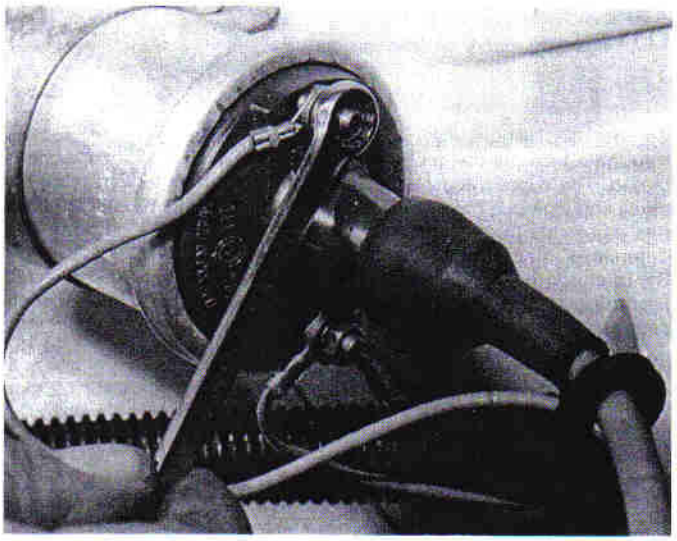


Fig. 4.2 Exploded view of contact breaker distributor showing the main components (Sec 10)

1 *Distributor cap*
2 *Brush*
3 *Rotor arm*
4 *Contact breaker points assembly*
5 *Baseplate assembly*
6 *LT terminal assembly*
7 *Condenser*
8 *Distributor body*



11.1 Disconnect the coil primary (LT) connections

connection. If the resistance is not as specified, renew the coil.
3 To remove the coil, loosen the upper and lower bracket securing bolts, then slacken the clamp bolt sufficiently to enable the coil to be withdrawn from the bracket.
4 Refitting is a reversal of removal.

12 Ignition timing – adjustment

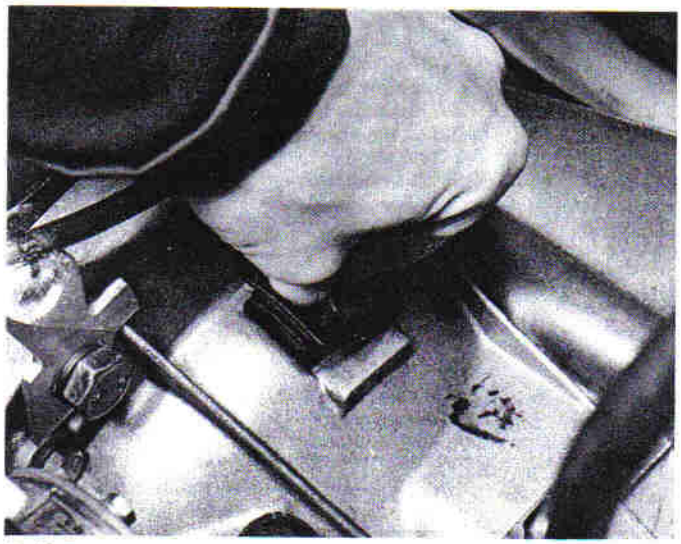
1 Ignition timing can be split into two categories – static and dynamic.
2 Static timing should be regarded as a means of setting the ignition timing after overhaul in order to get the engine running.
3 Dynamic timing, using a strobe light is far more accurate, and is the preferred method of setting the timing once the engine is running.
4 Before attempting to adjust the ignition timing, ensure that the ignition system components are in good order and that the spark plug gaps and points gap (where applicable) are correctly set.

Static timing

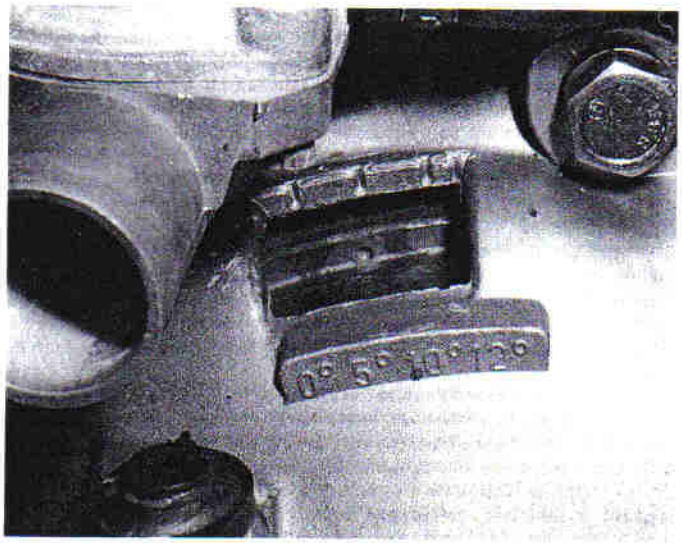
5 Turn the crankshaft in its normal direction of rotation (clockwise when viewed from the crankshaft pulley end) until the index mark on the crankshaft pulley lines up with the relevant timing mark on the timing gear case, with No 1 piston on its compression stroke. Alternatively, the marks on the flywheel and clutch bellhousing can be used.
6 In this position, both valves on No 1 cylinder should be closed.
7 This can be ascertained by removing No 1 spark plug and placing a thumb over the hole. When the engine is turned with No 1 piston on its compression stroke, the compression pressure will be felt.
8 With the crankshaft in this position, the rotor arm in the distributor should be pointing towards the index mark on the distributor rim. To check this, the distributor cap, rotor arm and plastic shield must be removed and the rotor arm temporarily refitted.
9 If the index mark and rotor arm do not line up, loosen the distributor clamp plate nut and turn the distributor body so that they do. Tighten

the clamp plate nut on completion. If there is no index mark on the distributor rim, check that the rotor arm points towards No 1 cylinder HT lead terminal in the distributor cap.
10 Refit the plastic shield, rotor arm and cap.
11 This will enable the engine to be started and dynamic timing carried out.

Dynamic timing
12 Where fitted, disconnect the vacuum hose from the distributor to the carburettor.
13 Remove the rubber bung from the timing mark aperture on the clutch bellhousing (photo).
14 On OHV engines there is a 'pip' on the flywheel and also an index mark on the flywheel periphery, with marks on the bellhousing indicating degrees before TDC (photo).
15 On OHC engines there is a dimple in the flywheel with marks on the bellhousing indicating degrees before TDC (photo).
16 It helps if these marks are highlighted using a marker pen, or quick-drying white paint.
17 Connect a strobe light to the ignition system in accordance with the manufacturer's instructions.
18 Start the engine and allow it to reach normal operating temperature. Check the idle speed (Chapter 3).



12.13 Removing the rubber bung from the timing mark aperture

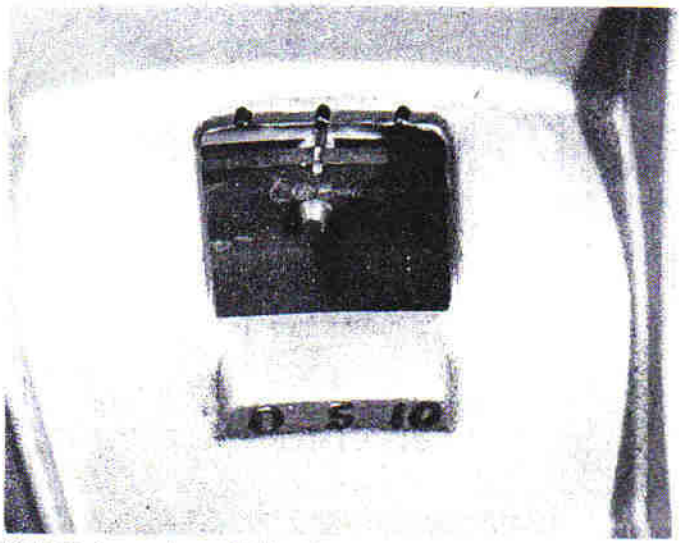


12.15 Timing marks on OHC engines

19 Aim the strobe light at the timing marks. The mark on the flywheel should appear to be stationary directly in line with the specified degrees BTDC mark (see Specifications).
20 To adjust the ignition timing, loosen the clamp plate nut at the base of the distributor and turn the distributor clockwise to retard the ignition or anti-clockwise to advance it, until the relevant marks line up.
21 Tighten the clamp plate nut and recheck the timing.
22 If the engine speed is now increased, the timing marks should move apart, indicating that the mechanical advance weights are functioning correctly.
23 Stop the engine and remove all test equipment.
24 Refit the rubber bung to the bellhousing aperture, and where applicable reconnect the vacuum hose.

13 Dwell angle – checking and adjustment

1 The setting of a contact breaker points gap using feeler gauges has nowadays become a basic setting only, and more emphasis is placed on the dwell angle.



12.14 Timing marks on OHV engines

2 The dwell angle may be expressed as the number of degrees through which the distributor driveshaft turns with the contact points closed. The wider the gap, the smaller the dwell angle. Checking the dwell angle gives a more accurate setting of the contact breaker points gap and tends to even out the effects of wear in the distributor and differences in height between the cam lobes.
3 To check the dwell angle a dwell meter will be required connected according to the manufacturer's instructions. Refer to the Specifications for the correct dwell angle.
4 With the dwell meter connected and the engine running, check the dwell angle. If it is too large, increase the points gap and vice versa. The dwell angle should always be checked before checking and adjusting the ignition timing.

14 Spark plugs – removal, inspection and refitting

Note: *Before disconnecting the HT leads from the spark plugs, label or mark them one to four so that they can be refitted in the correct positions in order to maintain the correct firing order.*

1 The correct functioning of the spark plugs is vital for the correct running and efficiency of the engine. It is essential that the plugs fitted are appropriate for the engine (the correct type is specified at the beginning of this Chapter). If this type is used, and the engine is in good con-

Are your plugs trying to tell you something?

Normal.
Grey-brown deposits, lightly coated core nose. Plugs ideally suited to engine, and engine in good condition.

Heavy Deposits.
A build up of crusty deposits, light-grey sandy colour in appearance.
Fault: Often caused by worn valve guides, excessive use of upper cylinder lubricant, or idling for long periods.

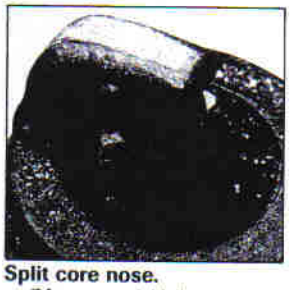
Lead Glazing.
Plug insulator firing tip appears yellow or green/yellow and shiny in appearance.
Fault: Often caused by incorrect carburation, excessive idling followed by sharp acceleration. Also check ignition timing.

Carbon fouling.
Dry, black, sooty deposits.
Fault: over-rich fuel mixture.
Check: carburettor mixture settings, float level, choke operation, air filter.

Oil fouling.
Wet, oily deposits. Fault: worn bores/piston rings or valve guides; sometimes occurs (temporarily) during running-in period.

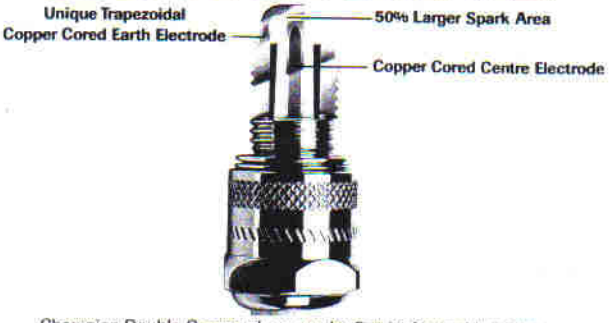
Overheating.
Electrodes have glazed appearance, core nose very white – few deposits. Fault: plug overheating. Check: plug value, ignition timing, fuel octane rating (too low) and fuel mixture (too weak).

Electrode damage.
Electrodes burned away; core nose has burned, glazed appearance. Fault: pre-ignition. Check: for correct heat range and as for 'overheating'.

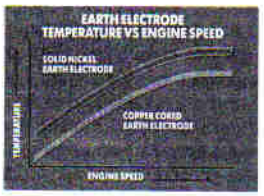


Split core nose.
(May appear initially as a crack). Fault: detonation or wrong gap-setting technique. Check: ignition timing, cooling system, fuel mixture (too weak).

WHY DOUBLE COPPER IS BETTER FOR YOUR ENGINE.



Champion Double Copper plugs are the first in the world to have copper core in both centre and earth electrode. This innovative design means that they run cooler by up to 100°C – giving greater efficiency and longer life. These double copper cores transfer heat away from the tip of the plug faster and more efficiently. Therefore, Double Copper runs at cooler temperatures than conventional plugs giving improved acceleration response and high speed performance with no fear of pre-ignition.



Champion Double Copper plugs also feature a unique trapezoidal earth electrode giving a 50% increase in spark area. This, together with the double copper cores, offers greatly reduced electrode wear, so the spark stays stronger for longer.

- **FASTER COLD STARTING**
- **FOR UNLEADED OR LEADED FUEL**
- **ELECTRODES UP TO 100°C COOLER**
- **BETTER ACCELERATION RESPONSE**
- **LOWER EMISSIONS**
- **50% BIGGER SPARK AREA**
- **THE LONGER LIFE PLUG**

Plug Tips/Hot and Cold.
Spark plugs must operate within well-defined temperature limits to avoid cold fouling at one extreme and overheating at the other.
Champion and the car manufacturers work out the best plugs for an engine to give optimum performance under all conditions, from freezing cold starts to sustained high speed motorway cruising.
Plugs are often referred to as hot or cold. With Champion, the higher the number on its body, the hotter the plug, and the lower the number the cooler the plug. For the correct plug for your car refer to the specifications at the beginning of this chapter.

Plug Cleaning
Modern plug design and materials mean that Champion no longer recommends periodic plug cleaning. Certainly don't clean your plugs with a wire brush as this can cause metal conductive paths across the nose of the insulator so impairing its performance and resulting in loss of acceleration and reduced m.p.g.
However, if plugs are removed, always carefully clean the area where the plug seats in the cylinder head as grit and dirt can sometimes cause gas leakage.
Also wipe any traces of oil or grease from plug leads as this may lead to arcing.

CHAMPION

DOUBLE COPPER

dition, the spark plugs should not need attention between scheduled service renewal intervals. Spark plug cleaning is rarely necessary, and should not be attempted unless specialised equipment is available, as damage can easily be caused to the firing ends.

2 At the intervals specified in *'Routine maintenance'*, the spark plugs should be removed and renewed, or the gap reset.

3 To remove the plugs, remove the air cleaner for access if necessary, and pull of the HT leads from the spark plugs (photo). (Do this only by gripping the rubber cover, not the lead itself, or damage to the lead may result.)

4 Clean the area around the spark plug recesses with a brush to remove dirt which may fall into the cylinder when the plugs are removed.

5 Remove each spark plug using a long reach socket or box spanner (photo).

6 Examination of the spark plugs can provide a good indication of engine condition.

7 If the nose of the plugs is clean and white, with little or no deposits, it indicates the fuel/air mixture is too weak.

8 If the nose of the plug is covered with a hard black deposit, then it shows the mixture is too rich.

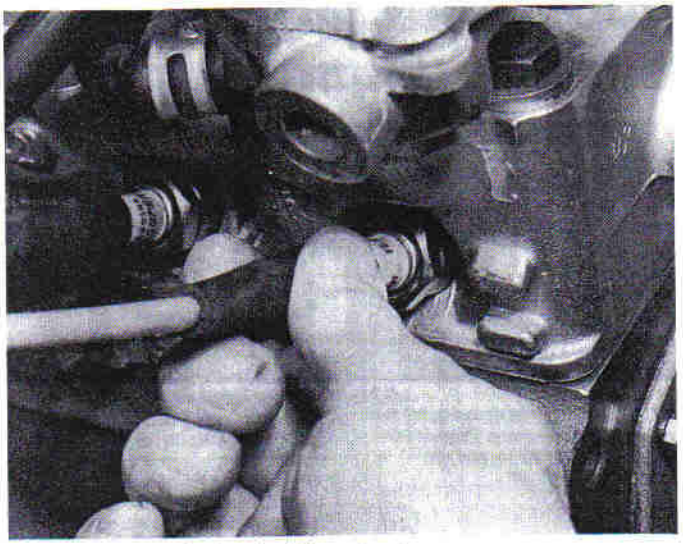
9 If the deposit is black, wet and oily, it may indicate that internal wear of the engine has occurred to the degree where oil is passing the pistons and being burned in the combustion chambers. Do not confuse this condition with that of an engine 'flooded' with petrol, where excessive use of throttle and choke has resulted in the plugs being soaked in petrol, with a resultant failure to start.

10 The ideal condition for the plugs to be in is that of an even light brown to greyish brown deposit, indicating the mixture is correct.

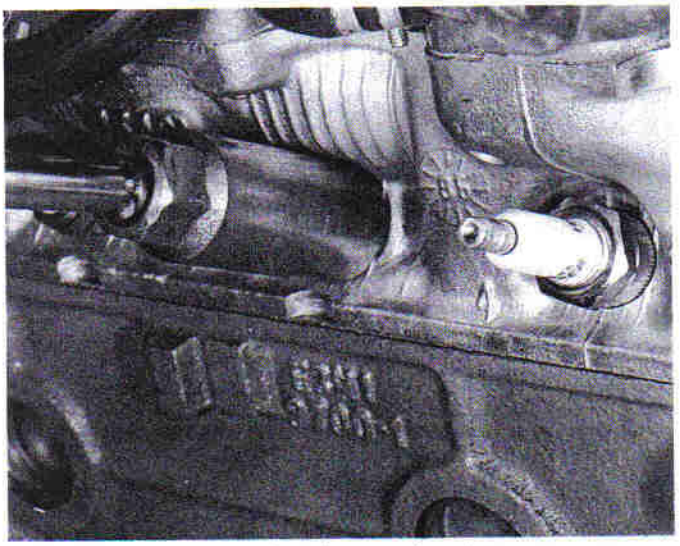
11 The size of the spark plug gap is vitally important to engine efficiency, and must be set correctly. To do this, measure the gap with feeler gauges, then bend the outer electrode either in or out until the gap is correct. Never try to bend the centre electrode or damage to the insulation will occur. Special tools for gap setting are available commercially at little expense, and are worth having (photo).

12 Lightly grease the plug threads using graphite or high melting point grease, then screw each plug in by hand, ensuring the plugs are not cross-threaded.

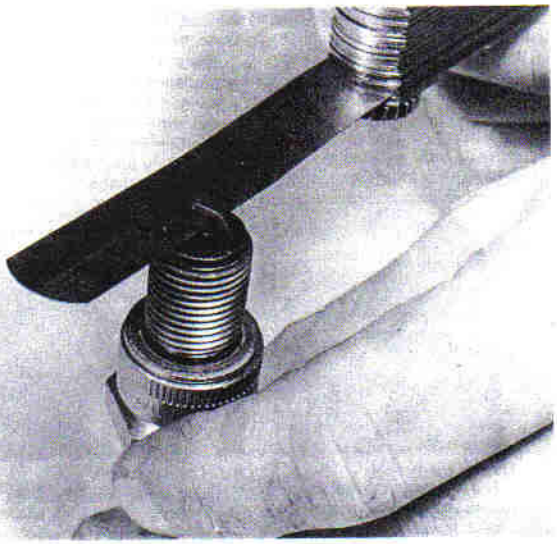
13 Tighten to the correct torque, using a torque wrench, to avoid danger of stripping the threads in the cylinder head.



14.3 Pulling a spark plug lead from the plug



14.5 Removing the plug using a long reach socket



14.11 Measuring a spark plug gap with a feeler gauge

15 HT leads – general

1 HT leads generally require little maintenance except for keeping them clean and dry.

2 The periodic application of commercial water repellent spray to the leads and their connections at the distributor cap and spark plugs is beneficial, especially in damp weather.

3 After long periods of service, the conductive properties of the leads can deteriorate and it is worth renewing them.

4 Ensure that the connections at the distributor cap and spark plugs are a firm, tight fit.

16 Lucas electronic ignition system – general description

Warning: *Electronic ignition systems produce a very high HT voltage which can prove extremely dangerous and possibly fatal. Do not touch any part of the ignition system when the engine is running, and follow all test procedures exactly to avoid any possibility of injury.*

The Lucas electronic ignition system is fitted to 55 GLS models from approximately March 1984 to April 1986. It is a breakerless system employing the 'Hall effect'.

The system employs a conventional distributor, the mechanical advance bobweights being retained, but the contact breaker assembly is replaced by the 'Hall effect' rotor and sensor.

As the rotor assembly, which incorporates a conventional rotor arm, rotates, each vane of the rotor passes through the sensor. As each cut-out in the rotor passes through the sensor, the LT current is interrupted causing the LT current in the primary coil to break down.

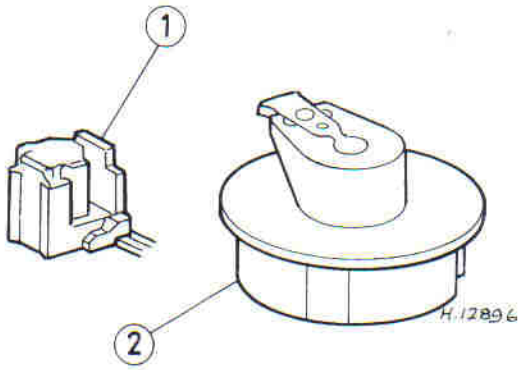


Fig. 4.3 Lucas electronic ignition 'Hall effect' sensor (1) and rotor assembly (2) (Sec 16)

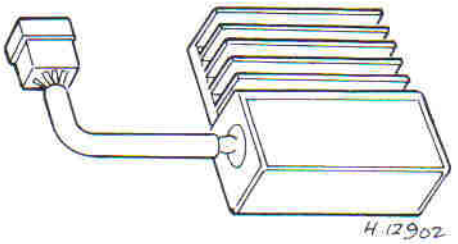


Fig. 4.4 Lucas electronic ignition control unit (Sec 16)

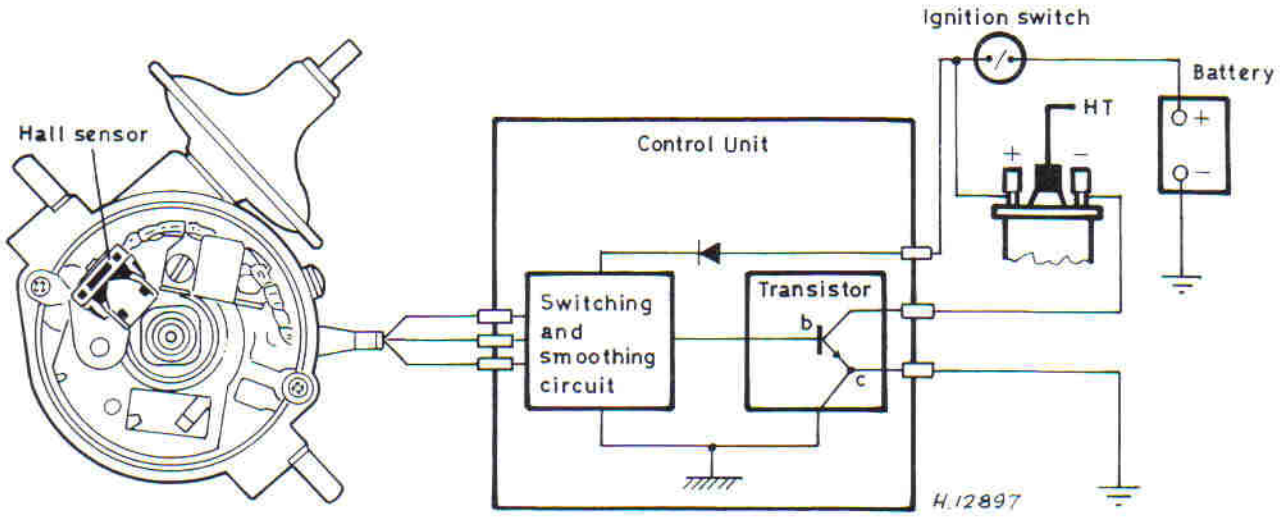


Fig. 4.5 Wiring diagram for Lucas electronic ignition system (Sec 16)

thus triggering the HT current in the secondary coil which is then delivered to the spark plugs in the conventional manner through the distributor. The width of each sensor vane represents the dwell angle, or the period when the points are closed in a mechanical contact system.

The control unit acts as a switching unit and also amplifies the signals produced by the sensor in the distributor.

17 Lucas electronic ignition system – testing

Note: *Refer to the warning note at the start of Section 16 before proceeding. A voltmeter and an ohmmeter will be required for the following tests.*

HT circuit test

1 Disconnect the HT lead between the coil and the distributor cap at the distributor.
2 Holding the HT lead about 6.0 mm (0.25 in) from the engine block using heavily insulated pliers, have an assistant crank the engine.
3 There should be a regular, strong spark from the HT lead. If not, test the control unit.
4 If the control unit proves serviceable, renew the HT lead.
5 If there is still no spark, renew the coil.

Control unit test (amplifier side)

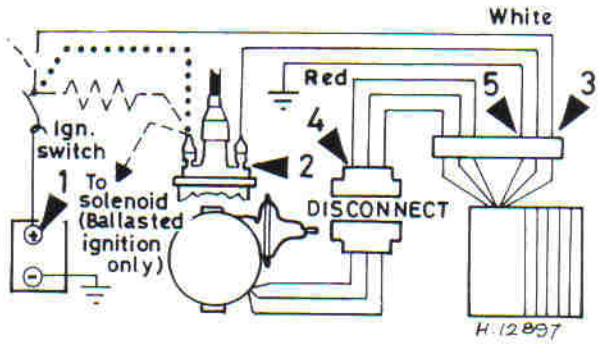
6 Disconnect the three-pin connector in the main harness to the distributor.
7 Refer to Fig. 4.6 and check the voltage between points 1, 2, 3, 4 and 5 and a good earth (ignition switched on).
8 The values should be as shown, with the possible causes of incorrect readings also given. For example, if the voltage at point 1 is low(L) with all others correct, suspect a discharged battery.
9 Connect a jumper lead across the black and green pins of the three-pin connector.
10 Connect a voltmeter between the coil LT negative terminal and a good earth.
11 Switch on the ignition. The voltmeter reading should not be less than 1 volt below battery voltage. If it is then suspect the coil. If the coil is serviceable then suspect the control unit.

Control unit test (switching side)

12 With all connections made, connect a voltmeter between the coil LT negative terminal and a good earth.
13 Crank the engine. The voltmeter reading should fluctuate between an average of 2.5 and 5.0 volts. If not, renew the sensor in the distributor.

Rotor assembly test

14 Remove the distributor cap.
15 Disconnect the coil HT lead from the distributor cap, and using heavily insulated pliers hold the lead about 3.0 mm (0.13 in) above the rotor arm electrode.
16 Have an assistant crank the engine.
17 There should be no sparking between the rotor and HT lead.
18 If there is, renew the rotor assembly.
19 A further test can be made as follows.
20 Connect an ohmmeter between a rotor vane and a good earth.
21 The reading should be less than 50.0 ohms. If more, renew the rotor assembly.



EXPECTED READINGS

1	More than 11.5 volts
2	Less than 2.0 volts
3	1 volt max below volts at 1
4	2.5 volts max below volts at 1
5	0 volt – 0.1 volt

Ballasted ignition circuit

Non-ballasted ignition circuit

1	2	3	4	5	SUSPECT
L	√	√	√	√	Discharged battery
√	H	L or √	L or √	√	Amplifier
√	√	L	L or √	√	Ignition switch and/or wiring
√	√	√	L	√	Amplifier
√	√	√	√	H	Amplifier earth (ground)

Fig. 4.6 Lucas electronic ignition control unit test procedure (Sec 17)

18 Distributor (Lucas electronic ignition) – overhaul

1 As already explained in Section 16 the distributor is similar to that used in the contact breaker system, and the procedure for removal and refitting is as described in Section 8.
2 Similarly, removal of the distributor cap is as described in Section 3.
3 Pull off the rotor assembly.
4 Remove the two screws securing the baseplate and sensor, and lift them out of the distributor.
5 The remaining procedure for removal of the bobweights is as described in Section 10, paragraphs 8 to 10.
6 Inspect the vanes of the rotor assembly and if they are worn, bent or broken, the assembly must be renewed. Inspect the rotor arm as described in Section 4.
7 If fault diagnosis indicates a fault with the sensor, renew the sensor and baseplate.
8 Reassembly is a reversal of removal.
9 The air gap between the rotor vanes and the sensor should be such that the vanes pass through the sensor centrally without touching any part of the sensor.
10 This is achieved by loosening the baseplate screws and moving the baseplate until the desired clearance is obtained. Tighten the screws and recheck.
11 Refit the distributor as described in Section 8, and check and if necessary adjust the ignition timing as described in Section 12.

19 Control unit (Lucas electronic ignition) – removal and refitting

1 The control unit is either bolted to the inner wing or in some cases may be found mounted on the back of the radiator grille.
2 Disconnect the multi-plug from the wiring harness.
3 Remove the control unit securing screws and lift out the unit.
4 Refit in reverse order.

20 Bosch electronic ignition system – general description

Note: *Refer to the warning note at the start of Section 16 before proceeding.*

The Bosch electronic system consists of a breakerless distributor, coil and control unit.

With the ignition switched on, battery voltage is supplied via the control unit to the primary (LT) side of the coil. When the engine is started, and the distributor turns, the rotor vanes generate impluses in the pick-up (the same effect as the contact breakers in the mechanical system). These impluses are sensed by the control unit which switches off the primary field in the coil, thus generating the HT voltage in the secondary windings. The HT voltage is distributed by the distributor to the spark plugs in the conventional manner.

21 Distributor (Bosch electronic ignition) – removal and refitting

The procedure is basically as described for the contact breaker distributor in Section 8.

22 Distributor (Bosch electronic ignition) – overhaul

Note: *The distributor should be renewed if the bushes are worn, causing sloppiness of the distributor shaft. The procedure given here deals only with those components the owner can reasonably expect to overhaul or renew.*

1 Remove the distributor as described in Section 8.
2 Using circlip pliers, remove the circlip securing the four-pole rotor to the shaft (photo). Remove the washers.
3 Using two screwdrivers placed at either side of the distributor,

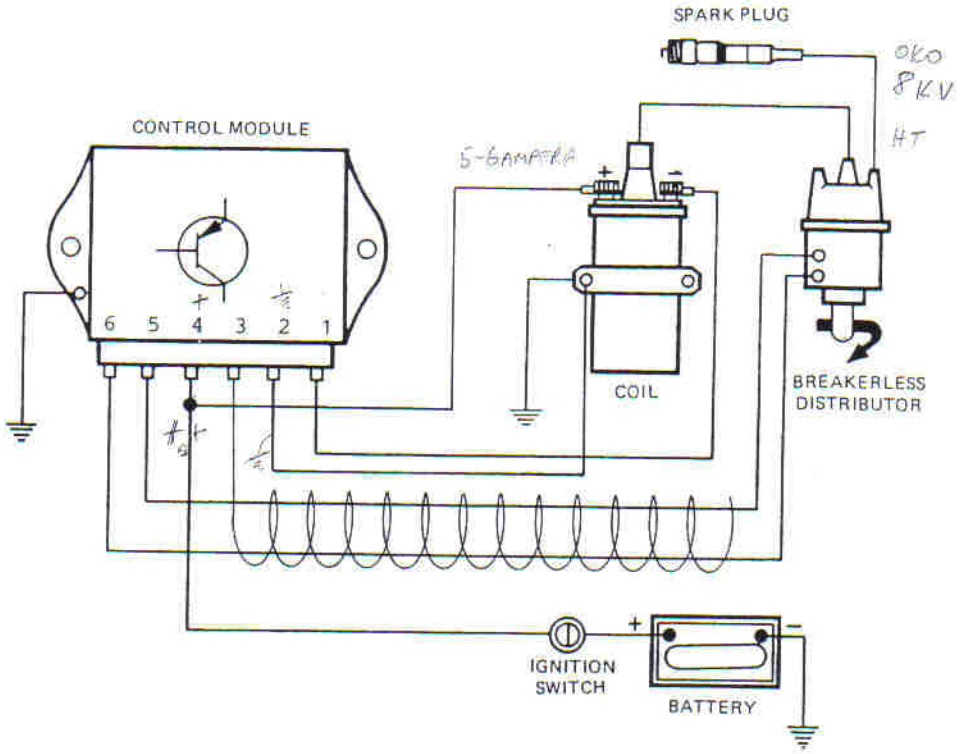
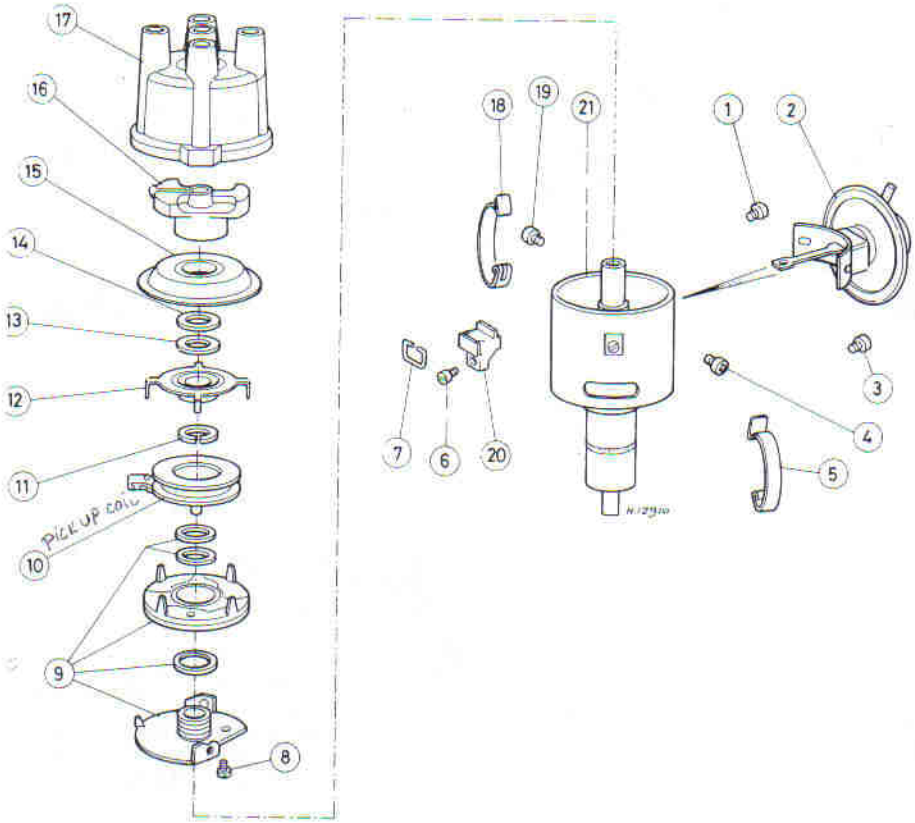


Fig. 4.7 Wiring diagram for Bosch electronic ignition system (Sec 20)

Fig. 4.8 Exploded view of Bosch electronic distributor (Sec 22)

1 Screw
2 Vacuum unit
3 Screw
4 Screw
5 Spring clip
6 Screw
7 Spring clip
8 Screw
9 Pick-up assembly
10 Pick-up coil
11 Circlip
12 Rotor
13 Washers
14 Circlip
15 Plastic shield
16 Rotor arm
17 Distributor cap
18 Spring clip
19 Screw
20 Wiring plug
21 Distributor body



carefully lever off the rotor. Do not attempt to lever out the pick-up assembly with it.
4 Retrieve the pin which locks the rotor to the shaft.
5 Remove the screws securing the vacuum unit.
6 Remove the circlip from the shaft directly above the pick-up coil.
7 Unscrew and remove the screws securing the pick-up assembly to the distributor body.
8 Lift out the pick-up assembly, disconnecting the vacuum unit from the spigot on the underside of the pick-up assembly, and remove the vacuum unit (photos).
9 Access is now available to the bobweights which govern the mechanical advance. Check to ensure that they are not sticking. The springs can be removed by unhooking them from the posts. Similarly, the bobweights can be removed by releasing the circlips. Apply a smear of grease to the bobweights and posts on refitting (photo).
10 Renew any of the electronic components which fault diagnosis may have proved to be faulty.
11 Commence reassembly by fitting the pick-up assembly and vacuum unit, ensuring that the operating arm engages with the spigot, then fit and tighten the pick-up assembly and vacuum unit securing screws.
12 Fit the circlip to the shaft (photo).
13 Fit the rotor, lining up the grooves for the retaining pin (photo).
14 Fit the retaining pin to the grooves and tap it home using a pin punch (photo).
15 Fit the washers and circlip, ensuring that the circlip slots into its groove in the shaft.
16 Carefully measure the gap between the pick-up and rotor tips, measuring the clearance between each rotor tip and all four pick-up tips. Bend the rotor tips to achieve the specified clearance.
17 Refit the distributor as described in Section 8.
18 Check and if necessary adjust the ignition timing as described in Section 12.

23 Bosch electronic ignition system – testing

Note: *Refer to the warning note at the start of Section 16 before proceeding. A voltmeter and an ohmmeter will be required for the following tests.*

Primary input test

1 Connect a voltmeter between the coil B+ terminal and a good earth and switch on the ignition. The voltmeter should read 12 volts. If not, check the battery, ignition switch and wiring connections.

Earth test

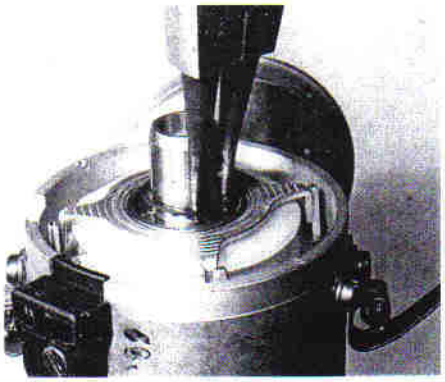
2 With the ignition switched off, connect an ohmmeter between the control unit mounting bracket and the battery negative terminal.
3 The reading should be less than 0.2 ohm. If not, check that the control unit mounting is clean and free from corrosion and that the mounting nuts are tight. Similarly check the battery and earth lead.

Coil resistance test

4 Disconnect both the coil primary leads and the secondary lead.
5 Connect the ohmmeter between the two primary terminals. The reading should be 0.7 ohm.
6 Change one ohmmeter lead over to the coil secondary terminal, when the reading should be 9500 ohms.
7 Renew the coil if these figures are not obtained.

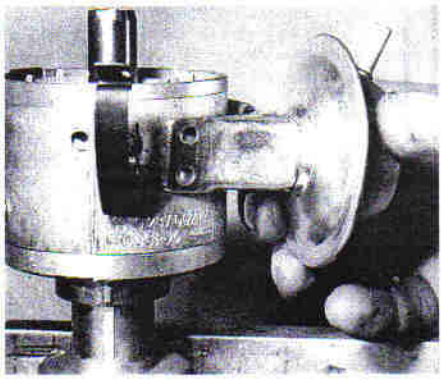
Pick-up assembly test

8 Disconnect the wiring plug from the distributor.
9 Connect the ohmmeter between the two pick-up assembly terminals.
10 The reading should be between 990 and 1210 ohms.
11 Disconnect one of the ohmmeter leads and connect it to the

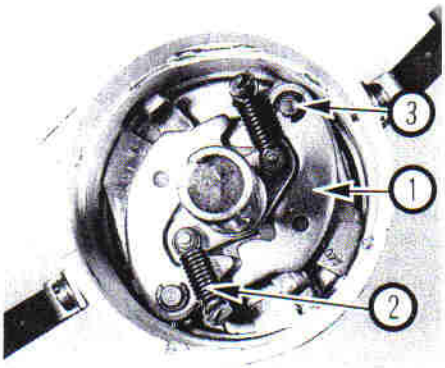


22.2 Removing the circlip securing the rotor to the shaft

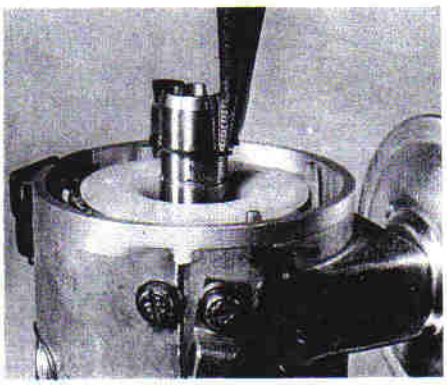
22.8A Lift out the pick-up assembly



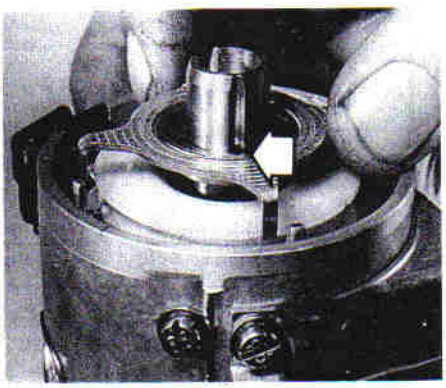
22.8B ... and remove the vacuum unit



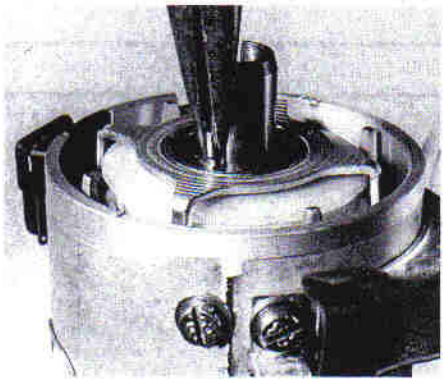
22.9 Bosch distributor mechanical advance mechanism
1 Bobweights
2 Springs
3 Circlips



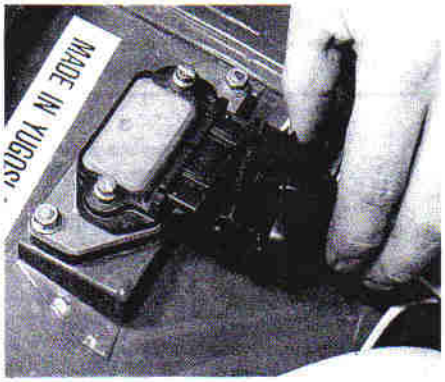
22.12 Fitting the pick-up assembly retaining circlip



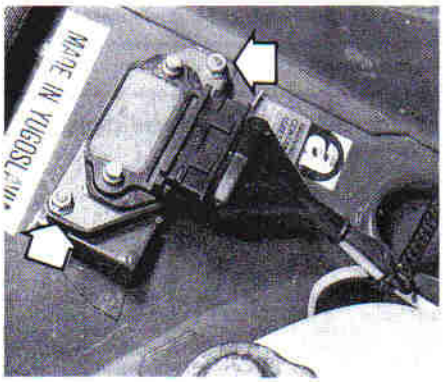
22.13 Fit the rotor, lining up the retaining pin grooves (arrowed)



22.14 Fit the retaining pin



25.1 Disconnecting the multi-plug from the control unit



25.2 Control unit mounting nuts (arrowed)

distributor body, when the reading should show infinity.
12 If the specified readings are not obtained, renew the pick-up assembly.

Control unit test

13 With all connections in the system made, disconnect the secondary (HT) lead between the coil and the distributor at the distributor.
14 Connect a spark plug to the lead.
15 Using heavily insulated pliers, have an assistant crank the engine and check for a spark.
16 Renew the control unit if no spark is obtained.

24 Rotor arm (Bosch electronic ignition) – removal, inspection and refitting

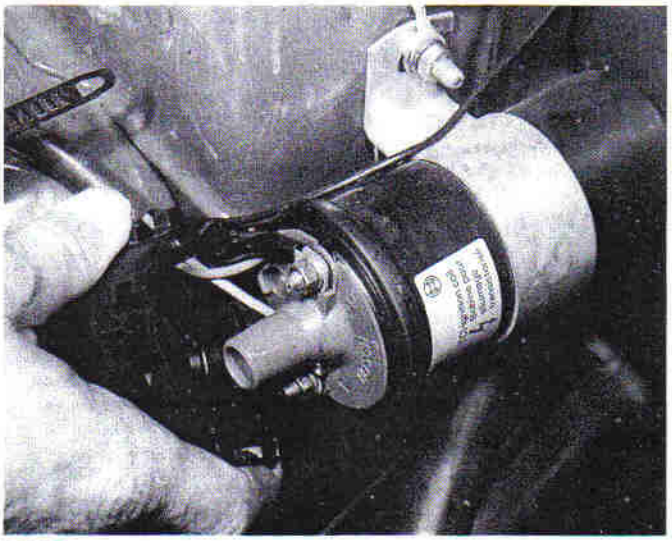
The procedure is as described for the contact breaker system in Section 4.

25 Control unit (Bosch electronic ignition) – removal and refitting

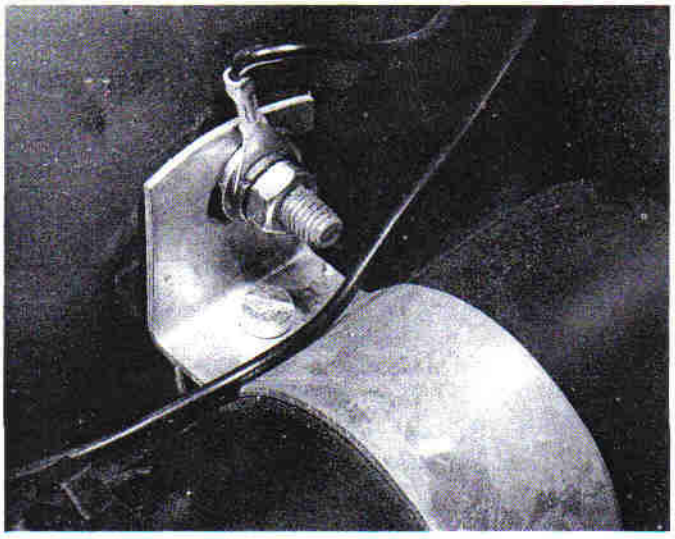
1 Disconnect the multi-plug from the control unit (photo).
2 Remove the nuts securing the unit to the support bracket on the inner wing (photo).
3 Refitting is a reversal of removal, but ensure that the mounting bracket and backplate are clean and free from corrosion, and that the mounting nuts are tight. A good earth between the bracket and the inner wing must be maintained.

26 Coil (Bosch electronic ignition) – removal and refitting

1 Disconnect the HT lead from the coil.
2 Remove the plastic cover fitted over the terminal end of the coil (photo).
3 Disconnect the LT leads.
4 Loosen the clamp bracket nuts and disconnect the earth lead (photo).
5 Slacken the clamp bolt sufficiently to allow the coil to be withdrawn.
6 Refit in reverse order, ensuring that the earth lead is secured under the bracket nut.



26.2 Remove the plastic cover



26.4 Clamp bracket nut and earth lead

Fault diagnosis overleaf

27 Fault diagnosis – ignition system

Symptom	Reason(s)
Mechanical contact breaker type	
Engine fails to start	Loose battery connections Discharged battery Oil in contact points Disconnected ignition leads Faulty condenser
Engine starts and runs but misfires	Faulty spark plug Cracked distributor cap Cracked rotor arm Worn advance mechanism Incorrect spark plug gap Incorrect contact points gap Faulty condenser Faulty coil Incorrect timing Poor engine/transmission earth connections
Engine overheats, lacks power	Seized distributor weights Perforated vacuum pipe Incorrect ignition timing
Electronic systems	
Refer to Section 17 for Lucas system and to Section 23 for Bosch system testing and fault finding.	

Chapter 5 Clutch

Contents

Specifications

Type	Single dry plate, diaphragm spring, cable-operated through ball type release bearing
Clutch pedal free play	25.0 mm (1.00 in)
Driven plate diameter LADA	181.5 mm (7.15 in)
Maximum run-out of driven plate	0.25 mm (0.01 in)

Torque wrench settings

	Nm	lbf ft
Clutch pressure plate bolts	16	12
Clutch release fork lockbolt	26	19

1 General description

The clutch on all models in the Yugo range is basically the same. Where any major differences occur, these are pointed out in the text.

The clutch is a cable-operated, single dry plate, diaphragm spring type, consisting of three main components – driven plate, pressure plate (incorporating the diaphragm spring) and the release bearing.

The driven plate has friction linings riveted to both surfaces, and is sandwiched between the flywheel and pressure plate. The centre hub is spring-loaded to take up transmission shocks.

In the engaged state, the drive plate, which is free to slide along the input shaft to which it is splined, is forced against the flywheel by the pressure exerted by the diaphragm spring of the pressure plate. Torque from the engine is thus transmitted to the gearbox.

When the clutch pedal is depressed, the clutch cable pulls the release arm on the clutch bellhousing, which, through the action of the release fork and release bearing, relieves the pressure exerted by the pressure plate on the driven plate and interrupts the transmission of torque.

2 Routine maintenance

At the intervals given in the *'Routine maintenance'* Section at the beginning of this manual, carry out the following.

Check and adjust as necessary clutch cable free play (Section 3)
Whenever the engine and transmission units are separated, take the opportunity to inspect the clutch components for wear and contamination, renewing as necessary (Section 7)

3 Clutch – adjustment

1 Clutch adjustment will be required periodically to compensate for wear in the friction linings of the driven plate.
2 Adjustment is by means of the threaded adjuster on the end of the clutch cable where it contacts the release arm on the bellhousing (photo).
3 The taughtness of the cable should be such that clutch pedal free play (the amount of movement of the clutch pedal before tension is applied to the cable) is as shown in the Specifications.
4 Undo the locknuts on the threaded adjuster at the release arm, then tighten the inner nut, thus pulling on the cable, until the specified free play is achieved at the clutch pedal. Tighten the outer nut against the inner to lock them and re-check the pedal free play.
5 The 'half-moon' shaped grommet in the release arm fork must be in good condition, or the accuracy of the adjustment will be affected.

4 Clutch cable – renewal

1 Slacken the locknuts on the adjuster at the release arm lever on the clutch bellhousing (see Section 3).
2 Disconnect the cable from the release arm and the bracket on the transmission casing (photo).
3 Where fitted, remove the bolt from the grommet where the cable passes through the engine bulkhead.
4 The cable is secured to the clutch pedal either by a pin and spring clip or a pin and split pin. Remove whichever is applicable and disconnect the cable from the pedal.
5 Pull the cable through the engine bulkhead into the engine compartment.
6 Fit a new cable by reversing the removal procedure. Note that the bolt which secures the grommet in the engine bulkhead will, if too long, rub against the cable. If this is the case the bolt should be shortened or a shorter bolt fitted.
7 Finally, adjust the cable as described in Section 3.

5 Clutch pedal – removal and refitting

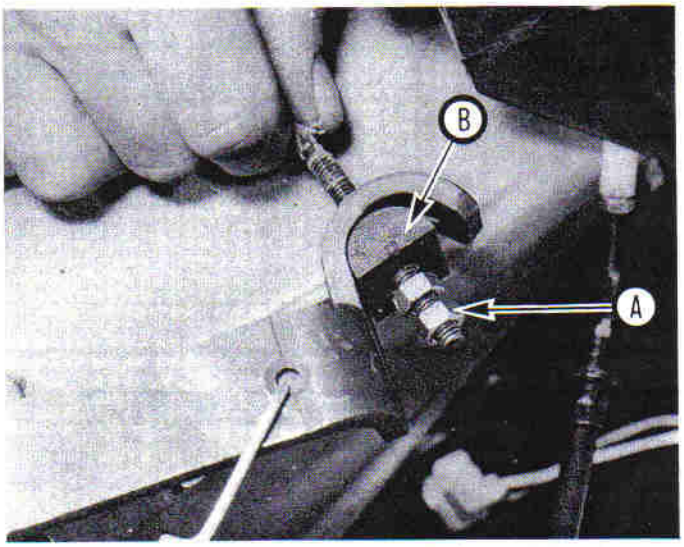
1 The clutch pedal hinges on the same cross-tube as the brake pedal, and to remove it the brake pedal and cross-tube must also be removed.
2 Disconnect the clutch cable from the pedal as described in Section 4.
3 Remove the brake pedal and cross-tube as described in Chapter 8, when the clutch pedal will also be released.
4 Refit in reverse order, adjusting the clutch cable as described in Section 3 on completion.

6 Clutch – removal

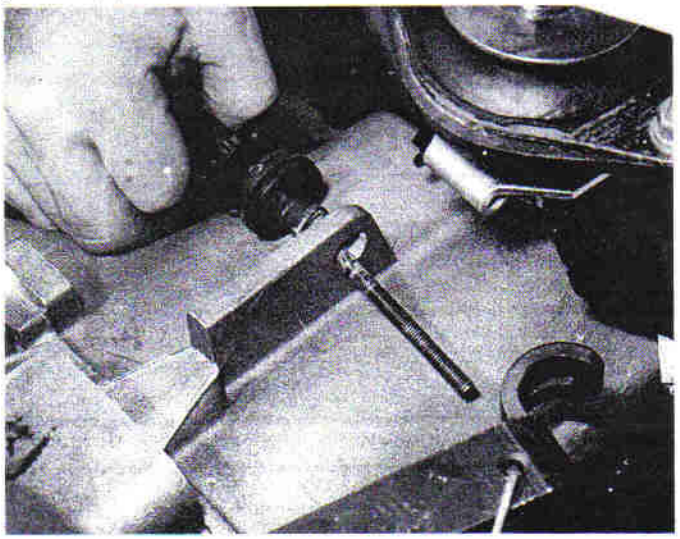
1 Remove the engine/transmission unit from the vehicle, then separate the transmission from the engine, as described in Chapter 1.
2 Remove the bolts securing the pressure plate to the flywheel, undoing them progressively a few turns at a time, and working in a criss-cross pattern until all pressure exerted by the spring diaphragm is released.
3 Remove the bolts completely and lift off the pressure plate, catching the driven plate which will be free to fall as the pressure plate is removed (photo).
4 Inspect the clutch components as described in Section 7.

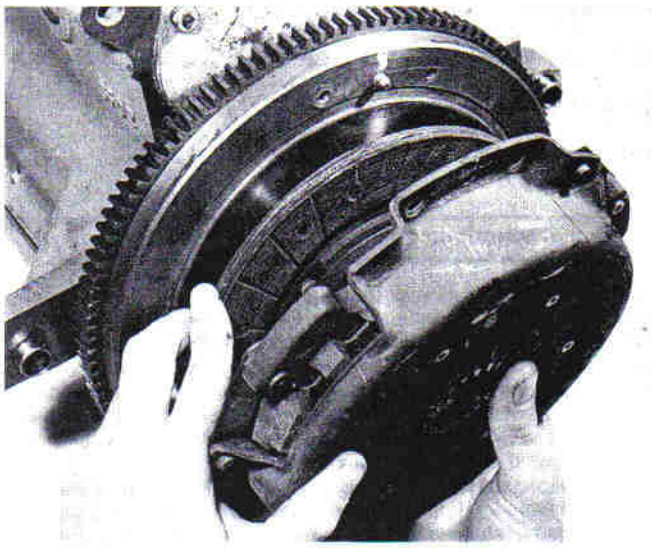
7 Clutch components – inspection

1 Clean the flywheel, driven plate and pressure plate with a damp cloth. Take care not to inhale the dust as it may contain asbestos, and dispose of the dust and cloth safely.
2 Examine the friction surfaces of the flywheel and pressure plate for scoring or cracks. Light scoring may be ignored. More excessive scoring and cracks can sometimes be machined off the flywheel face –



3.2 Clutch cable adjuster locknuts (A) and 'half-moon' shaped grommet (B)


4.2 Disconnecting the cable from the release arm and bracket


6.3 Lifting off the clutch pressure plate and driven plate

consult a specialist. The pressure plate must be renewed if it is badly scored or it is warped (photo).

3 Inspect the pressure plate cover and the diaphragm spring for damage or blue discolouration indicating overheating. Pay close attention to the spring fingers where they come into contact with the release bearing. If a ridge has worn in the fingers the cover plate should be renewed (photo).

4 Renew the driven plate if the linings are worn down to, or close to, the rivet heads. If there is any indication of oil contamination on the linings or a hard black glaze is evident, inspect the gearbox input shaft oil seal and crankshaft rear oil seal for leakage and rectify before refitting the clutch (photo).

5 Inspect the driven plate splined hub for signs of wear or cracking.

6 Check the operation of the release bearing and if it shows any signs of wear, indicated by excessive rattle, roughness or play, it should be renewed as described in Section 8 (photo).

7 It is false economy in terms of time not to renew all three clutch components (driven plate, pressure plate and release bearing) at the same time, especially as the engine has to be removed for the renewal.

Note: *Prior to March 1986, on OHC engines, the clutch pressure plate was matched to the thickness of the flywheel. On 1116 cc engines the flywheel is 28 mm thick and on 1298 cc and 1301 cc engines the flywheel is 31 mm thick. The correct size of pressure plate must be fitted to the relevant thickness of flywheel, or difficulty in clutch adjustment may be encountered (pressure plates can be identified by part number – consult your Yugo dealer). From March 1986 all OHC engines were progressively modified to accept the 28 mm flywheel.*

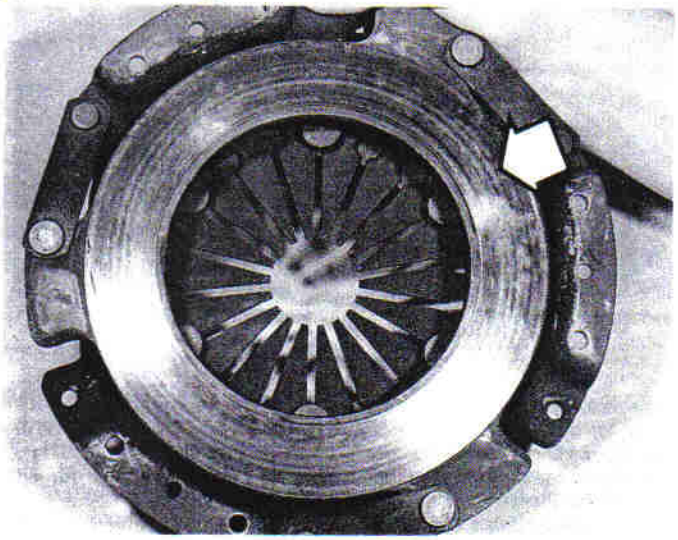
8 Clutch release arm and bearing – removal and refitting

1 Extract the two spring clips securing the release bearing to the release arm and lift the bearing from the transmission unit input shaft (photo).

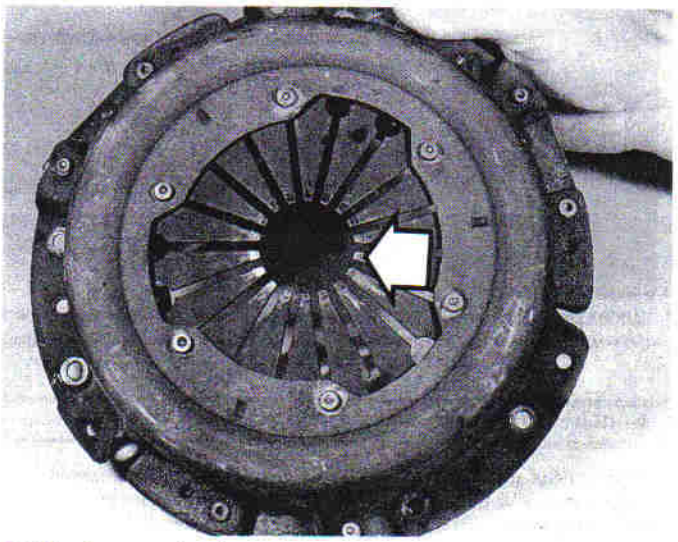
2 Examine the release arm pivot shaft bushes for play, indicating wear. If the bushes need renewing, undo the lockbolt and remove the pivot shaft (photos).

3 Remove the bushes and fit new ones, applying a little high melting point grease before refitting the shaft and lockbolt.

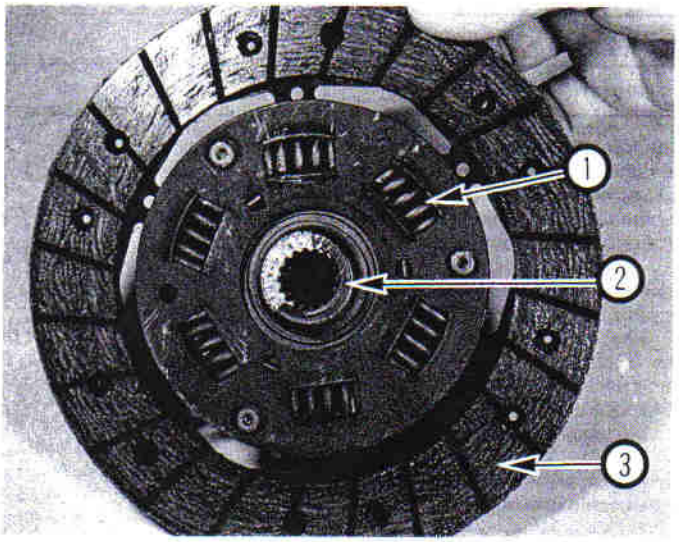
4 Refit the release bearing, ensuring the spring clips are correctly fitted. The release bearing is lubricated for life and requires no greasing.



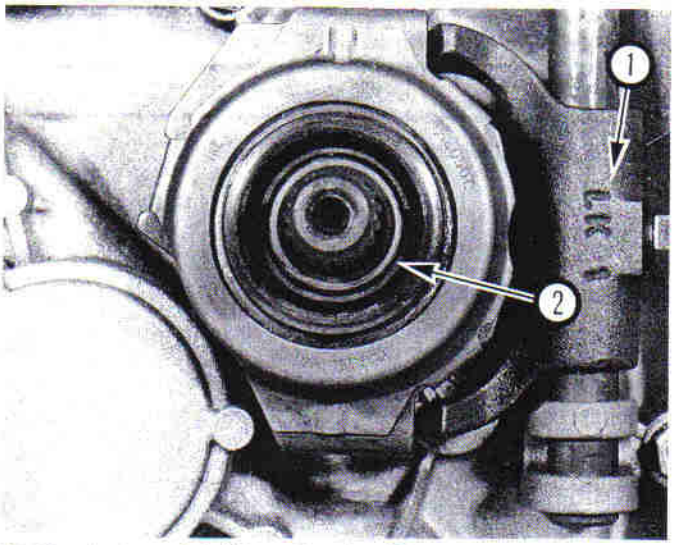
7.2 Pressure plate friction surface (arrowed)



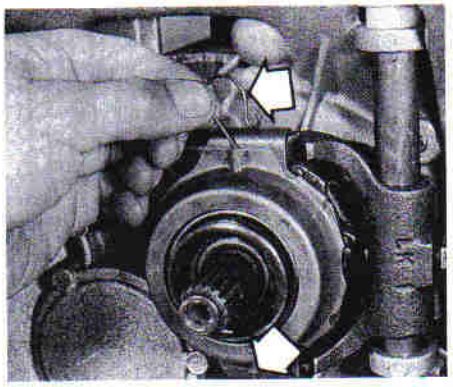
7.3 Diaphragm spring finger wear area (arrowed)



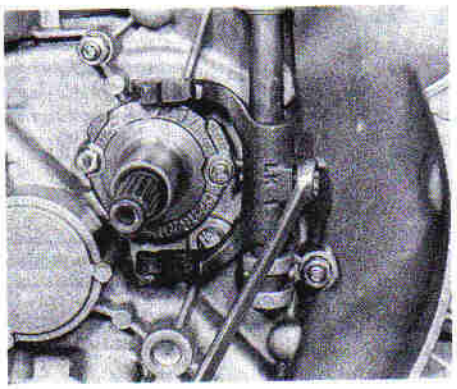
7.4 Driven plate showing springs (1), splined hub (2) and friction linings (3)



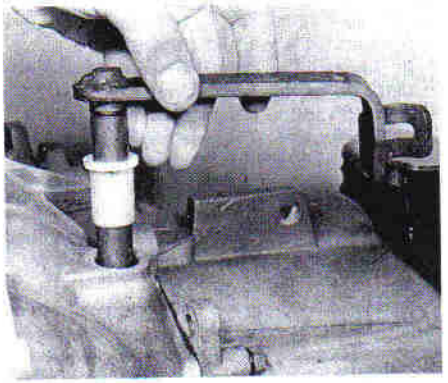
7.6 Clutch release fork (1) and bearing (2)



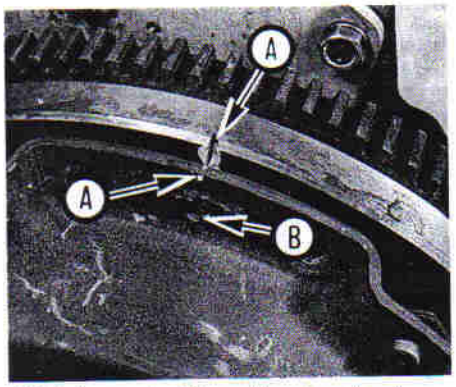
8.1 Release bearing spring clips (arrowed)



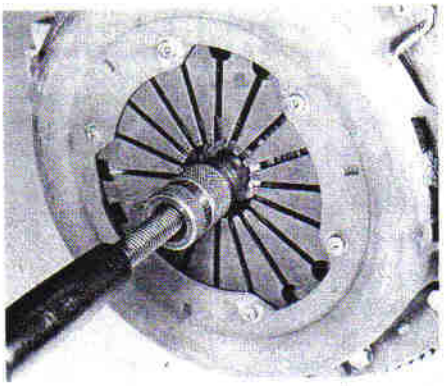
8.2A Removing the lockbolt ...



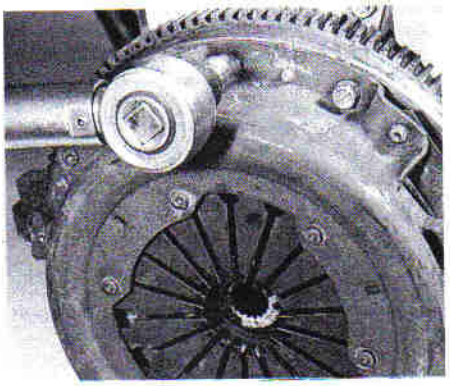
8.2B ... and withdrawing the pivot shaft and bushes



9.2 Index marks (A) and locating dowel (B) for flywheel and pressure plate



9.4A Using a clutch alignment tool to centralise the driven plate



9.4B Tightening the pressure plate bolts

9 Clutch – refitting

1 Position the driven plate on the flywheel with the hub lined up approximately with the centre of the flywheel. The longer protruding boss of the driven plate hub must face away from the flywheel.
2 Fit the pressure plate over the driven plate and onto the locating dowels on the flywheel, lining up the index marks (photo).
3 Fit the retaining bolts fingertight.
4 Preferably using a clutch alignment tool, centralise the drive plate within the pressure plate assembly and with the centre of the flywheel, then tighten the retaining bolts to their specified torque. If a centralising tool is not available, a length of wooden dowel turned down to the inside diameter of the flywheel and the driven plate hub could be used, but the centralising operation must be accurate for the input shaft to enter the flywheel (photos).
5 Refit the transmission unit to the engine and the engine/transmission unit to the vehicle as described in Chapter 1.

10 Fault diagnosis – clutch

Symptom	Reason(s)
Judder when taking up drive	Clutch friction surfaces worn Oil contamination of clutch Splines on driven plate or input shaft worn Pressure plate defective Engine/gearbox mountings worn
Clutch drag (fails to release)	Driven plate sticking on splines Driven plate rusted to flywheel (after long periods without use) Incorrect cable adjustment
Clutch slip (engine speed increases without increase in road speed)	Friction surfaces worn or contaminated with oil Pressure plate defective Incorrect cable adjustment
Noise when clutch pedal depressed (engine stopped)	Pedal pivot shaft dry Clutch cable or release arm/fork dry
Noise when clutch pedal depressed (engine running)	Release bearing dry or worn Pressure plate spring fingers worn or damaged

Chapter 6 Transmission

Contents

Specifications

Type	Manual, four or five forward gears depending on model plus reverse gear. Floor-mounted gear lever
Ratios	
4-speed:	
1st	3.583 : 1
2nd	2.235 : 1
3rd	1.454 : 1 (1.461 : 1 on 45A and 55A from 1986-on)
4th	1.042 : 1 (1.033 : 1 on 45A and 55A from 1986-on)
Reverse	3.714 : 1
5-speed:	
1st	4.090 : 1
2nd	2.235 : 1
3rd	1.469 : 1
4th	1.043 : 1
5th	0.862 : 1
Reverse	3.714 : 1
Final drive ratio:	
All models with OHV engine	4.07 : 1
All models with OHC engine	3.76 : 1
Lubrication	
Type/specification	Esso gear oil number AL 2801 (CZ 90 or ST 90) (no Duckhams equivalent)
Capacity (4 and 5-speed)	3.15 litres (5.5 pints)

Torque wrench settings	**Nm**	**lbf ft**
End cover bolts/nuts	10	7
Engine-to-transmission bolts/nuts	78	57
Gearcase-to-bellhousing bolts/nuts	25	18
Reverse idler shaft nut	10	7
Selector fork bolts	18	13
Selector shaft dog bolt	18	13
Selector housing bolts	10	7
Crownwheel bolt	69	51
Input shaft nut (5-speed only)	118	87
Mainshaft nut (5-speed only)	118	87

1 General description

The transmission unit is mounted transversely in line with the engine. The differential/final drive assembly is integral with the transmission unit.

Lubrication is independent from the engine lubrication system.

Four or five forward speeds are fitted depending on model.

All forward gears have synchromesh, first and second having baulk ring (Borg Warner) type synchronisers, and three, four and five, Porsche spring segment type synchronisers.

The gearchange control lever is floor mounted, linked to the transmission selector mechanism by rod.

2 Routine maintenance

1 At the intervals specified in *'Routine maintenance'* and with the transmission cold and the car standing on level ground, unscrew and remove the oil filler/level plug. If oil just starts to dribble out then the oil level is correct. If it does not, add oil of the correct grade to bring it up to level. Refit the plug.

2 At the intervals specified in *'Routine maintenance'* the transmission oil should be renewed.

3 Drain the oil hot by removing the filler/level plug and drain plug. When the oil has ceased dripping, refit the drain plug and refill with the correct grade and quantity of oil. Screw in and tighten the filler/level plug (photos).

3 Gearchange lever and linkage – removal and refitting

1 Working underneath the vehicle, remove the four nuts/screws securing the protective shield to the floor pan (photos).

2 Disconnect the gearchange rod joint by removing the two nuts and bolts (photo).

3 Pull the shield down and along the gearchange rod (photo).

4 Pull back the rubber cover and remove the spring clip from the control rod pin to disconnect the rod from the lever (photo).

5 Inside the vehicle, prise out the gearlever boot plastic clips and slide the boot up the gear lever (photo) Where fitted, the centre floor console must first be removed.

6 Remove the three nuts (bolts on some early models) securing the gearlever gate to the floor pan and lift out the gearlever (photo).

7 The ball and cups may now be removed for cleaning, inspection and greasing.

8 On pre-1987 models, check the reverse gear push-down mechanism for freedom of movement and lubricate as necessary.

9 Refit in reverse order, adjusting the gearchange rod-to-selector lever joint to give positive selection of all gears.

4 Transmission – removal and refitting

1 The transmission can be removed on its own, leaving the engine in-situ, but there is little room for access, especially where a five-speed unit is fitted. It is just as easy to remove the engine and transmission together (as described in Chapter 1), and to separate the two after removal. The procedure given here is for removal of the transmission unit on its own.

2 Apply the handbrake, chock the rear wheels, raise the front of the vehicle and support on axle stands.

3 Open the bonnet, disconnect the battery negative terminal and remove the spare wheel.

4 Disconnect the speedometer cable by unscrewing the knurled nut.

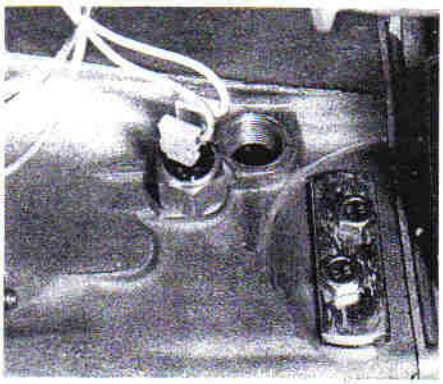
5 Refer to Chapter 5 and disconnect the clutch cable.

6 Disconnect the reversing light switch (photo).

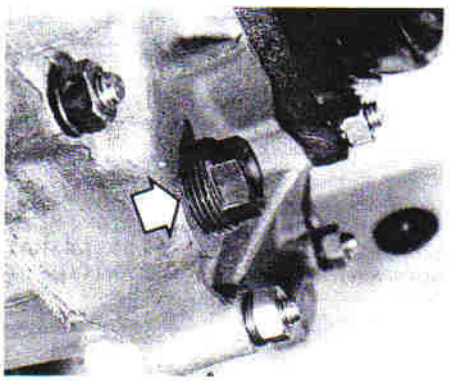
7 Refer to Chapter 12 and remove the starter motor.

8 Refer to Chapter 7 and remove the driveshafts.

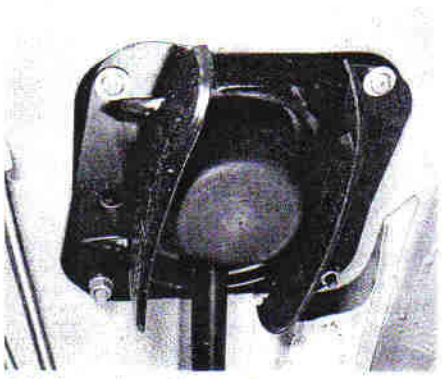
9 Refer to Chapter 10 and remove the anti-roll bar.



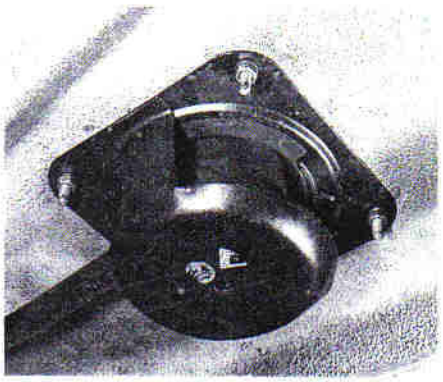
2.3A Transmission oil filler plug removed for level checking



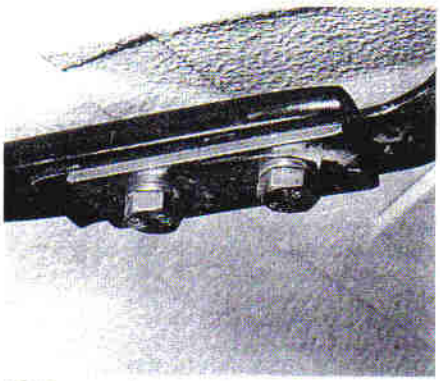
2.3B Transmission oil drain plug (arrowed)



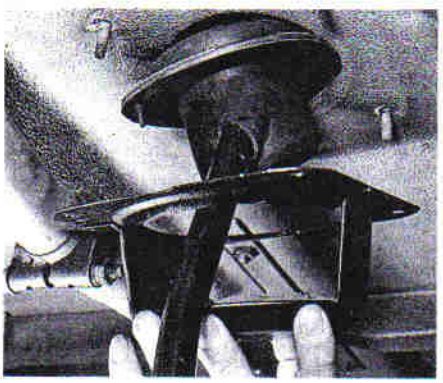
3.1A Protective shield on 3/4/5 series ...



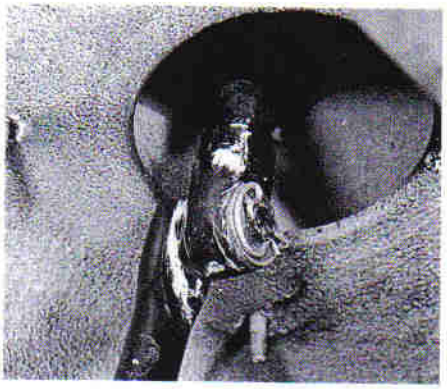
3.1B ... and on 45/55/65 models



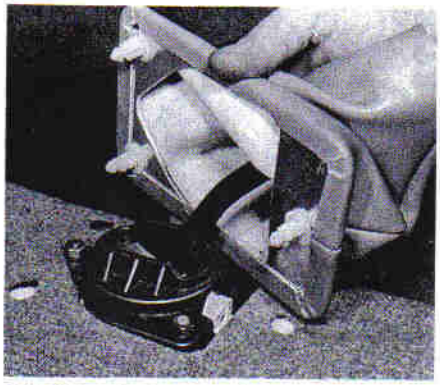
3.2 Remove the two bolts to disconnect the gearchange rod joint



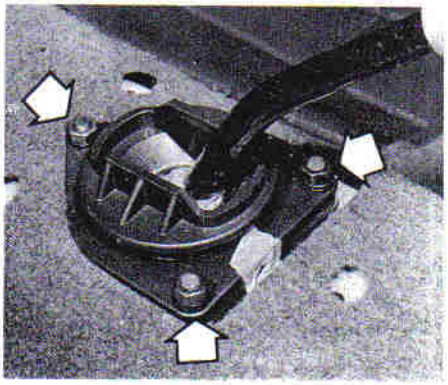
3.3 Pull the shield along the gearchange rod



3.4 Spring and pin securing the gearchange rod to lever



3.5 Sliding the boot up the gearlever



3.6 Remove the three nuts (arrowed) securing the gearlever gate

10 Disconnect the gearchange rod from the gearbox selector shaft. Note the assembly order of the bolt, collar and washer, which must be maintained (photos).
11 Drain the transmission oil as described in Section 2.
12 Remove the exhaust bracket from between the transmission unit and the exhaust pipe.
13 Remove the flywheel cover. This is the black painted panel bolted to the underside of the transmission unit.
14 Position a trolley jack under the engine and just take the weight, using a block of wood between the jack head and the engine. An alternative method of supporting the engine is shown in Fig. 6.1.
15 Remove the centre engine mounting and the crossmember.
16 Support the transmission unit on a trolley jack, then, on 45 series models remove the right-hand engine mounting.
17 Remove the engine-to-transmission connecting bolts, noting the earth lead under the bolt nearest the clutch release arm (photo).
18 Pull the transmission slightly away from the engine, then lower it gently and remove it from under the vehicle.
19 Refitting is a reversal of removal, noting that new lock tabs must be used on the engine mounting crossmember.
20 Fill the transmission with the correct quantity and grade of oil when the car is standing on its wheels.

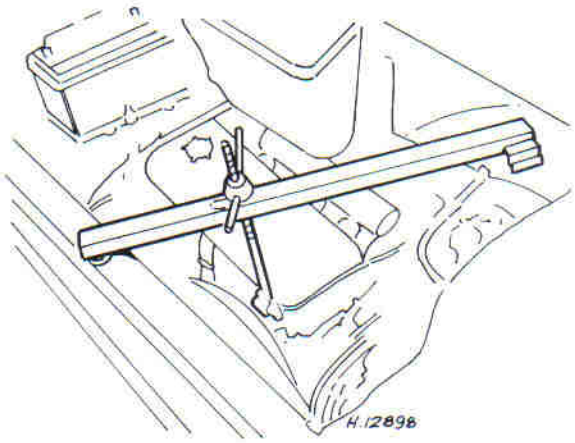


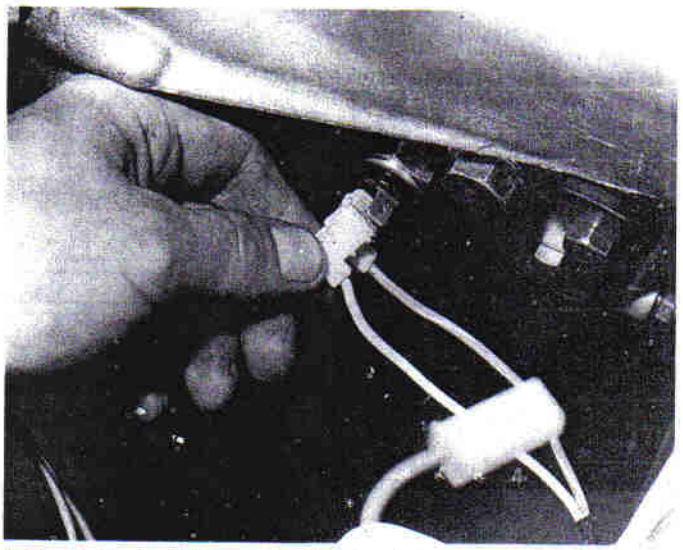
Fig. 6.1 One method of supporting the engine during removal of transmission (Sec 4)

5 Transmission – dismantling into assemblies

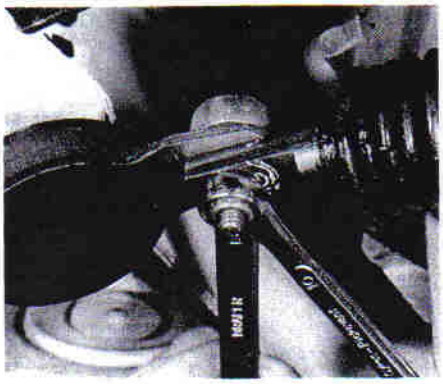
1 If the transmission unit has been removed with the engine, separate the two as described in Chapter 1.
2 Clean external surfaces using paraffin or commercial solvent.
3 If not already done, drain the transmission oil.
4 Remove the reversing light switch.
5 Disconnect the clutch release lever return spring.
6 Undo the nuts inside the bellhousing which secure the gearcase to the bellhousing. Turn the transmission unit onto the bellhousing face, gearcase facing upwards.
7 On 45/55/65 models, remove the transmission mounting bracket from the end cover.
8 On all models, remove the end cover, exposing the shaft ends on 4-speed transmissions or 5th gear components on 5-speed transmissions.
9 Unbolt and remove the detent spring plate and recover the springs and balls, noting their colours and positions. Use a pencil magnet to remove the balls, or alternatively sticky grease on the end of a screwdriver.
10 Using an Allen key, remove the lockbolt and lift out the speedometer drivegear.

4-speed

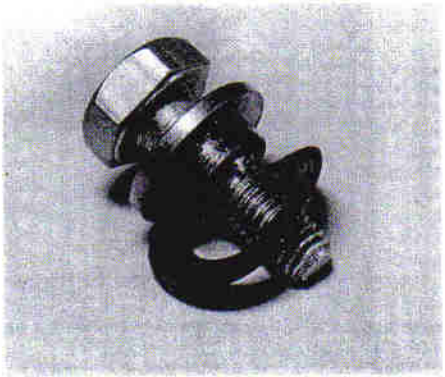
11 Remove the circlip from the end of the input shaft, and the snap-ring from the bearing.
12 The mainshaft has a Belville washer assembly which consists of two cone shaped washers fitted with their cones facing away from each other and compressed together by the circlip. This makes the circlip difficult to remove.



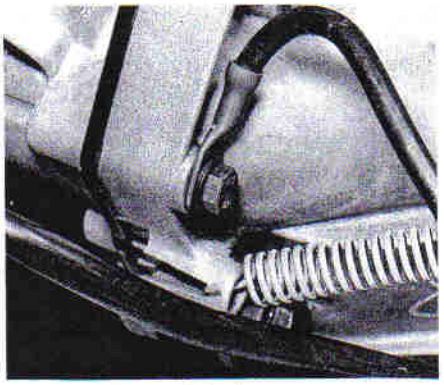
4.6 Disconnecting the reversing light switch



4.10A Undoing the gearchange rod from the gearbox selector shaft



4.10B Maintain the correct assembly order of the bolt, collar and washer

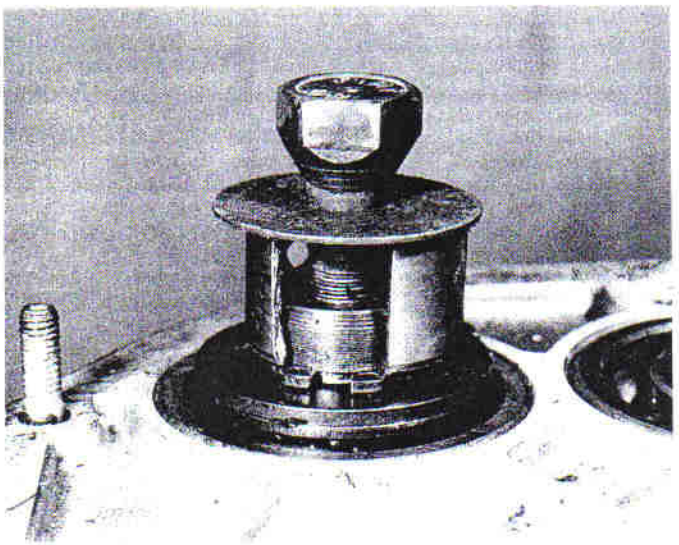


4.17 Note the earth lead

13 Where the mainshaft is internally threaded, a roadwheel bolt will fit the thread, and a Belville washer compressor can be made up using a length of tubing with a cut-out in it for access to the circlip, and a large washer as shown in the accompanying photo.
14 Where the shaft is not threaded, the circlip will have to be knocked off using a wide flat-bladed tool. Place a piece of cloth over the end of the shaft to prevent the circlip and washers flying off and becoming lost, and wear eye protection.
15 Remove the snap-ring from the mainshaft bearing.
16 Remove the nuts/bolts securing the gearcase to the bellhousing, then tap the gearcase gently with a mallet to free it from the bellhousing, and lift it off.
17 The bearings will either lift with the casing or remain on the surface. If the shafts lift with the casing, tap them with a mallet to free them from the bearings which will remain in the casing and can be removed later for inspection.
18 Unbolt and remove the selector lever housing.
19 Unbolt the reverse idler gear shaft lockplate, then lift out the reverse gear shaft and gear.
20 Remove the lockbolts from the selector forks and dogs and lift out the shafts, forks and dogs. All three shafts must be lifted out together, taking care not to lose the interlock pin from the 3rd/4th selector shaft.
21 The two remaining interlock pins will remain in their bores in the housing, and can be removed using a pencil magnet.
22 Lift out the input and mainshafts together.
23 Remove the mainshaft bearing from the bellhousing.
24 Lift out the differential/final drive assembly.
25 Remove the magnetic filter from the gearcase.

5-speed

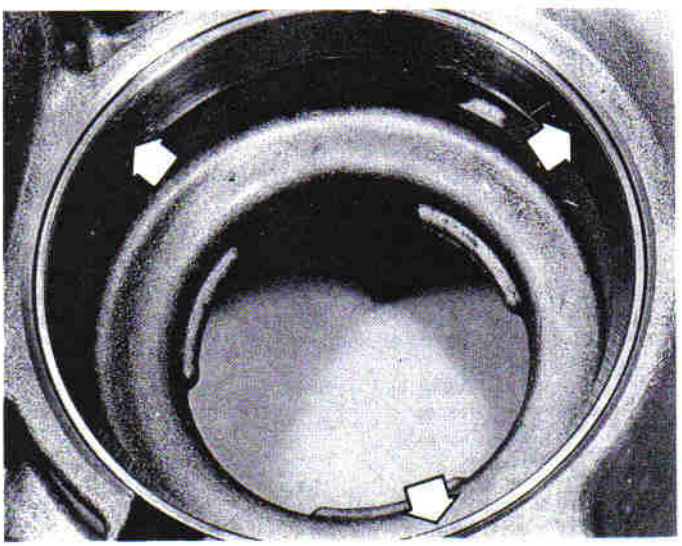
26 Lock two gears together by moving the selector dogs.
27 Relieve the staking on the input and mainshaft nuts, then unscrew and remove the nuts.
28 Remove the 5th gear selector fork lockbolt.
29 Pull off 5th gear, synchroniser unit, and selector fork and bush from the mainshaft.
30 Pull 5th gear from the input shaft.
31 Unbolt and remove the intermediate plate from the gearcase.
32 The remaining procedure is as described for 4-speed transmissions.



5.13 One method of compressing the Belville washers (pre-1986 models only)

6 Inspection of components

1 Inspect all components for obvious damage and wear such as chips, cracks and pitting. All gear teeth should be smooth and shiny.
2 The outer tracks of the final drive taper roller bearings should be smooth and free from scoring, and no signs of discolouration due to burning should be evident (photo).
3 Inspect all bearings for excessive shake or rattle indicating wear, and for discolouration due to burning. If the taper roller bearings of the final drive unit need renewing, the outer tracks must also be renewed (photo). In this case the differential bearing pre-load must be re-set – refer to Section 7.
4 The mainshaft bearing in the bellhousing will lift out of its seat (photo), and the main and input shaft bearings at the other end of the



6.2 Outer track of the final drive taper roller bearing (arrowed)

shafts can either be pushed out of the gearcase or pulled from the shafts, as applicable.
5 Check the synchroniser baulk rings for wear. The baulk ring should be very stiff to turn when pressed into the synchroniser cone (photos).
6 On Porsche type synchronisers, the stop plates can be renewed after removal of the circlip, for which a strong pair of circlip pliers will be required (photo).
7 The condition of worn synchroniser units will be obvious before dismantling due to 'crunchy' gearchanges.
8 Check the casings for cracks. If there are any leaks from core plugs they must be renewed. The old plug can be tapped out and a new plug fitted by tapping it into position sufficiently to expand the plug but not deform it.
9 Remove the differential side covers and renew the O-ring seals. Do not lose the shims under the covers and ensure that they are refitted in the same positions from which they were removed (photos).
10 Check the movement of the selector rods in their bores in the casing. They should move freely without appreciable play. Inspect the selector fork ends for wear and damage.
11 Ensure that the oil breather on the gearcase end cover is not blocked (photo).
12 Remove the lockbolt from the selector shaft dog and slide out the selector shaft.
13 Make sure the rubber boot is in good condition and renew the oil seal inside the seal housing in the casing (photos).
14 Remove the bolts securing the input shaft oil seal housing to the bellhousing and lift off the oil seal housing.
15 The oil seal can be prised out of the housing and a new seal pressed into position.
16 Refer to Chapter 5 for renewal of the clutch release arm bushes.

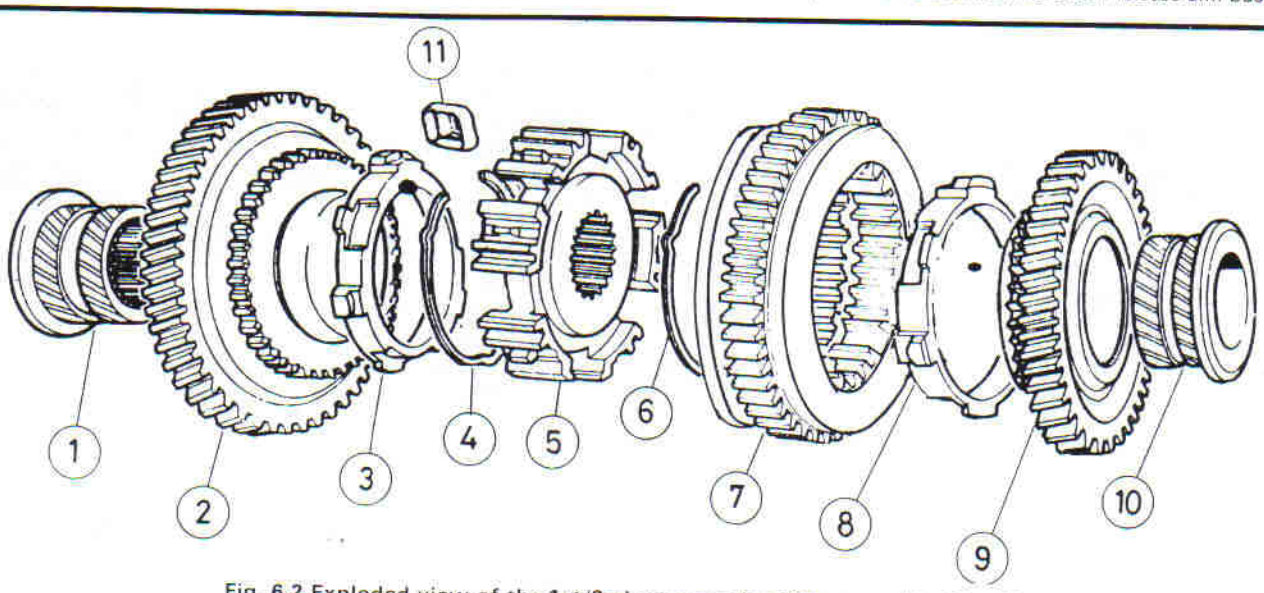


Fig. 6.2 Exploded view of the 1st/2nd gear synchroniser assembly (Sec 6)

1 *1st gear bush*
2 *1st gear*
3 *1st gear synchroniser baulk ring*
4 *Spring*
5 *Synchroniser hub*
6 *Spring*
7 *Synchroniser sleeve*
8 *2nd gear synchroniser baulk ring*
9 *2nd gear*
10 *2nd gear bush*
11 *Spring insert*

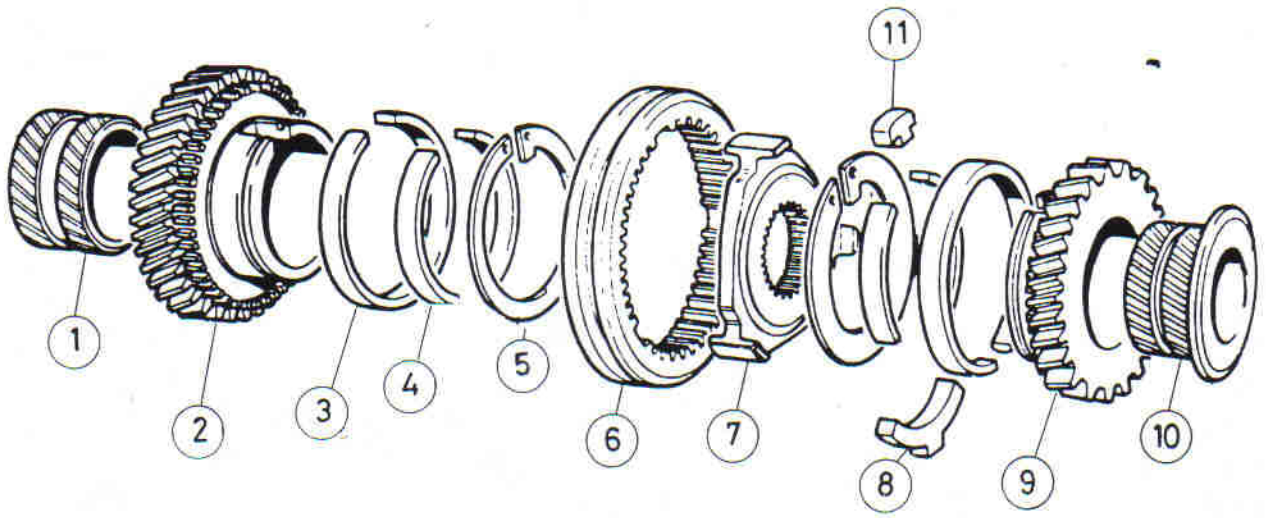
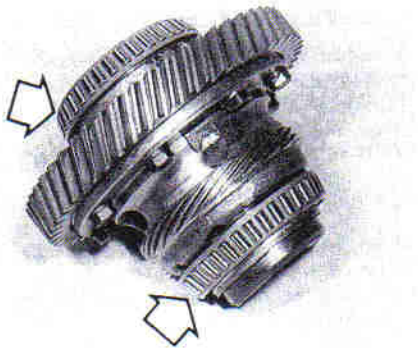
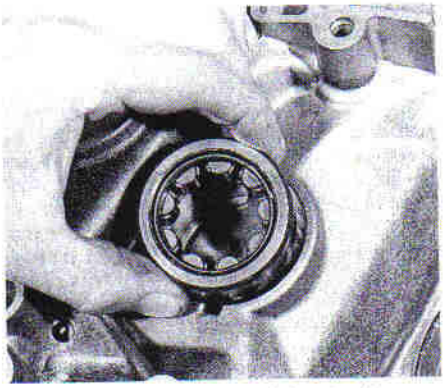


Fig. 6.3 Exploded view of the 3rd/4th gear synchroniser assembly (Sec 6)

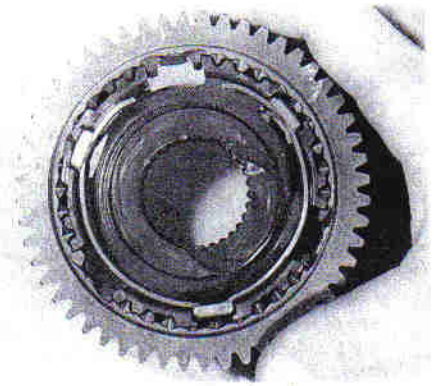
1 *3rd gear bush*
2 *3rd gear*
3 *Synchroniser ring*
4 *Spring*
5 *Circlip*
6 *Synchroniser sleeve*
7 *Synchroniser hub*
8 *Wedge insert*
9 *4th gear*
10 *4th gear bush*
11 *Wedge insert*



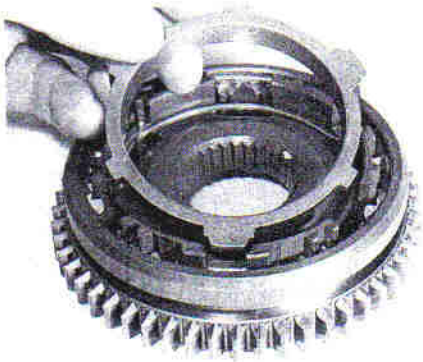
6.3 Final drive unit taper roller bearings (arrowed)



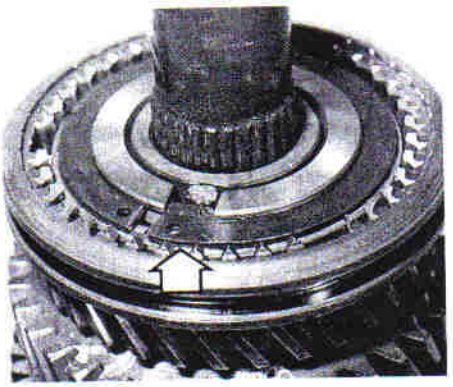
6.4 Lifting out the mainshaft bearing from the bellhousing



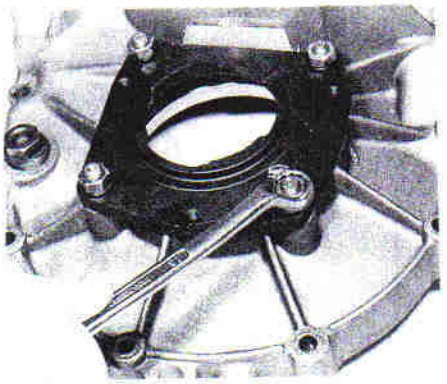
6.5A Baulk ring type synchroniser assembly ...



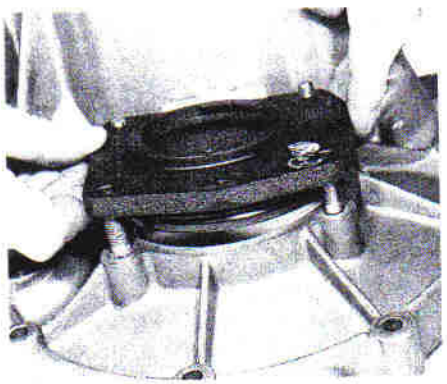
6.5B ... and removing the synchroniser baulk ring



6.6 Circlip on Porsche type synchroniser assembly

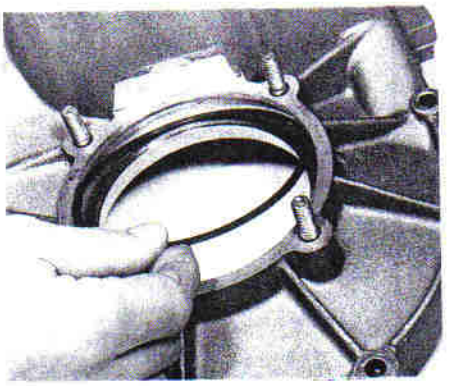


6.9A Remove the differential side cover retaining nuts ...

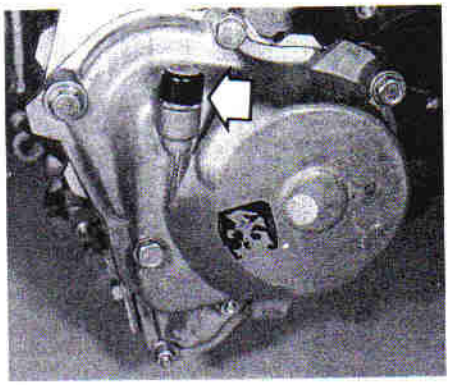


6.9B ... and remove the cover

6.9C Removing the O-ring seal

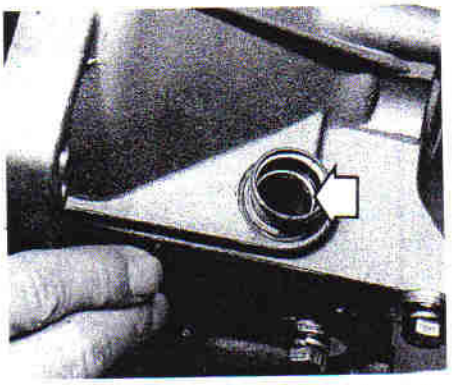


6.9D Removing a shim



6.11 One breather (arrowed) on gear case endcover

6.13A Pulling off the rubber boot with the selector shaft



6.13B Oil seal (arrowed) inside the housing

7 Differential – overhaul

1 Overhaul of the differential is not generally a practical proposition for the home mechanic.
2 Special tools are required to set the bearing pre-load whenever the bearings are removed. This is achieved by inserting shims under the bearings and side covers, and requires an axial loading of some 3430 N (2531 lbf) to be applied in order to settle the bearings.
3 Incorrect pre-load will result in a noisy differential, and it is best to leave this work to the specialists.

8 Input and mainshafts – dismantling and reassembly

Input shaft

1 Only the bearing can be removed. Use a puller to remove it from the shaft (photo).
2 The new bearing should be pressed into position.

Mainshaft

3 All the components can be removed from the mainshaft. If the bearing is still fitted to the shaft and is tight, use a puller to remove it, and if the gear bushes are tight, warm them with a heat gun which will ease their removal.
4 Keep all components in order as they are removed. Inspect them and renew as necessary as described in Section 6.
5 Reassemble the mainshaft as follows, lubricating each component as work proceeds.
6 Place the mainshaft upright in a vice (photo).
7 Slide on the 1st gear bush (photo).
8 Fit 1st gear (photo).
9 Fit the synchroniser baulk ring (photo).
10 Slide on the synchroniser sleeve and hub together with 2nd gear synchroniser baulk ring (photo).
11 Fit 2nd gear (photo).
12 Fit the 2nd gear bush (photo).
13 Fit the 3rd gear bush (photo).
14 Fit the 3rd gear and synchroniser sleeve (photo).
15 Slide on the 3rd gear synchroniser hub (photo).
16 Fit 4th gear with the synchroniser ring assembly (photo).
17 Slide on the 4th gear bush (photo).
18 Fit the bearing over the end of the shaft (photo).
19 On 4-speed transmissions, fit the Belville washers, their cones facing away from each other (photos).
20 Fit the circlip, pushing it down over the shaft as far as it will go (photo).
21 Use a press and socket over the Belville washers and circlip to compress the washers and allow the circlip to snap down into its groove, locking the washers to the shaft (photo).
22 The shafts are now ready for assembly into the casing as described in Section 9.

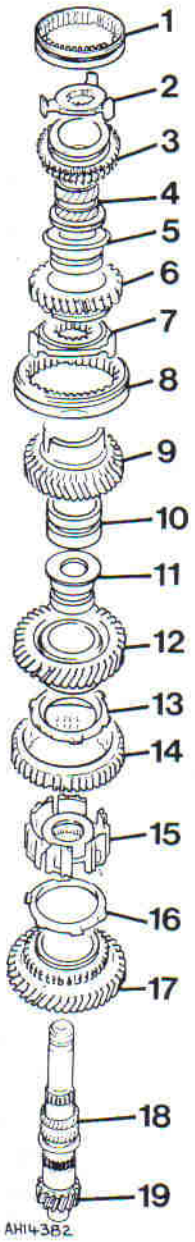
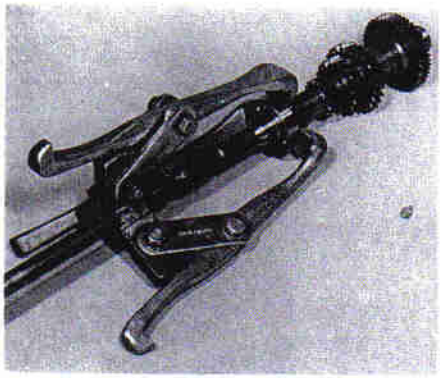
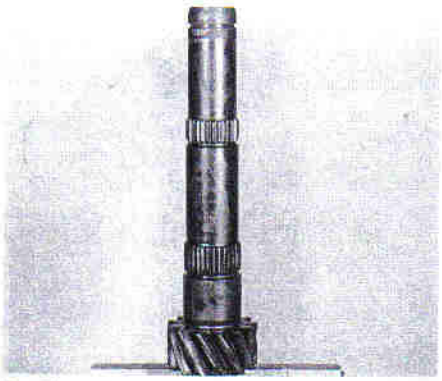


Fig. 6.4 Exploded view of mainshaft components – 5-speed transmission (Sec 8)

1 5th gear synchroniser sleeve
2 Synchroniser hub
3 5th gear
4 5th gear bush
5 4th gear bush
6 4th gear
7 3rd/4th synchroniser hub
8 3rd/4th synchroniser sleeve
9 3rd gear
10 3rd gear bush
11 2nd gear bush
12 2nd gear
13 2nd gear synchroniser baulk ring
14 1st/2nd synchroniser sleeve with reverse gear
15 1st/2nd synchroniser hub
16 1st gear synchroniser baulk ring
17 1st gear
18 1st gear bush
19 Pinion (final drive) gear

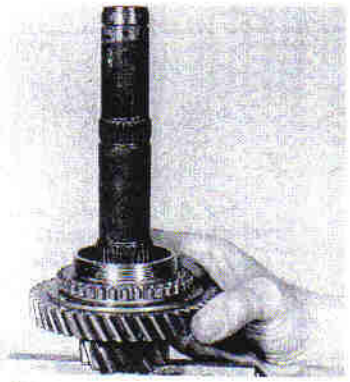


8.1 Pulling the bearing from the input shaft

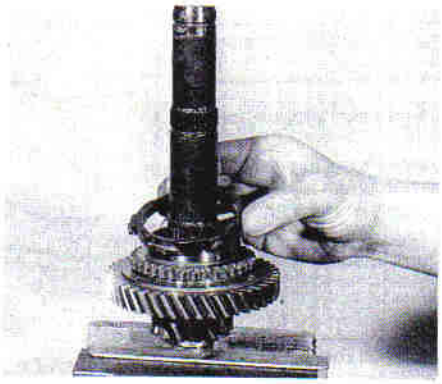


8.6 Place the mainshaft upright in a vice

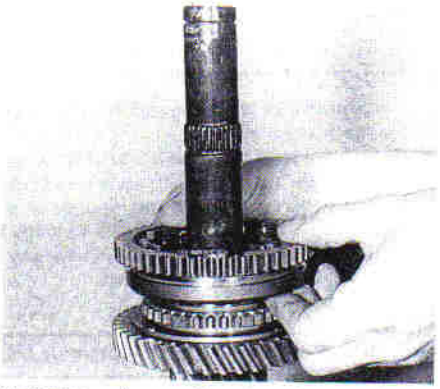
8.7 Slide on the 1st gear bush



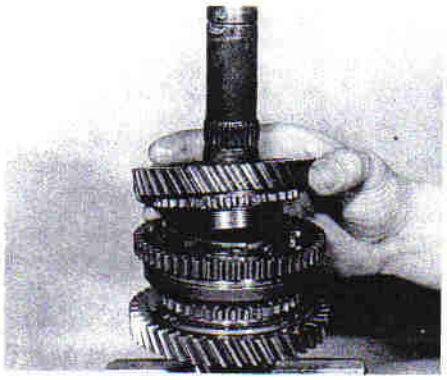
8.8 Fitting 1st gear ...



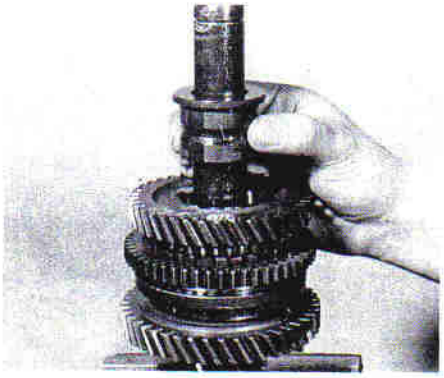
8.9 ... followed by the synchroniser baulk ring



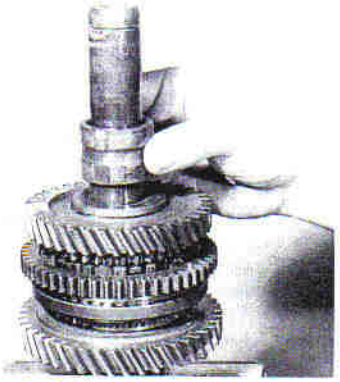
8.10 Fitting the synchroniser sleeve and hub with 2nd gear synchroniser baulk ring



8.11 Fitting 2nd gear ...

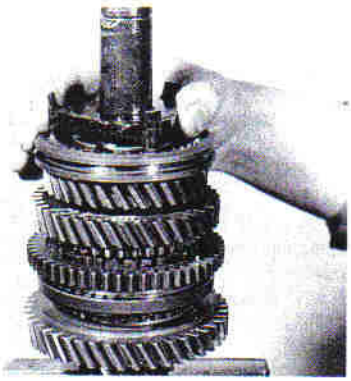


8.12 ... followed by the 2nd gear bush

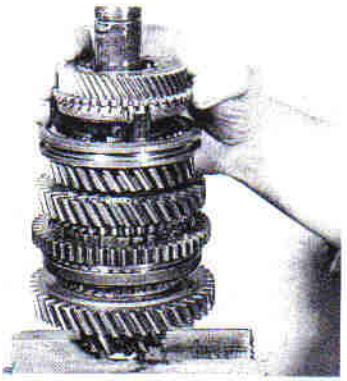


8.13 Fitting the 3rd gear bush

8.14 Fitting 3rd gear and synchroniser sleeve

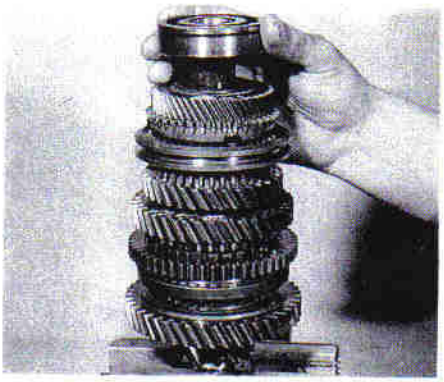


8.15 ... followed by the synchroniser hub



8.16 Fitting 4th gear with synchroniser ring assembly ...

8.17 ... and 4th gear bush

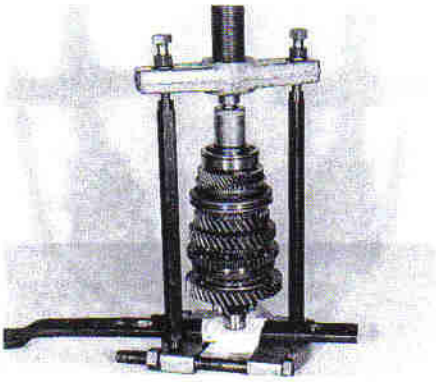


8.18 Fitting the bearing over the end of the shaft

8.19A Fitting the inner Belville washer on 4-speed transmission ...

8.19B ... and the outer washer

8.20 Fitting the circlip



8.21 Compressing the Belville washers to lock the circlip

9 Transmission – reassembly

1 Oil all parts liberally with the specified transmission oil as work progresses.
2 Fit the magnetic filter if not already done (photo).
3 Fit the speedometer drivegear and lock in place with the Allen bolt (photo).
4 Fit the selector shaft into the bellhousing, slide on the selector shaft dog and lock it with the bolt (photos).
5 Lift in the differential/final drive assembly, speedometer drivegear facing downwards (photo).
6 If not already done, fit the mainshaft bearing into the bellhousing.
7 Mesh the input and mainshafts together and fit them into position in the bellhousing (photo).
8 Fit the large interlock pins into their bores on either side of the 3rd/4th selector rod bore (photo).
9 Fit the selector forks to the grooves on their synchroniser sleeves, then slide the selector rods down through them and into the bores in the casing, fitting the selector dogs as you do so (photos).
10 Ensure that the small interlock pin is in position in the 3rd/4th selector rod (photo).
11 Line up the forks and dogs with the holes in the rods and fit and tighten the lockbolts (photos).
12 Fit reverse gear to its fork, then slide in the reverse gear shaft (photos).
13 Fit the lockplate and tighten the bolt (photo).
14 Fit the gear selector housing ensuring that the gearchange selector engages on the underside of the housing and the selector lever engages with the dogs (photos).
15 Fit and tighten the bolts.
16 Fit a new gasket to the bellhousing, then gently lower the gearcase over the geartrains and onto the bellhousing, locating it over the locating dowels (photos). Fit and tighten the securing bolts/nuts.
17 Fit the input shaft bearing complete with snap-ring (photo).
18 Tap the bearing down gently using a mallet and socket placed over the inner race (photo).
19 Fit the circlip, ensuring that it seats correctly in its groove (photo).
20 Fit the snap-ring to the mainshaft bearing, interlocking it with the input shaft snap-ring and ensuring that it seats correctly in its groove (photos).
21 Fit the detent balls and springs – green (reverse) nearest to the filler plug, then the plain spring, and finally blue (photos).
22 Fit the cover over the springs using a new gasket (photo).
23 Fit the reversing light switch (photo).

4-speed

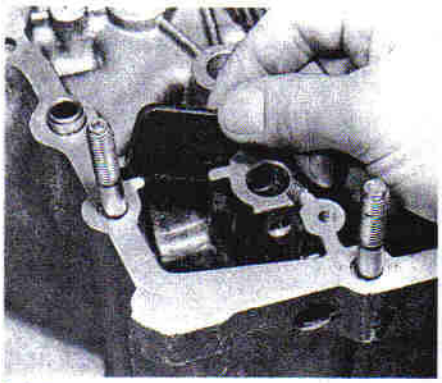
24 Using a new gasket, bolt on the end cover (photos).
25 On 45 series models, fit the transmission mounting bracket (photo).

5-speed

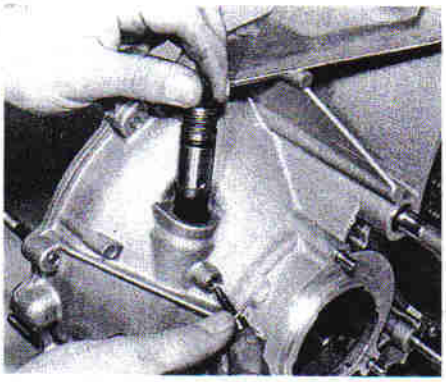
26 Using a new gasket, fit the intermediate plate.
27 Fit the 5th gear bush to the mainshaft (photo).
28 Fit 5th gear over the input shaft (photo).
29 Fit the 5th gear synchroniser assembly to the mainshaft and fit the 5th gear selector fork, engaging them together, with the fork over the end of the selector rod (photos).
30 Fit the washers and nuts to both input and mainshaft, lock two gears together and tighten the nuts to the specified torque. On completion stake the nuts to the shafts (photos).
31 Fit and tighten the selector fork lockbolt (photo).
32 Fit the end cover using a new gasket and tighten the bolts (photos).

All models

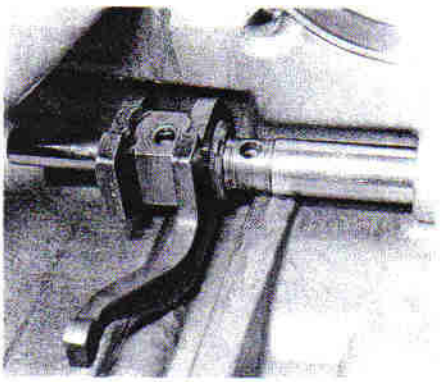
33 Using a new gasket, fit the input shaft oil seal housing and tighten the retaining bolts (photos).
34 Fit and tighten the gearcase retaining bolts in the bellhousing (photo).



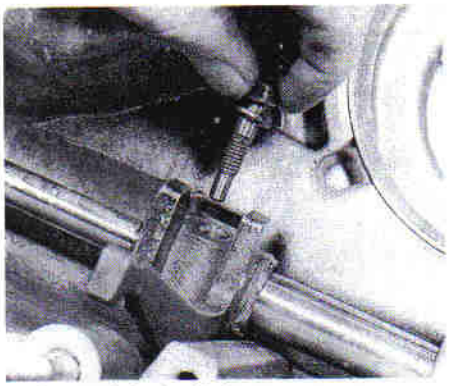
9.2 Fitting the magnetic filter



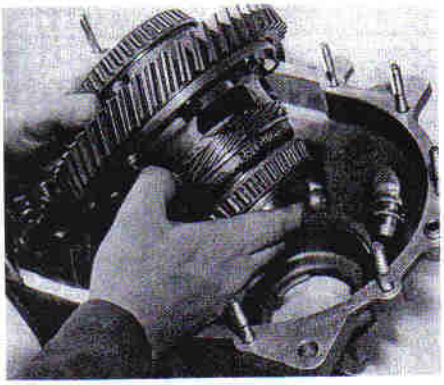
9.3 Fitting the speedometer drive gear and Allen bolt



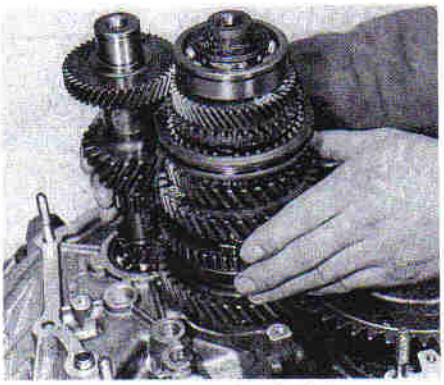
9.4A Fitting the selector shaft and dog ...



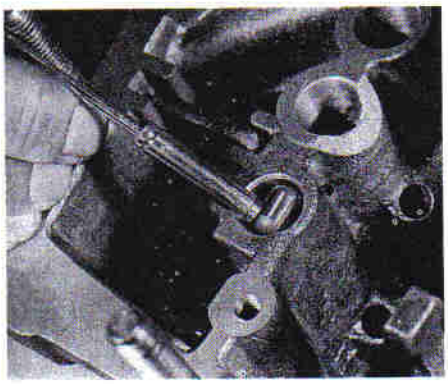
9.4B ... and the lockbolt



9.5 Lift in the differential/final drive assembly

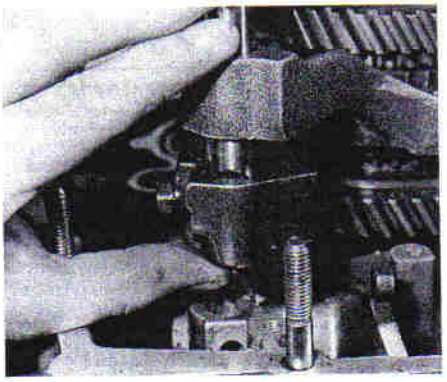


9.7 Fitting the input and mainshafts



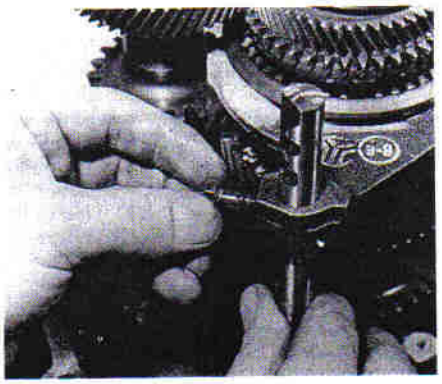
9.8 Fitting a large interlock pin

9.9A Fitting a selector rod and fork ...

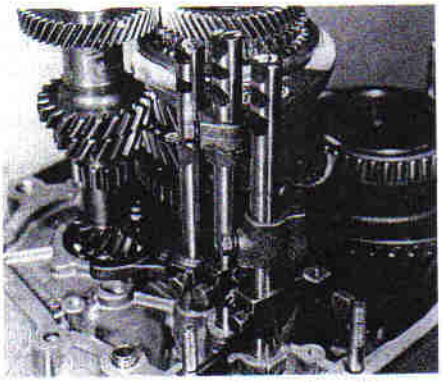


9.9B ... and the selector dog

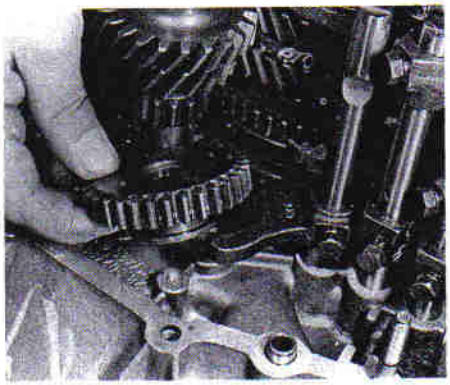
9.10 Small interlock pin in 3rd/4th selector shaft



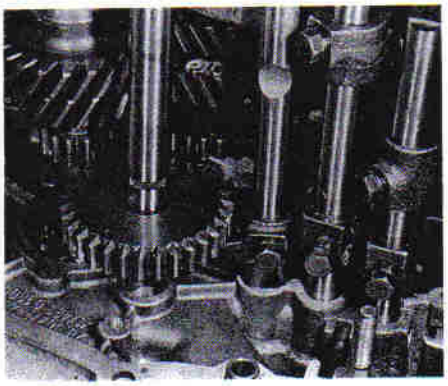
9.11A Fitting a selector fork lockbolt



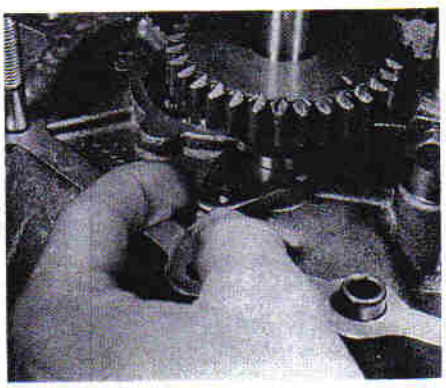
9.11B Selector forks and dogs in position



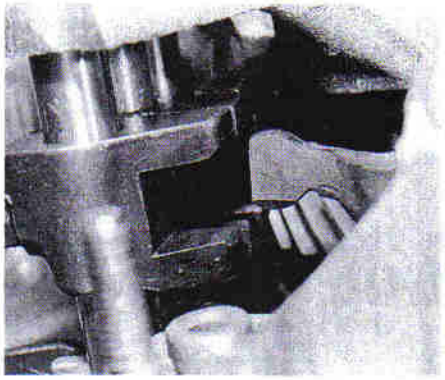
9.12A Fit reverse gear to its fork ...



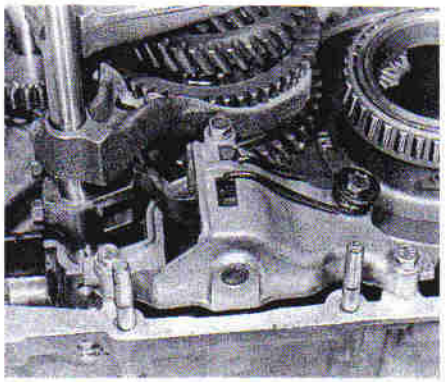
9.12B ... before the shaft is fitted



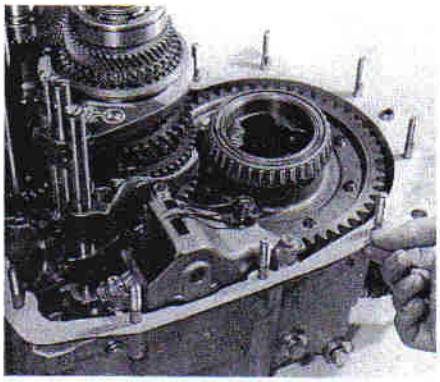
9.13 Fit the lockplate



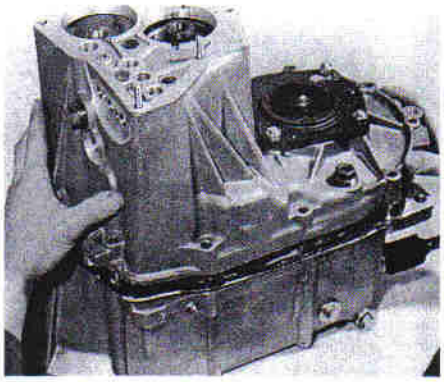
9.14A Engaging the selector lever with the dogs ...



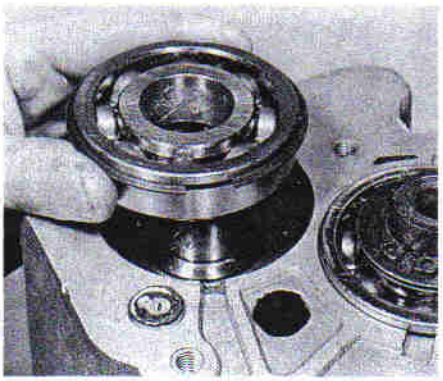
9.14B ... as the selector housing is fitted



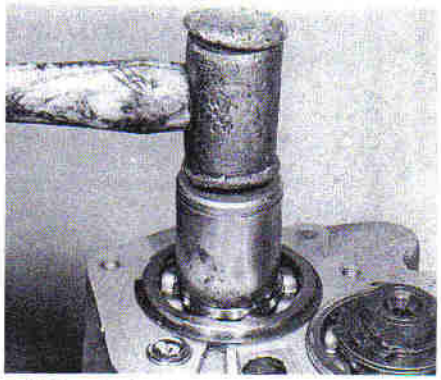
9.16A Fit a new gasket to the bellhousing ...



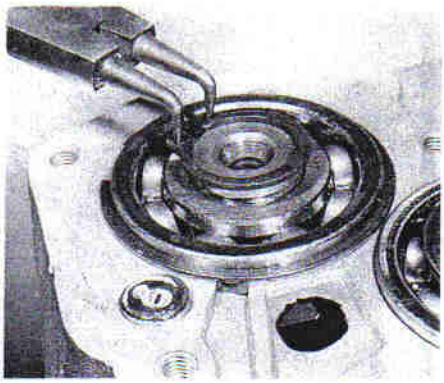
9.16B ... and gently lower the gearcase into position



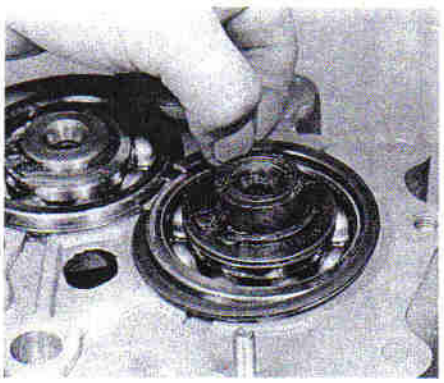
9.17 Positioning the bearing over the input shaft



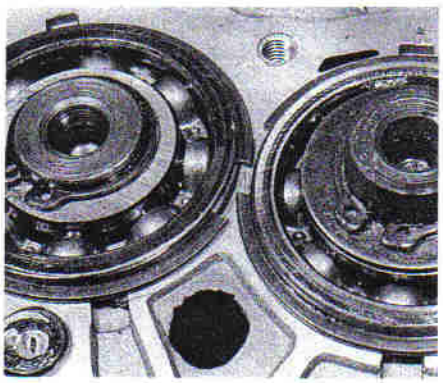
9.18 Tap the bearing down gently



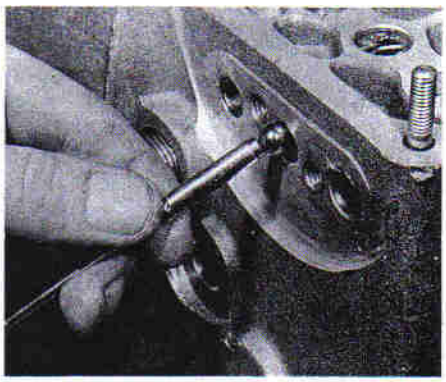
9.19 Fitting the input shaft circlip



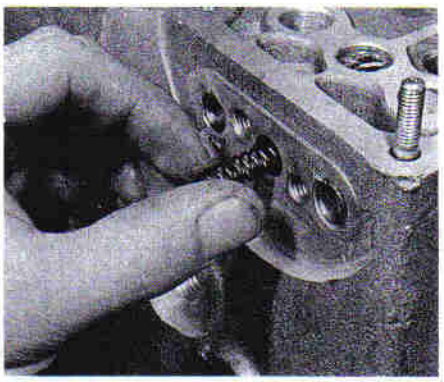
9.20A Snap ring on the mainshaft ...



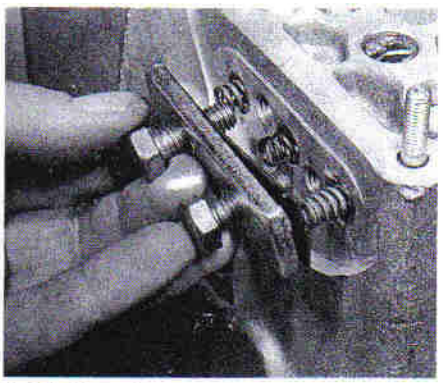
9.20B ... interlocks with that on the input shaft



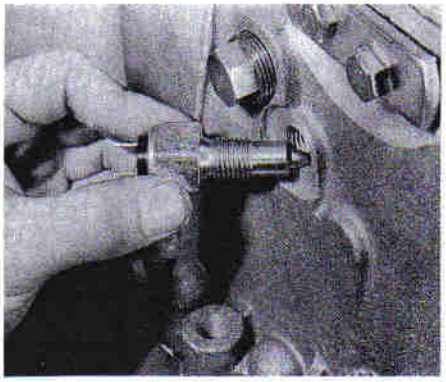
9.21A Using a pencil magnet to fit the detent balls ...



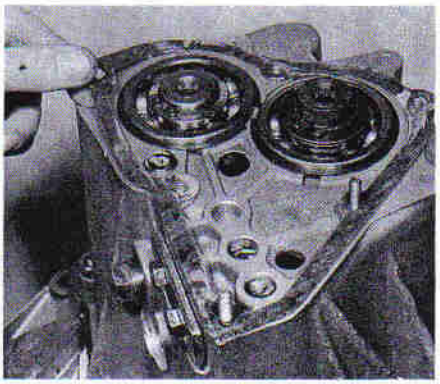
9.21B ... followed by the springs



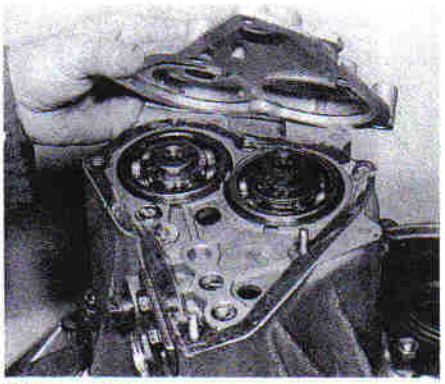
9.22 Fitting the cover over the springs



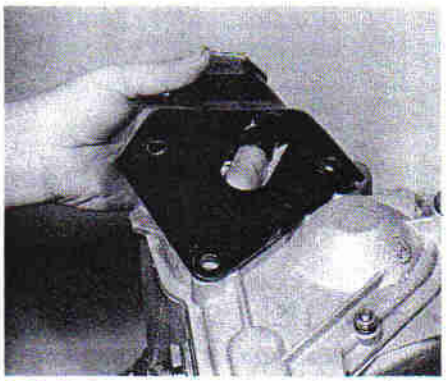
9.23 Refitting the reversing light switch



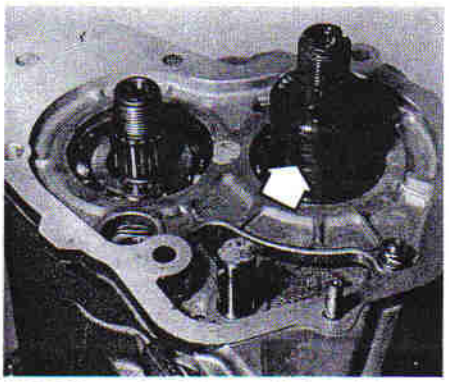
9.24A Using a new gasket ...



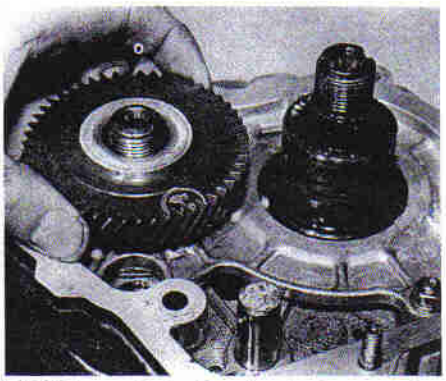
9.24B ... fit the end cover ...



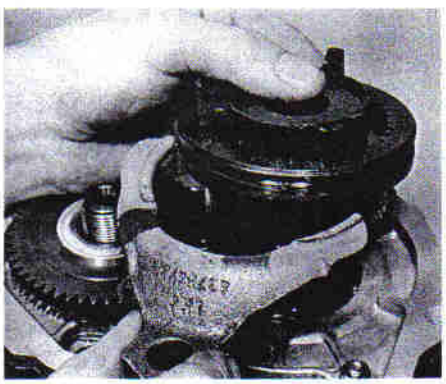
9.25 Fitting transmission mounting bracket on a 45 model



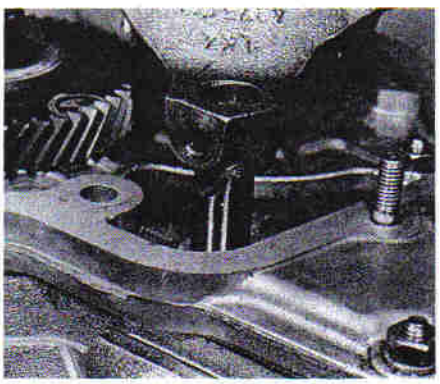
9.27 5th gear bush (arrowed) in position on the mainshaft



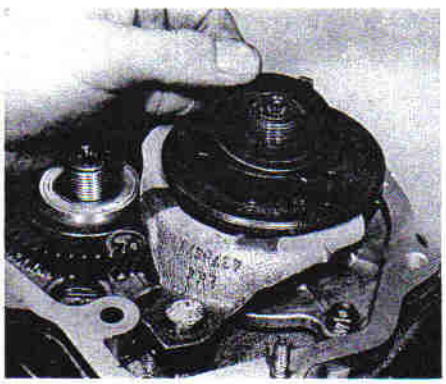
9.28 5th gear being fitted to the input shaft



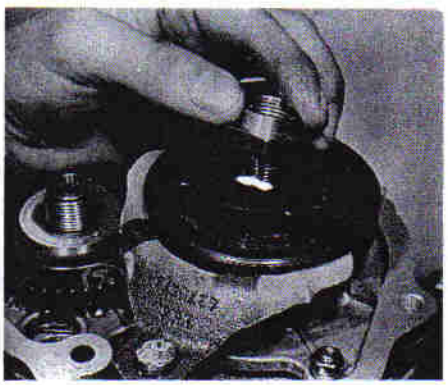
9.29A Fitting the 5th gear synchroniser assembly and selector fork



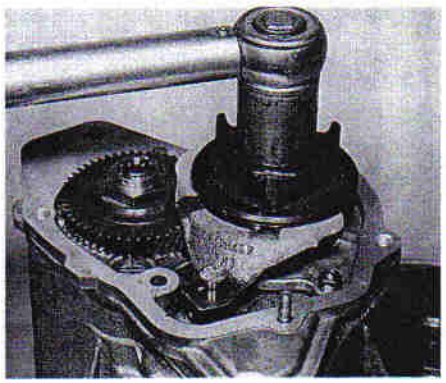
9.29B Locate the fork over the selector rod



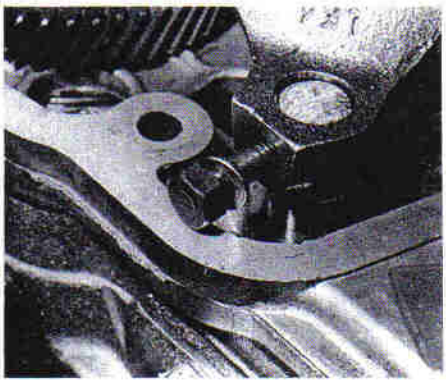
9.30A Fit the washer ...



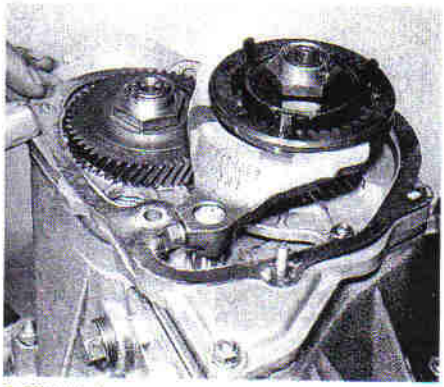
9.30B ... and nut to the mainshaft



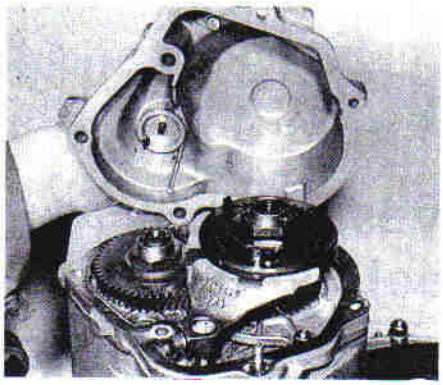
9.30C ... and tighten to specified torque



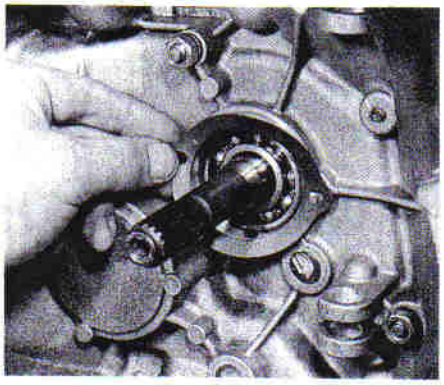
9.31 Fit and tighten the selector fork lockbolt



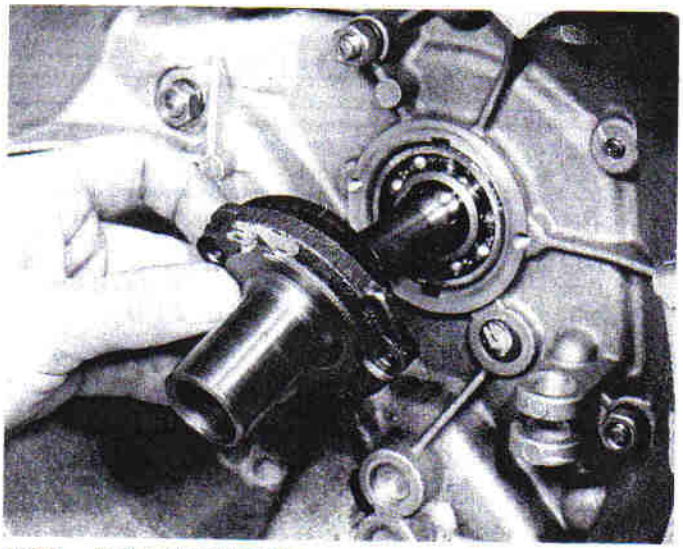
9.32A Using a new gasket ...



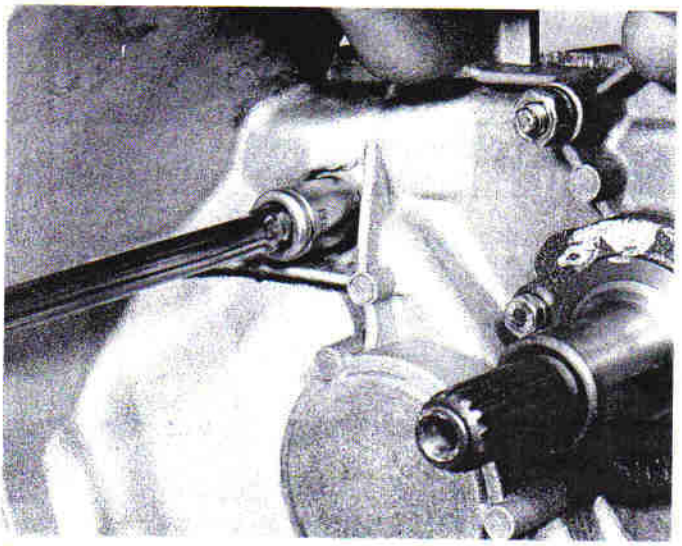
9.32B ... fit the end cover



9.33A Using a new gasket ...



9.33B ... fit the oil seal housing



9.34 Tightening the gearcase retaining bolts in the bellhousing

10 Fault diagnosis – transmission

Symptom	Reason(s)
Weak or ineffective synchromesh	Synchro baulk rings worn, split or damaged Synchromesh units worn, or damaged
Jumps out of gear	Gearchange mechanism worn Synchromesh units badly worn Selector fork badly worn
Excessive noise	Incorrect grade of oil in gearbox or oil level too low Gearteeth excessively worn or damaged Worn bearings
Difficulty in engaging gears	Clutch cable adjustment incorrect
Noise when cornering	Wheel bearing or driveshaft fault Differential fault

Note: *It is sometimes difficult to decide whether it is worthwhile removing and dismantling the gearbox for a fault which may be nothing more than a minor irritant. Gearboxes which howl, or where the synchromesh can be 'beaten' by a quick gearchange, may continue to perform for a long time in this state. A worn gearbox usually needs a complete rebuild to eliminate noise because the various gears, if re-aligned on new bearings, will continue to howl when different wearing surfaces are presented to each other. The decision to overhaul therefore, must be considered with regard to time and money available, relative to the degree of noise or malfunction that the driver has to suffer.*

Chapter 7 Driveshafts, hubs, roadwheels and tyres

Contents

Specifications

Driveshafts

Type	Solid, with constant velocity (CV) joint at outboard end and tripode joint at inboard end
Lubrication	Inboard joint from transmission oil, outboard joint with not more than 95 g (3.3 oz) of specified grease
Grease type (outboard joint)	Lithium based molybdenum disulphide grease (Duckhams LBM 10)

Hub bearings

Type (front and rear)	Double track ball-bearing, sealed for life
Bearing adjustment	Non-adjustable, set by driveshaft/hub nut torque

Wheels and tyres

	Wheels	Tyres
Wheel and tyre sizes:		
ZLM, ZLC, ZLX and ZLXE	4½J x 13	145 SR 13 or 165/70 SR 13
1983-on:		
311, 511 and 513 models except 311 GL and 513 GL	4½J x 13 (alloy)	145 SR 13
	5J x 13 (alloy)	165/70 SR 13
311 GL and 513 GL	4J x 13	135 SR 13
45 models	4½J x 13	145 SR 13
	4½J x 13	145 SR 13
45A models	4½J x 13	145 SR 13
	5J x 13 (alloy)	165/70 SR 13
1984-on:		
411 and 413 models except 413 GL	4½J x 13	145 SR 13
	5J x 13 (alloy)	165/70 SR 13
413 GL	4½J x 13	145 SR 13
53 L	5J x 13 (alloy)	155/70 SR 13
55 GLS	4½J x 13 (alloy)	145 SR 13
	5J x 13 (alloy)	155/70 SR 13
1986-on:		
45A	4½J x 13	145 SR 13
	5J x 13 (alloy)	155/70 SR 13
45A GLS	4½J x 13 (alloy)	145 SR 13
	5J x 13 (alloy)	155/70 SR 13
55A and 55 GL	4½J x 13 (alloy)	145 SR 13
	5J x 13 (alloy)	155/70 SR 13
55A LS and 55A GLS	4½J x 13 (alloy)	145 SR 13
	5J x 13 (alloy)	155/70 SR 13
1988-on:		
311 and 511 models	4½J x 13	145 SR 13
	5J x 13 (alloy)	155/70 SR 13
513 models	4½J x 13 (alloy)	145 SR 13
	5J x 13 (alloy)	155/70 SR 13
55A models	4½J x 13 (alloy)	145 SR 13
	5J x 13 (alloy)	155/70 SR 13
65A GLX	4½J x 13 (alloy)	145 SR 13
	5J x 13 (alloy)	155/70 SR 13
Van (all models)	4½J x 13	145 SR 13

Tyre pressures (cold):	Front	Rear
45 models	1.9 bar (27.0 lbf/in²)	2.0 bar (29.0 lbf/in²)
55 models	1.6 bar (23.0 lbf/in²)	1.8 bar (26.0 lbf/in²)
45A, 55A and 65A models	1.7 bar (24.0 lbf/in²)	1.8 bar (26.0 lbf/in²)
311, 411 and 511 models	1.8 bar (26.0 lbf/in²)	1.7 bar (24.0 lbf/in²)
513 models	1.8 bar (26.0 lbf/in²)	1.7 bar (24.0 lbf/in²)

Torque wrench settings

	Nm	lbf ft
Front hub nut (large) – see Section 3	216	160
Front hub nut (small) – see Section 3	138	102
Rear hub nut	138	102
Driveshaft boot flange bolts	10	7
Roadwheel bolts	86	63

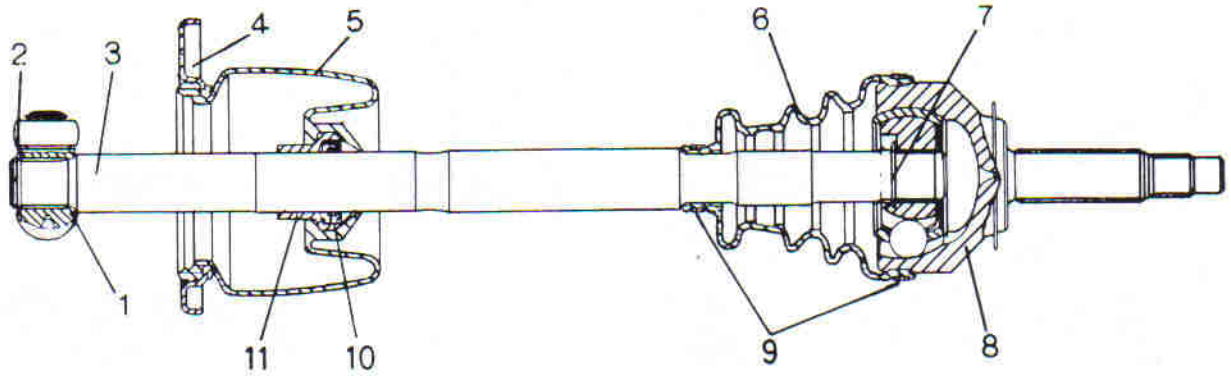


Fig. 7.1 Sectional view of typical driveshaft (Sec 1)

1 Inboard tripode type joint
2 Circlip
3 Driveshaft
4 Boot retaining flange
5 Boot
6 Boot
7 Circlip
8 Constant velocity (CV) joint
9 Boot clamping bands
10 Integral oil seal
11 Oil seal sleeve

1 General description

The driveshafts, although of different lengths and diameters depending on model, are basically similar for all models, and the procedures given in the following Sections are applicable to all models. The same is true of the front and rear hubs.

The driveshafts transmit power from the transmission final drive unit to the roadwheels, and are of the open type, with a tripode type joint at the inboard end and a constant velocity (CV) joint at the outboard end.

The tripode joints are located in the transmission bevel side gears and are lubricated by the transmission oil.

The constant velocity joints are lubricated for life with grease.

The front and rear hub bearings are of double ball-bearing type, press fitted in the hubs, and lubricated for life. No adjustment of the bearings is required.

The roadwheels are of pressed steel or alloy depending on model. Radial ply tyres are fitted.

2 Routine maintenance

The driveshaft joints are lubricated for life and require no regular lubrication. Similarly, the front and rear hub bearings require no regular adjustment or lubrication, although they should be checked for wear periodically.

At the intervals given in the *'Routine maintenance'* Section at the beginning of this manual carry out the following operations:

Inspect the driveshaft boots for leaks, splits, tears or other damage, and for security of the securing bands (Section 4)
Inspect the driveshafts for damage, distortion or cracks
Check the tyre pressures and the condition of the tyre treads and walls, not forgetting the spare (Section 8)
Check the tightness of the roadwheel bolts (see 'Jacking, towing and wheel changing' at the beginning of this manual)

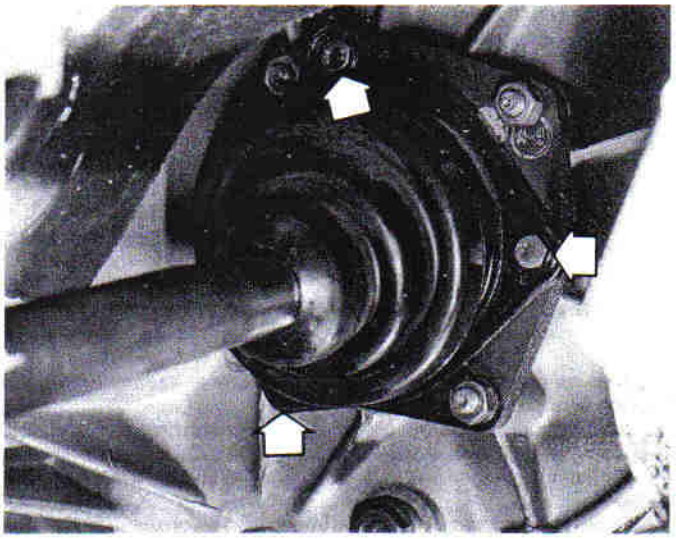
3 Driveshafts – removal and refitting

1 Raise the front of the vehicle onto axle stands positioned under the front support pads.
2 Remove the front roadwheel.
3 Where fitted, remove the engine undershields.
4 Relieve the staking on the driveshaft nut.
5 With an assistant firmly applying the footbrake, undo the driveshaft nut. Use a socket and long bar as the nuts are very tight. Note that on reassembly a new nut must be used. Remove the large washer from under the nut.
6 Unbolt the flexible hydraulic brake hose support bracket from the lower part of the suspension strut to avoid straining the hose when the hub carrier is tilted downwards.
7 Disconnect the steering tie-rod from the hub carrier (see Chapter 9).
8 Remove the suspension strut-to-hub carrier bolts.
9 Undo the bolts securing the inboard joint flange plate to the transmission unit and pull back the flange and boot (photo). Expect some loss of oil.
10 Push the outer end of the driveshaft out of the hub carrier. If it is tight, refit the driveshaft nut by a few threads to protect the end of the shaft, then give it a sharp tap with a mallet to free it.
11 Separate the suspension strut from the hub carrier, and holding the strut out of the way, tilt the hub carrier downwards and pull out the driveshaft from the rear of the hub (photo).
12 Carefully extract the inner end of the driveshaft from the transmission unit and remove the driveshaft from under the vehicle (photo).
13 Refitting is a reversal of removal using a new driveshaft nut tightened to the specified torque and staked to the driveshaft – refer to the following note (photos).

Note: Hub nut (driveshaft nut) torque wrench setting

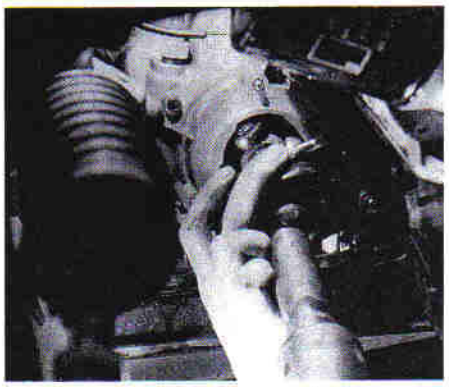
There are two different hub nut torque wrench settings depending on the size of the hub nut. The easiest way to check this is to compare the size of the front and rear hub nuts. If the front hub nut is larger than the rear hub nut, use the higher torque figure, and if the front hub nut is the same size as the rear hub nut, use the lower figure. Have an assistant apply the footbrake firmly, and use a socket and extension bar to tighten the nut

14 Check and if necessary top up the transmission oil level.

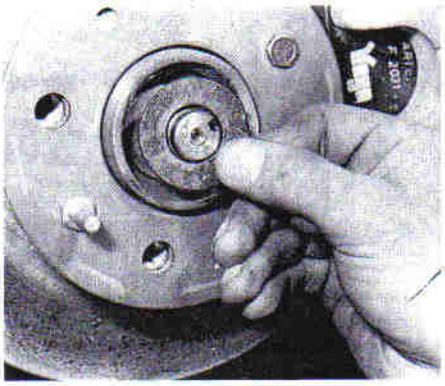


3.9 Inboard joint flange plate bolts (arrowed)

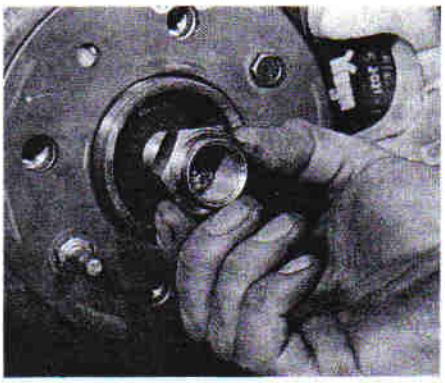
3.11 Removing the driveshaft from the rear of the hub



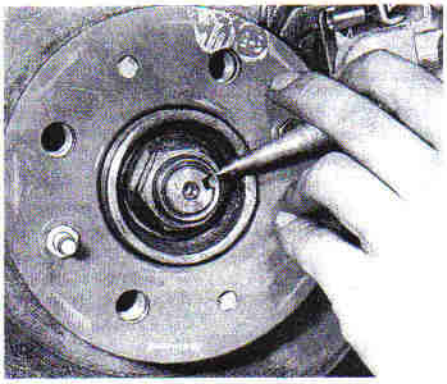
3.12 Withdrawing the inner end of the driveshaft from the transmission



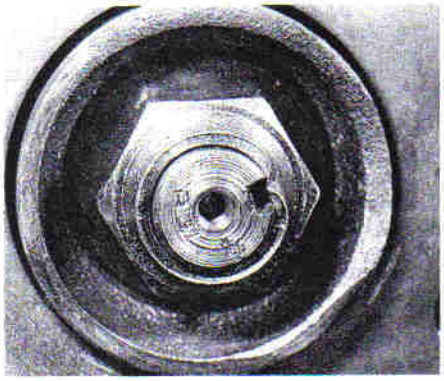
3.13A Fit the washer ...



3.13B ... and nut



3.13C Use a punch ...



3.13D ... to stake the nut

4 Driveshaft rubber boots – general

1 Protective rubber boots are fitted over the inboard and outboard driveshaft joints, to keep the lubricant in and dirt out.
2 The inboard boot contains an integral seal around the driveshaft, and is bolted to the transmission casing, remaining stationary with the driveshaft rotating in it.
3 The outboard boot is secured to the driveshaft by metal clips, and rotates with it.
4 The boots should be inspected at regular intervals for signs of any damage which could allow dirt to enter the joint. Inspect them for cracks, splits, tears or leakage. If any damage is evident the relevant boot must be renewed at once (see Section 5), or rapid wear of the joint will result from dirt ingress.

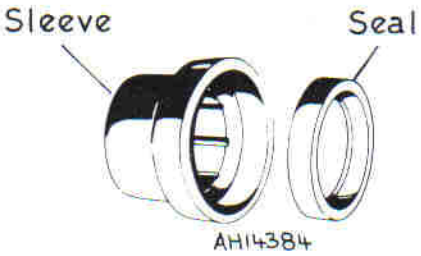
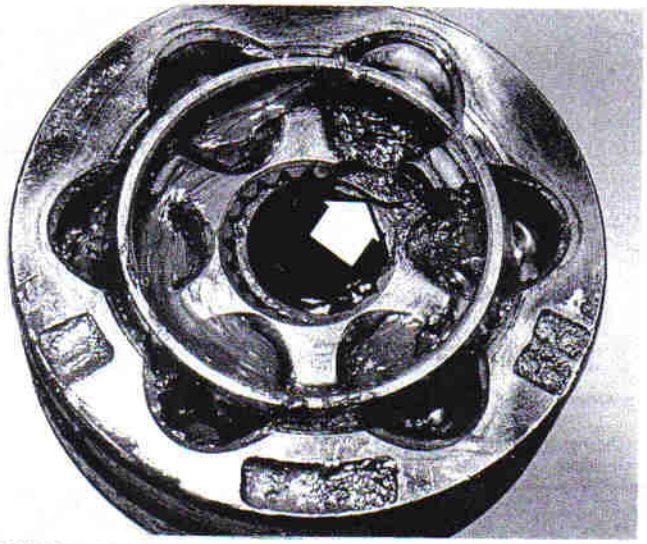


Fig. 7.2 Oil seal and sleeve located in inboard boot of driveshaft (Sec 4)

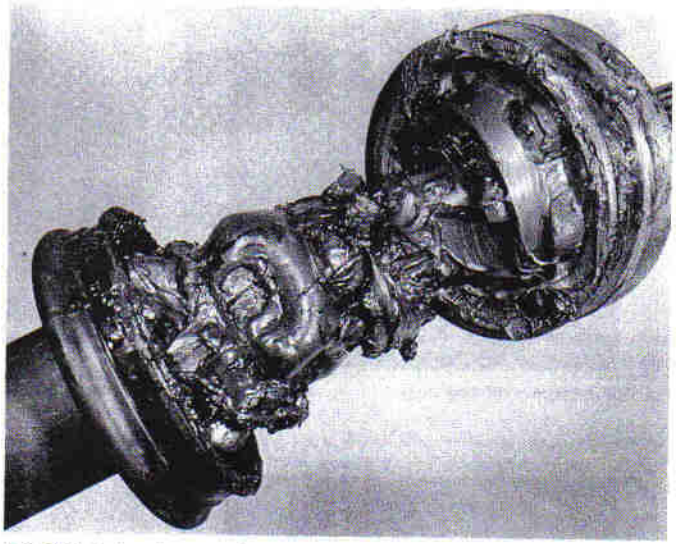
5 Driveshaft joints – overhaul

Outboard (constant velocity) joint

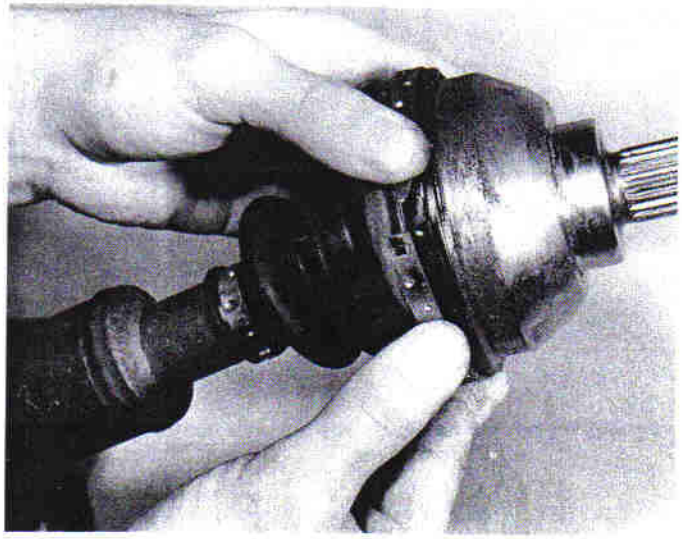
1 Remove the driveshaft as described in Section 3 and clamp it in a vice.
2 Remove both clips securing the outer boot to the driveshaft, and peel back the boot.
3 Clean off all the old grease from the joint and locate the circlip securing the joint to the driveshaft.
4 Extract the circlip and pull or tap the joint from the driveshaft (photo).
5 No renewal of the individual components of the joint is possible and if the joint shows signs of wear, a new joint must be fitted. It would also make sense to renew the rubber boot, as the joint has to be removed to do this in any case.
6 Remove the old boot from the driveshaft.
7 Apply some of the specified grease to the inside of the new boot and slide it onto the driveshaft.
8 Also smear some of the grease onto the end of the driveshaft and into the new joint, then slide the new joint onto the driveshaft. The circlip which locks the joint to the driveshaft can be located in its groove in the joint, and the driveshaft can be used to expand it as the joint is fitted. The circlip will then lock in position when the groove in the driveshaft lines up with it. Ensure that this has happened by pushing and pulling the joint on the driveshaft. It is vital that the circlip locks the joint on the driveshaft.
9 Apply more of the specified grease to the joint, working it in around the caged rollers, but do not apply more than the specified amount (photo).
10 Pull the boot into position over the joint and secure it in place with the metal bands (photo).
11 Refit the driveshaft as described in Section 3.



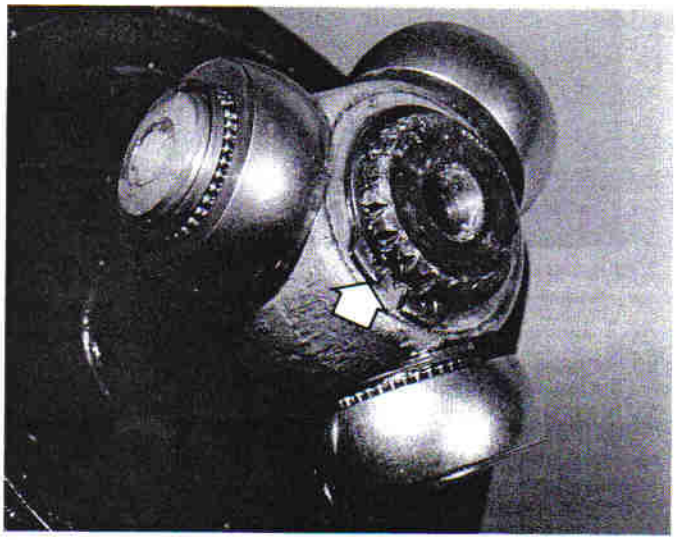
5.4 CV joint (circlip arrowed)



5.9 CV joint well greased



5.10 Secure the boot with the metal bands



5.13 Tripode joint circlip (arrowed)

Inboard (tripode) joint

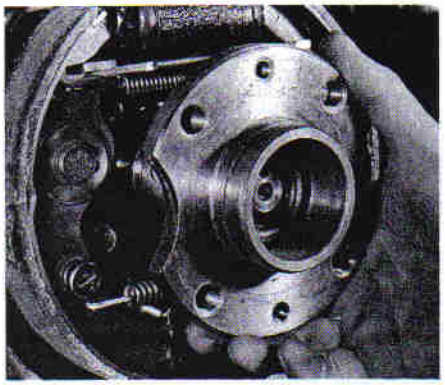
12 Remove the driveshaft as described in Section 3.
13 Remove the circlip securing the joint to the driveshaft, and lift off the spider and bearings (photo).
14 Pull off the rubber boot.
15 On some models, the individual bearings are secured to the joint spider by circlips and can be renewed if the bearings are available as spares, although it is more satisfactory to renew the complete joint. It is also advisable to renew the rubber boot, as the joint has to be removed to do this in any case.
16 Lubricate the sleeve and seal with transmission oil and fit the seal into the sleeve.
17 Fit the sleeve complete with seal into the rubber boot.
18 Fit the boot onto the driveshaft.
19 Lubricate the new joint with transmission oil, then fit the joint to the driveshaft, making sure that the circlip is located correctly in its groove.
20 Refit the driveshaft as described in Section 3.
21 Check and if necessary top up the transmission oil level.

6 Front hub bearings – renewal

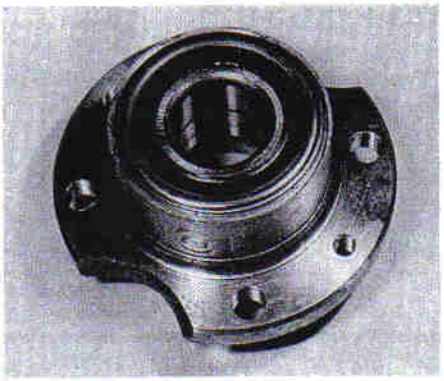
1 The renewal of the front hub bearings is best entrusted to a dealer, as apart from the need for special tools and presses there are many pitfalls due to modifications to the hubs.
2 If desired, the hub carrier can be removed as described in Chapter 10 and taken to a dealer for renewal of the hubs.
3 To check a bearing for wear, raise the front of the vehicle so that the wheel is clear of the ground. Grasp the wheel at top and bottom and attempt to rock it on the stub axle. If axial play exceeds 2.5 mm (0.10 in) the bearing is worn and must be renewed.

7 Rear hub bearings – checking, removal and refitting

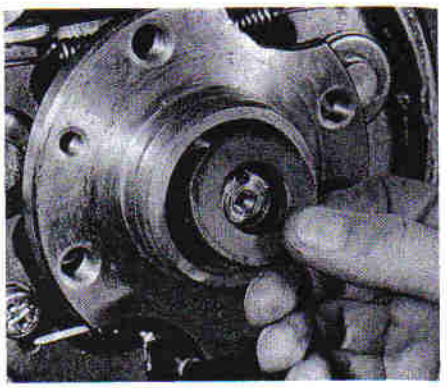
1 The rear hub bearings are lubricated for life and require no adjustment in service.
2 A bearing can be checked for wear by raising the relevant rear wheel clear of the ground, grasping the wheel at top and bottom and attempting to rock it on the stub axle. If axial play exceeds 2.5 mm (0.10 in) the bearings must be renewed as follows.
3 Raise the rear of the vehicle onto axle stands placed under the rear support pads and remove the relevant rear wheel.
4 Remove the rear brake drum as described in Chapter 8.
5 Prise and tap off the hub cap.
6 Relieve the staking on the hub retaining nut and remove the nut and large washer. Apply the handbrake, and have an assistant apply



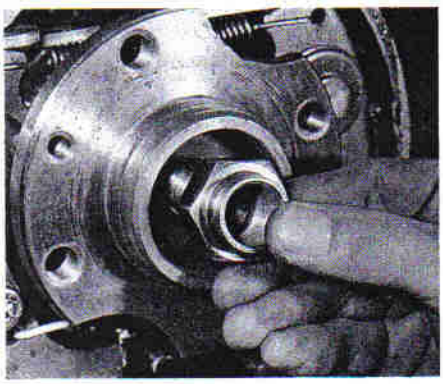
7.7 Lifting off the hub



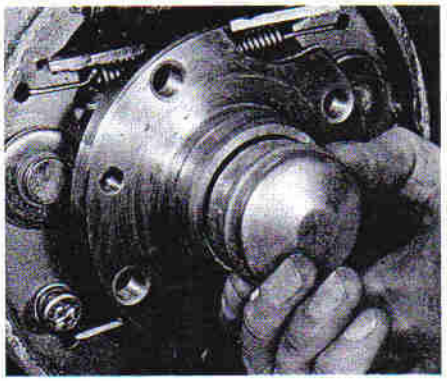
7.8 Hub and bearing assembly



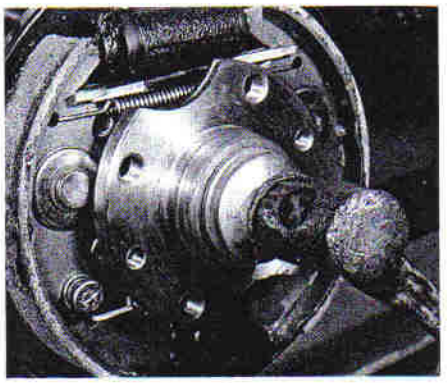
7.9A Fit the washer ...



7.9B ... and nut ...



7.9C Fit the hub cap ...



7.9D ... and tap into place

the footbrake firmly when loosening the hub nut, as it is very tight.
7 The hub, complete with bearing can now be lifted off the stub axle. If it is tight, use a puller (photo).
8 The bearing and hub assembly come as a complete unit and if the bearing is worn, the complete bearing/hub assembly must be renewed (photo). If the bearing/hub assembly is being renewed, refer to the note at the beginning of Section 9 in Chapter 8.
9 Refitting is a reversal of removal using a new hub retaining nut tightened to the specified torque and staked to the stub axle on completion (photos). Apply the handbrake, and have an assistant apply the footbrake firmly when tightening the hub nut.

8 Wheels and tyres – general care and maintenance

1 Wheels and tyres should give no real problems in use provided that a close eye is kept on them with regard to excessive wear or damage. To this end, the following points should be noted.
2 Ensure that tyre pressures are checked regularly and maintained correctly. Checking should be carried out with the tyres cold and not immediately after the vehicle has been in use. If the pressures are checked with the tyres hot, an apparently high reading will be obtained owing to heat expansion. Under no circumstances should an attempt be made to reduce the pressures to the quoted cold reading in this instance, or effective underinflation will result.
3 Underinflation will cause overheating of the tyre owing to excessive flexing of the casing, and the tread will not sit correctly on the road surface. This will cause a consequent loss of adhesion and excessive wear, not to mention the danger of sudden tyre failure due to heat build-up.
4 Overinflation will cause rapid wear of the centre part of the tyre tread coupled with reduced adhesion, harsher ride, and the danger of shock damage occurring in the tyre casing.
5 Regularly check the tyres for damage in the form of cuts or bulges, especially in the sidewalls. Remove any nails or stones embedded in

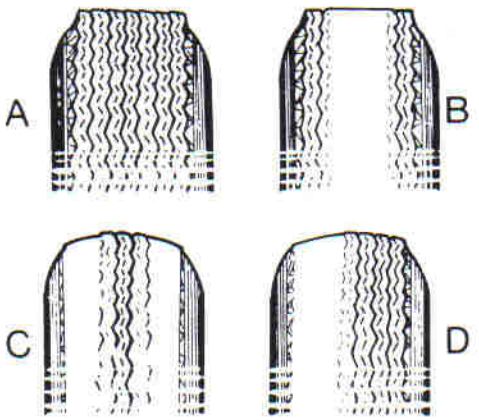


Fig. 7.3 Tyre wear patterns and causes (Sec 8)

A 'Feathering' due to incorrect toe-in
B Over inflation
C Under inflation
D Wear due to incorrect camber, worn wheel bearings or fast cornering

the tread before they penetrate the tyre to cause deflation. If removal of a nail *does* reveal that the tyre has been punctured, refit the nail so that its point of penetration is marked. Then immediately change the wheel and have the tyre repaired by a tyre dealer. Do *not* drive on a tyre in such a condition. In many cases a puncture can be simply repaired by the use of an inner tube of the correct size and type. If in any doubt as to the possible consequences of any damage found, consult your local tyre dealer for advice.

6 Periodically remove the wheels and clean any dirt or mud from the inside and outside surfaces. Examine the wheel rims for signs of rusting, corrosion or other damage. Light alloy wheels are easily damaged by 'kerbing' whilst parking, and similarly steel wheels may become dented or buckled. Renewal of the wheel is very often the only course of remedial action possible.

7 The balance of each wheel and tyre assembly should be maintained to avoid excessive wear, not only to the tyres but also to the steering and suspension components. Wheel imbalance is normally signified by vibration through the vehicle's bodyshell, although in many cases it is particularly noticeable through the steering wheel. Conversely, it should be noted that wear or damage in suspension or steering components may cause excessive tyre wear. Out-of-round or out-of-true tyres, damaged wheels and wheel bearing wear/maladjustment also fall into this category. Balancing will not usually cure vibration caused by such wear.

8 Wheel balancing may be carried out with the wheel either on or off the vehicle. If balanced on the vehicle, ensure that the wheel-to-hub relationship is marked in some way prior to subsequent wheel removal so that it may be refitted in its original position.

9 General tyre wear is influenced to a large degree by driving style – harsh braking and acceleration or fast cornering will all produce more rapid tyre wear. Interchanging of tyres may result in more even wear, but this should only be carried out where there is no mix of tyre types on the vehicle. However, it is worth bearing in mind that if this is completely effective, the added expense of replacing a complete set of tyres simultaneously is incurred, which may prove financially restrictive for many owners.

10 Front tyres may wear unevenly as a result of wheel misalignment. The front wheels should always be correctly aligned according to the settings specified by the vehicle manufacturer.

11 Legal restrictions apply to the mixing of tyre types on a vehicle. Basically this means that a vehicle must not have tyres of differing construction on the same axle. Although it is not recommended to mix tyre types between front axle and rear axle, the only legally permissible combination is crossply at the front and radial at the rear. When mixing radial ply tyres, textile braced radials must always go on the front axle, with steel braced radials at the rear. An obvious disadvantage of such mixing is the necessity to carry two spare tyres to avoid contravening the law in the event of a puncture.

12 In the UK, the Motor Vehicles Construction and Use Regulations apply to many aspects of tyre fitting and usage. It is suggested that a copy of these regulations is obtained from your local police if in doubt as to the current legal requirements with regard to tyre condition, minimum tread depth, etc.

9 Fault diagnosis – driveshafts and hubs

Symptom	Reason(s)
Knock or clunk when taking up drive	Loose hub nut Loose driveshaft flange bolts Worn shaft-to-hub splines Worn CV or tripode joint
Clicking or knocking, especially when cornering	Worn or damaged CV joint
Vibration (check wheel balance first)	Bent driveshaft Worn driveshaft/hub bearings Worn CV joint Loose hub carrier mountings
Noise when cornering	Worn hub bearings
Roadwheel rock when gripped top and bottom with wheel raised	Worn bearings Incorrectly tightened hub nut Loose roadwheel bolts

Chapter 8 Braking system

Contents

Specifications

General

System type	Dual-circuit hydraulic with servo assistance on certain models. Rear brakes pressure regulated. Disc brakes at front and drum at rear. Mechanical handbrake acting on rear drums

Disc brakes

Type	Single cylinder, sliding caliper
Disc diameter	227.0 mm (8.94 in)
Disc thickness	10.7 to 10.9 mm (0.42 to 0.43 in)
Minimum regrind thickness	9.35 mm (0.37 in)
Minimum wear thickness of pad friction material	1.5 mm (0.06 in)
Caliper cylinder diameter	48.0 mm (1.89 in)

Drum brakes

Type	Single cylinder with automatic adjusters
Drum internal diameter	185.25 to 185.53 mm (7.30 to 7.31 in)
Maximum regrind diameter	186.33 mm (7.34 in)
Minimum thickness of shoe lining friction material	1.5 mm (0.06 in)
Cylinder diameter:	
3/4/5 series models	19.05 mm (0.75 in)
45/55/65 models	17.5 mm (0.68 in)

Brake pedal rest height

3/4/5 series models	10.0 mm (0.39 in) higher than clutch pedal (approximately)
45/55/65 models	Level with clutch pedal (approximately)

Brake pressure regulator

Torsion rod adjustment (distance below chassis member – see Section 11):	
ZLM, ZLC, ZLX and ZLXE models	70.0 ± 5.0 mm (2.75 ± 0.20 in)
311, 411, 413, 511 and 513 models	54.0 ± 5.0 mm (2.13 ± 0.20 in)
45/55/65 models with 3-leaf suspension spring	45.0 ± 5.0 mm (1.77 ± 0.20 in)
45/55/65 models with 2-leaf suspension spring	60.0 ± 5.0 mm (2.36 ± 0.20 in)

Hydraulic fluid

Type	Hydraulic fluid to DOT 3 (Duckhams Universal Brake and Clutch Fluid)
Capacity	0.33 litre (0.58 pint)

Torque wrench settings

	Nm	lbf ft
Master cylinder mounting nuts	25	18
Brake servo mountings nuts	15	11
Rear brake pressure regulating valve bolts	25	18
Front caliper support bracket bolts	47	35
Rear wheel cylinder bolts	10	7
Rear brake backplate bolts	25	18
Flexible hose-to-front caliper union	27	20
Flexible hose-to-rear wheel cylinder union	20	14

1 General description

The braking system is hydraulic acting through disc brakes on the front wheels and drum brakes on the rear.

The system is split into two circuits, front and rear, so that if a fault occurs in one circuit the other will remain operational.

A vacuum servo is fitted to all models in the range except 45 models.

A brake pressure regulator is incorporated in the rear circuit and prevents the rear wheels locking before the front wheels under heavy braking.

The handbrake is mechanical, acting on the rear brakes through cables.

The braking system on all models is very similar and is treated as such throughout this Chapter. Where major differences do occur, these are pointed out in the text.

2 Routine maintenance

At the intervals specified in the *'Routine maintenance'* Section at the start of this manual, carry out the following operations:

Check the fluid level in the reservoir and top up as necessary (Section 3)
Inspect the braking system for leaks, and check the condition of all flexible hoses and rigid pipelines
Check the condition of the front brake pads (Section 4) and brake discs (Section 5)
Check the operation of the handbrake and adjust as necessary (Section 20)
Carry out a functional check of the brake system, paying particular attention to the brake servo, brake pedal and crosstube, and the rear brake pressure regulating valve
Inspect the rear brake shoes, drums and wheel cylinders
Renew the brake fluid in the complete system

It is also recommended that at 60 000 mile (100 000 km) or 5 yearly intervals the flexible brake hoses are renewed, irrespective of condition, to avoid sudden bursting due to fatigue.

3 Brake fluid level – checking and topping-up

1 The level in the brake fluid reservoir should be checked at the specified intervals (see *'Routine maintenance'*).
2 The level must be maintained between the MAX and MIN marks on the side of the reservoir (photo).
3 If topping-up is necessary, remove the cap from the reservoir filler neck (there is no need to disconnect the low level indicator connections as the outer cap will revolve around the central terminal).
4 Fill the reservoir to the correct level with the specified brake fluid (photo).
5 On completion, refit the cap and mop up any spillage immediately – brake fluid is a very effective paint stripper.
6 The need for frequent topping-up of the system indicates a leak somewhere in the system and must be investigated.

4 Disc pads – inspection and renewal

1 Jack up the front of the car and remove the roadwheels.
2 Inspect the thickness of the friction material on each pad. If it is less than the specified minimum the pads must be renewed.
3 To remove the pads, extract the spring clips and slide out the locking blocks (photos).
4 Lift the caliper body from the disc and withdraw the pads, one from each side of the disc. Remove the anti-rattle springs (photo).
5 Brush away any dust and dirt from the caliper, taking care not to inhale the dust – this contains asbestos and is thus potentially injurious to health.
6 As the new pads are thicker than the old ones, the caliper piston must be depressed into its cylinder to accommodate them. This will cause the fluid level to rise in the reservoir. Anticipate this by syphoning some out beforehand, but take care not to let it drip onto the paintwork – it acts as an effective paint stripper!
7 Refit the anti-rattle springs, the pads (friction lining-to-disc), the caliper body, the locking blocks and their retaining clips (photo).
8 Refit the roadwheel and apply the footbrake hard, several times, to bring the pads into contact with the brake disc.
9 Renew the pads on the opposite brake. The pads should always be renewed in axle sets.
10 Top up the fluid reservoir.

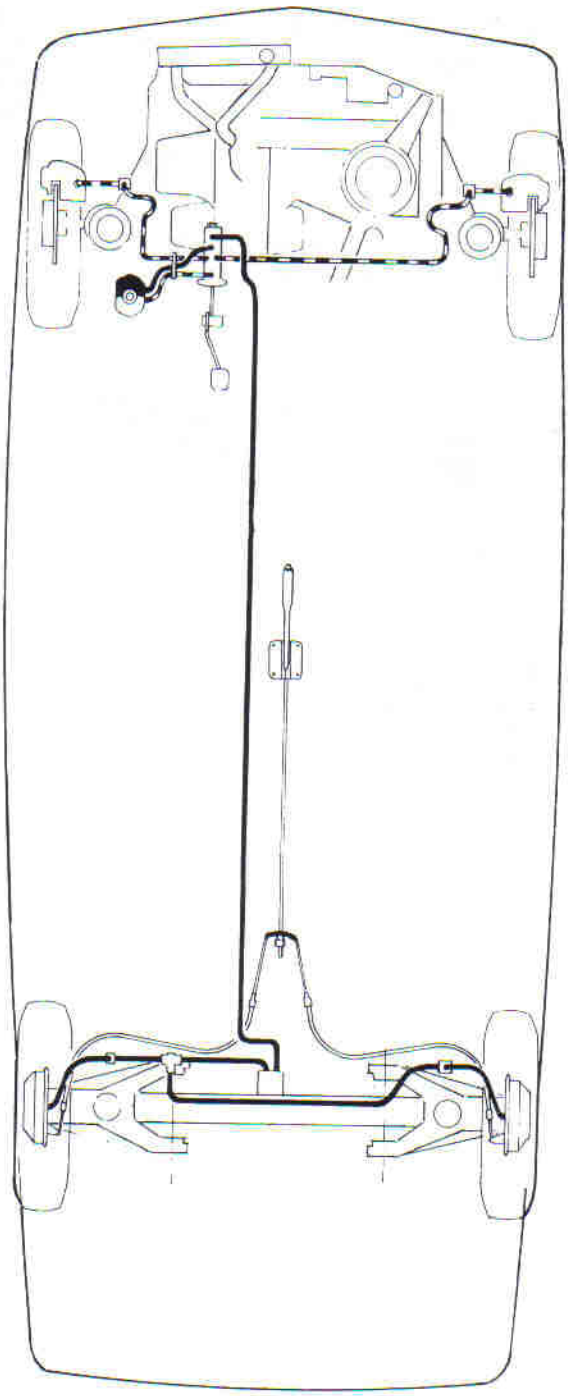
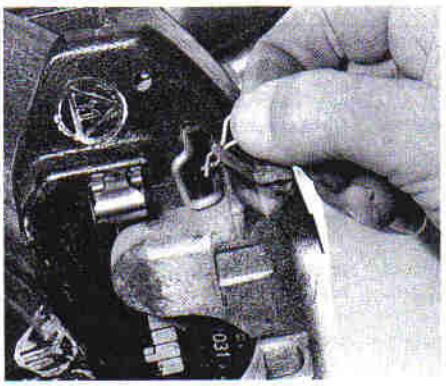
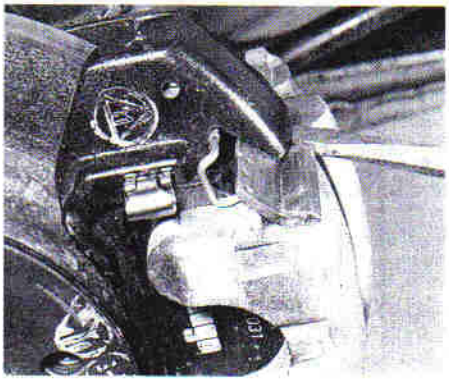


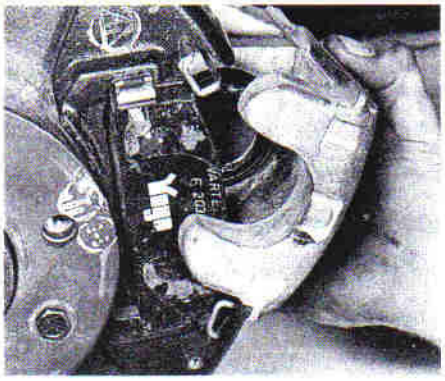
Fig. 8.1 Layout of the braking system (Sec 1)

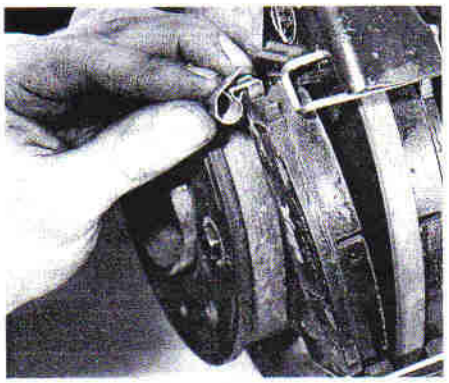
3.2 Max and Min marks on reservoir

3.4 Filling the reservoir


4.3A Extract the spring clips ...

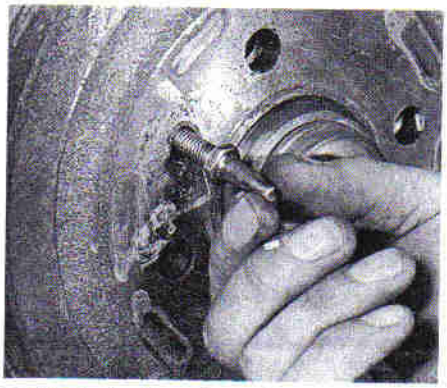

4.3B ... and slide out the locking blocks


4.4 Lift the caliper body from the disc

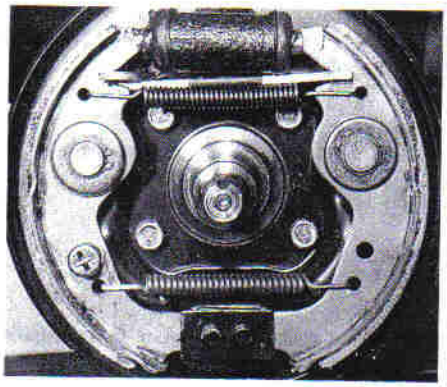

4.7 Fitting an anti-rattle spring to the pad

5 Rear brake shoes – inspection and renewal

1 Jack up the rear of the car and remove the roadwheels.
2 Fully release the handbrake.
3 Unscrew and remove the drum securing bolts. One of these is a long locating spigot for the roadwheel (photo).
4 Pull off the drum. If it is tight, clean off the rust at its joint with the hub flange, and apply a little penetrating fluid. On models where the holes in the drum for the drum securing bolts are tapped, two bolts may be screwed into the drum securing bolt holes and the drum thus eased off the hub.
5 Brush away all the dust and dirt from the shoes and operating mechanism, taking care not to inhale it.
6 The friction linings fitted as original equipment are of the bonded type and the rivet heads normally used as a guide to wear are not, of course, fitted. However, if the thickness of the friction linings is down to less than the specified minimum, the shoes must be renewed. Always purchase new or factory relined brake shoes.
7 Before removing the brake shoes, note the way in which the shoes are positioned, with respect to leading and trailing ends (the end of the shoe not covered by lining material). Note also into which holes in the shoe web the return springs are connected. Sketch the shoes or mark the holes on the new shoes with quick drying paint if you are doubtful about remembering (photo).
8 Undo the steady springs by depressing and rotating their caps a quarter turn to disengage the slot from the pin (photo). On some models a U-shaped steady spring is used. Depress and slide it out.
9 Rotate the hub until the cut-outs in its rear flange face are in alignment with the shoe self-adjusters, or remove the hub which makes the removal task easier.
10 Pivot the trailing shoe on the self-adjuster post and disengage the ends of the shoe from the slot in the wheel cylinder tappet and from the lower anchor block.
11 Work the shoe up the self-adjuster pivot post until the self-adjuster boss enters the cut-out in the hub flange. The shoe can now be withdrawn.
12 Once off the self-adjuster post, the pull-off spring tension is eased, as the shoe can move towards the other, so the springs can be unhooked.
13 Remove the leading shoe in a similar way.
14 The pistons in the wheel cylinder have a habit of creeping out once released. Guard against this by restraining them in some way. We used a plastic cable tie (photo).
15 The new shoes will already be fitted with new self-adjusters.
16 Fit the new shoes to their self-adjuster posts, making sure that the handbrake shoe lever is correctly located (photo). Engage the ends of the shoes.
17 Using a wooden or plastic-faced mallet, tap the shoes inwards against the friction of their self-adjuster coil springs. This will have the effect of reducing the overall diameter of the shoes to facilitate fitting of the shoe return springs and to allow the brake drum to slide over them.
18 Using pliers, reconnect the upper (longer) and lower shoe return springs (photo).
19 Hold the steady pins in position from the rear of the backplate. Fit the spring seats, the small coil springs and the retaining caps, again using pliers to grip the cap and to depress and turn it to engage the pin (photos). On later models fit the U-shaped springs.
20 Before refitting the drum, clean it out and examine it for grooves or scoring (refer to Section 9).
21 Fit the drum and the roadwheel.
22 Apply the brakes two or three times to position the shoes close to the drum.
23 Renew the shoes on the opposite brake in a similar way.
24 The handbrake should be automatically adjusted by the action of the shoe adjuster. If the handbrake control lever has excessive travel, refer to Section 20 for separate adjusting instructions.

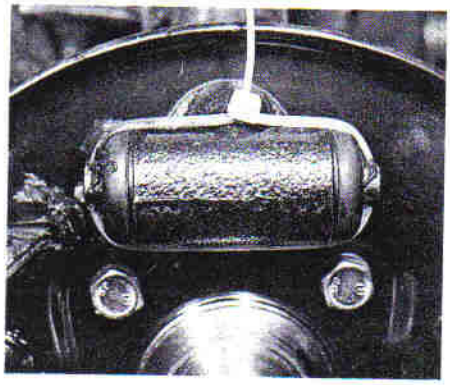


5.3 Roadwheel locating spigot on brake drum

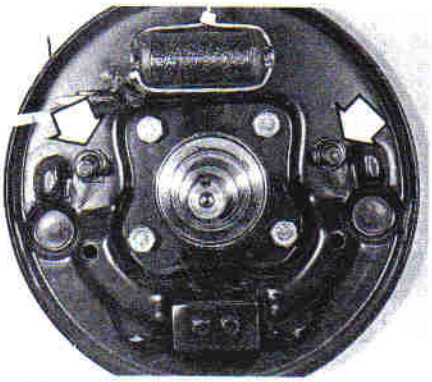


5.7 View of drum brake assembly before dismantling (hub removed)

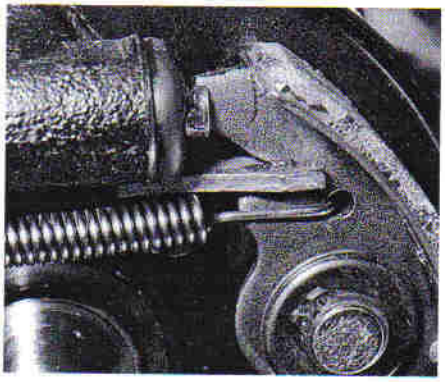
5.8 Depress and rotate the steady spring cap



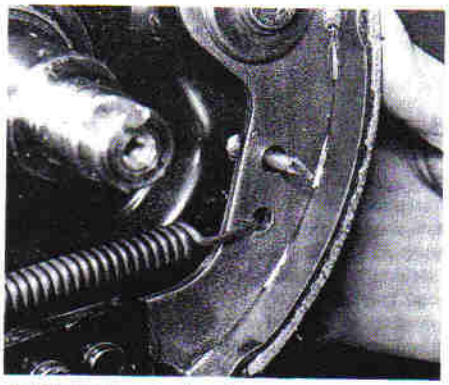
5.14 Method of restraining the pistons



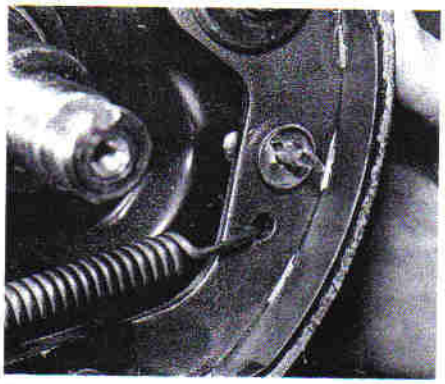
5.16 Self adjuster posts (arrowed)



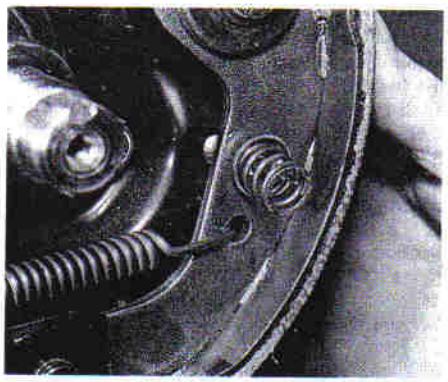
5.18 Correct engagement of upper return spring, spreader bar and shoe



5.19A Fit the steady pin ...



5.19B ... spring seat ...

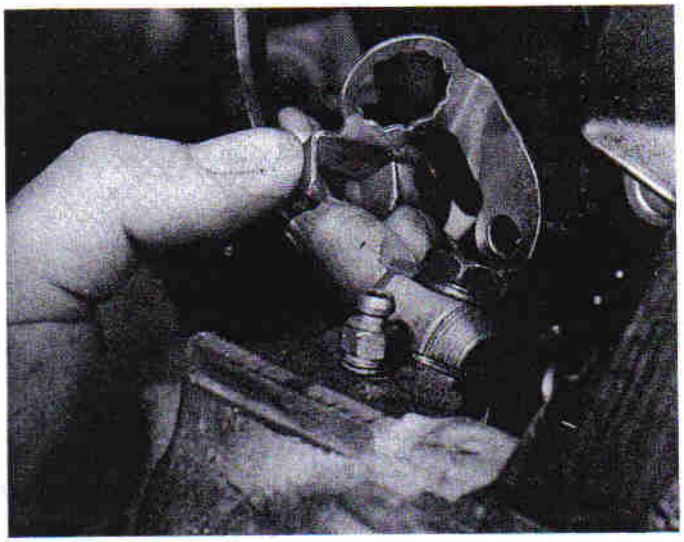


5.19C ... and spring

6 Caliper – removal and refitting

1 Before commencing overhaul, buy a caliper/piston repair kit obtainable from Yugo dealers.
2 Raise the front of the vehicle onto axle stands.
3 Remove the front wheels.
4 Taking precautions against dust inhalation, brush away the accumulation of brake dust from the caliper. This dust may contain asbestos and if inhaled can be injurious to health.
5 Remove the bolt from the locking plate on the flexible hose banjo union on the caliper and lift off the locking plate (photo).
6 Disconnect the banjo union by unscrewing the central bolt, being prepared for spillage and plug the end of the pipe as soon as possible.
7 Remove the brake pads and lift off the caliper as described in Section 4.
8 Clean the caliper thoroughly in solvent and dry off before transferring it to the bench. Lay it on clean newspaper to keep parts clean.
9 Prise off the piston protective boot.
10 Eject the piston by applying gentle air pressure from a hand or foot pump, directing the air into the banjo union bolt hole. Place a thin block of wood in the caliper 'throat' to prevent damage to the piston as it comes out.
11 Carefully prise out the piston seal from the groove in the caliper cylinder bore.
12 Wash all components in hot water and dry thoroughly.
13 Inspect the piston and cylinder bore for signs of wear, scoring or pitting, or any other damage.
14 If any of these signs are evident, the complete caliper and piston assembly must be renewed.
15 Commence reassembly by lubricating all components in clean hydraulic fluid.
16 Carefully install the piston seal into the cylinder bore, ensuring that

it is seated correctly all the way round the groove.
17 Push the piston into the cylinder, inserting it all the way into the bore.
18 Fit the protective boot, ensuring that it is located correctly on the piston and the caliper.
19 Refit the caliper and brake pads as described in Section 4.
20 Reconnect the flexible hose and bleed the front brake system as described in Section 14.
21 Refit the roadwheels and remove the vehicle from the axle stands.



6.5 Removing the banjo union locking plate

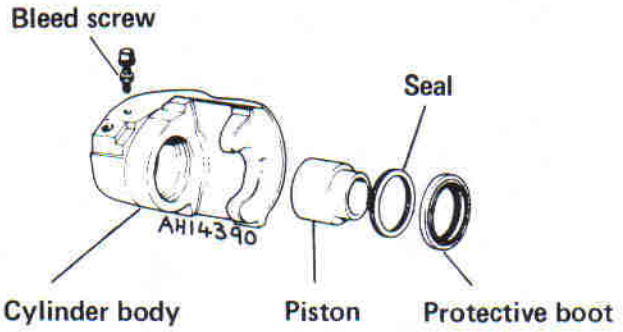


Fig. 8.2 Exploded view of caliper, piston and seals (Sec 6)

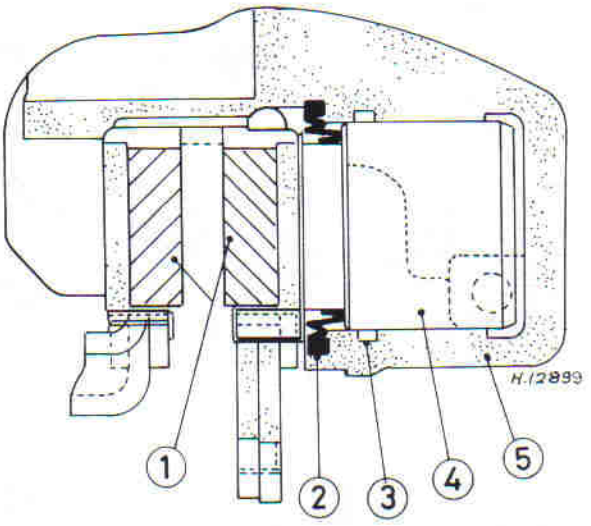
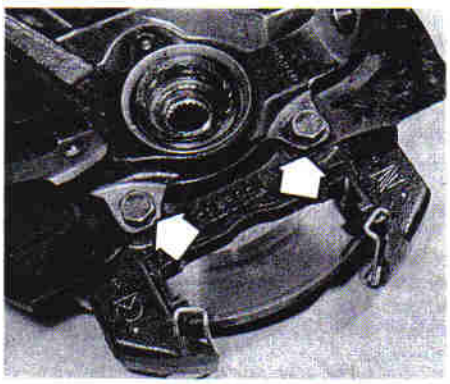


Fig. 8.3 Sectional view of caliper (Sec 6)

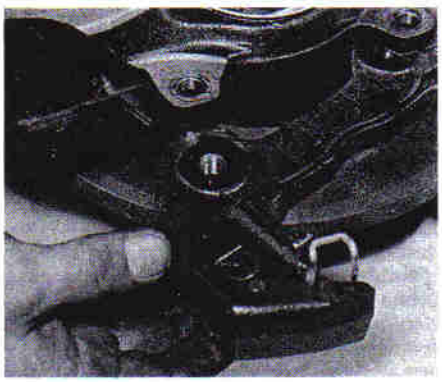
1 Pads
2 Piston boot
3 Piston seal
4 Piston
5 Cylinder bore

7 Brake disc – inspection, renovation and renewal

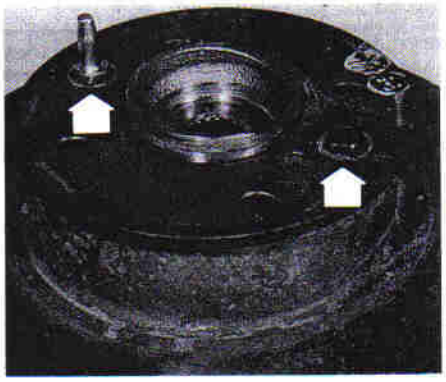
1 Whenever the front disc pads are being checked for wear, take the opportunity to inspect the discs for deep scoring or grooving. After a high mileage the disc may become reduced in thickness away from the extreme outer edge of the disc. If this wear is rapid, it is possible that the friction pads are of too hard a type.
2 If the disc has evidence of many tiny cracks, these may be caused by overheating due to a seized caliper piston in the 'applied' position.
3 The foregoing conditions may be corrected by regrinding the disc provided that the thickness of the disc is not reduced below that specified by such action. Alternatively, fit a new disc.
4 To remove a disc, take off the caliper and pads as described in Section 4. Tie the caliper up, out of the way.
Note: *Although the photographic sequence shows the hub carrier removed from the vehicle, this is not necessary, and the brake disc can be removed with the hub carrier* in situ.
5 Remove the bolts and lift off the caliper support bracket (photos).
6 Unscrew and remove the brake disc securing bolts. One of these is for wheel locating purposes (photo).
7 Lift off the spacer plate (photo).
8 The disc can now be removed from the hub. If it is tight, use a large two or three-legged puller to remove it.
9 The brake disc backplate can be removed after removal of the bolts securing it to the hub carrier (photo).
10 Refitting is a reversal of the removal process. If the disc has excessive run-out, repositioning it in relation to the hub may bring it within tolerance by cancelling out the run-out characteristics in the hub and disc, once the most suitable fitted position has been found.



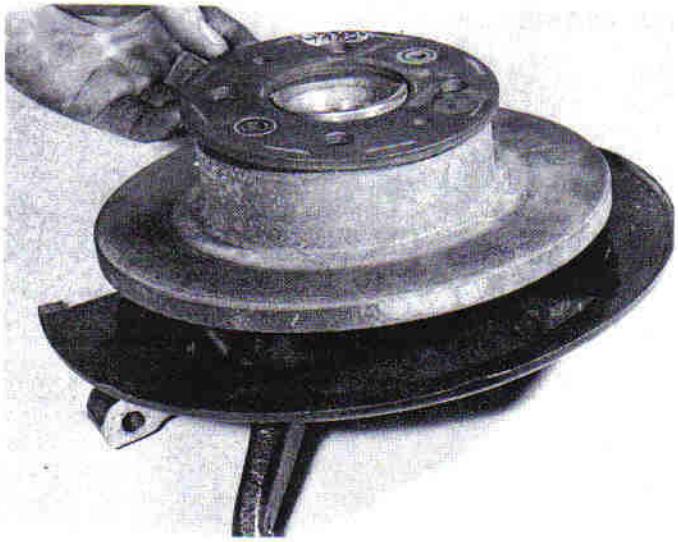
7.5A Caliper support bracket bolts (arrowed)



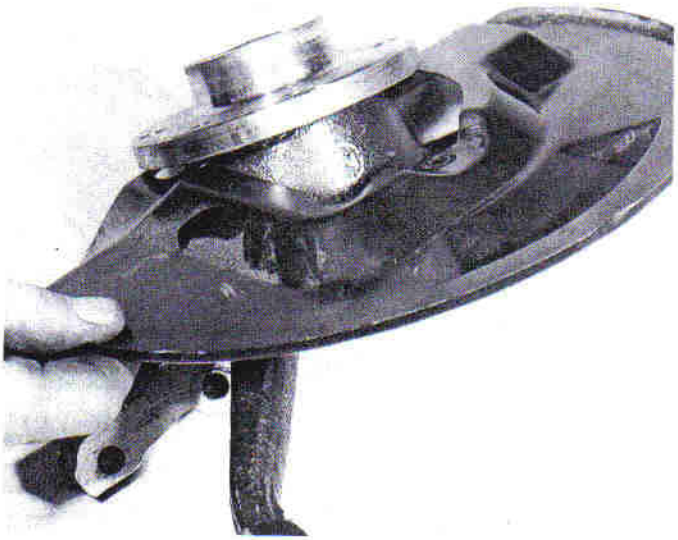
7.5B Lift off the support bracket



7.6 Brake disc securing bolt and wheel locating spigot (arrowed)



7.7 Lift off the spacer plate



7.9 Removing the brake disc backplate

8 Rear wheel cylinder – removal, overhaul and refitting

1 Fluid seepage from the ends of a rear wheel cylinder is an indication of worn seals or cylinder, and must be investigated as soon as possible.
2 Before commencing work, buy a repair kit which contains the necessary seals from a Yugo dealer.
3 The cylinder can be dismantled *in situ* but due to the danger of underwing dirt contaminating components, this is not recommended.
4 Remove the brake shoes as described in Section 5.
5 Remove the locking plate from the banjo union on the back of the cylinder, then undo the banjo union (photo). Plug the pipe end as soon as possible to minimise fluid loss.
6 Unscrew and remove the setscrews securing the cylinder to the brake backplate and withdraw the cylinder.
7 Clean the cylinder thoroughly in solvent and dry off.
8 Prise off the protective boot from each end of the cylinder.
9 Apply gentle air pressure from a hand or foot-operated pump through the banjo union bolt hole to eject the pistons.
10 Inspect the pistons and cylinder bores for signs of wear, scoring or pitting.
11 If any of these signs are evident, renew the complete wheel cylinder and piston assembly.
12 If the components are in good condition, soak all parts, including the new seals in clean hydraulic fluid prior to reassembly.
13 Fit the spring and washer assembly to the cylinder, followed by the seals and pistons.
14 Fit the protective boots over the ends of the pistons and cylinder.
15 Refit the wheel cylinder to the brake backplate and fit and tighten the banjo union and locking plate.
16 Fit the brake shoes as described in Section 5.
17 Bleed the hydraulic system as described in Section 14.

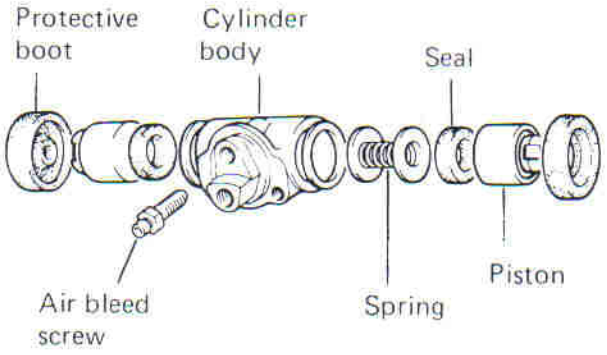
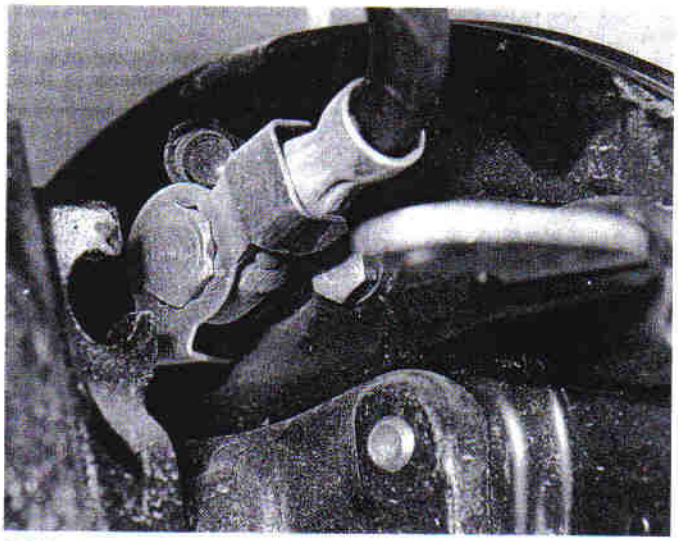


Fig. 8.4 Exploded view of rear hub cylinder (Sec 8)

9 Brake drum – inspection, renovation and renewal

Note: *two sizes of hub and drum are in use. On early models the brake drum has unthreaded locating bolt holes and a centre hole diameter of 58.0 mm (2.28 in). Later versions have threaded locating bolt holes and a centre hole diameter of 59.0 mm (2.32 in). It is essential that the brake drum centre hole matches the outside diameter of the hub to which it is fitted, or brake judder may result (see Fig. 8.5).*
1 Whenever the rear brake linings are being checked for wear, take the opportunity to inspect the internal surfaces of the brake drums.
2 If the drums are grooved or deeply scored, they may be reground, provided that their new internal diameter will not then exceed the specified dimension. If it will, or the drum is cracked, it must be renewed.
3 Removal and refitting of a brake drum is described in Section 5.



8.5 Banjo union and locking plate on rear brake cylinder

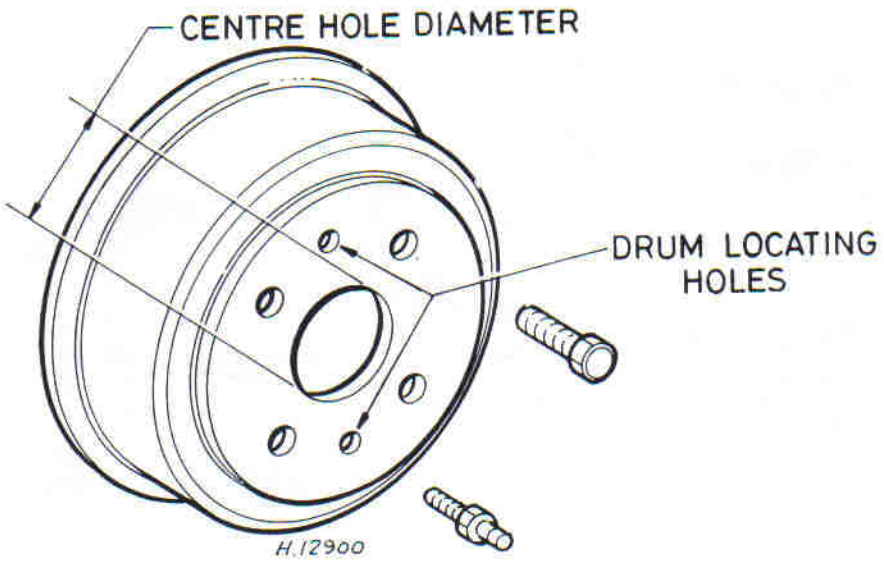


Fig. 8.5 Brake drum and hub diameter measurement (Sec 9)

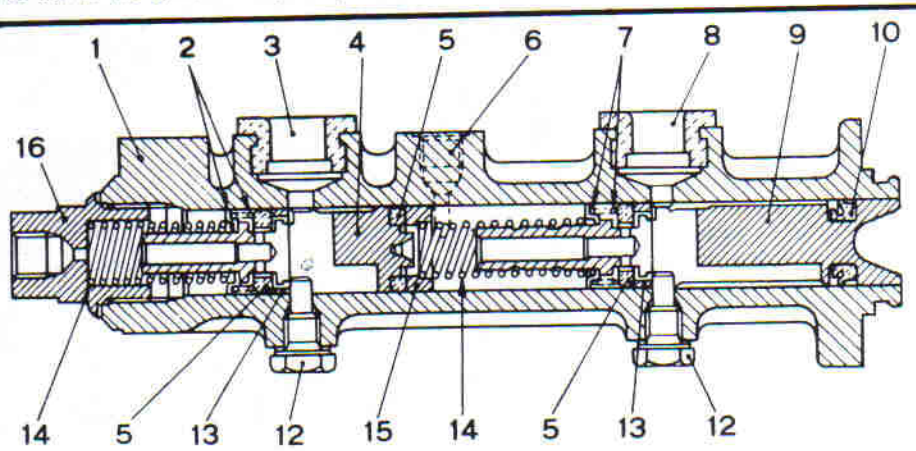
10 Master cylinder – removal, overhaul and refitting

Note: *Obtain a repair kit from a Yugo dealer before work commences.*

1 The master cylinder is fitted to the front face of the vacuum servo unit on all models except 45 which has no servo. In this case the cylinder is bolted directly to the engine bulkhead (photos).
2 Disconnect the low fluid level warning switch connections from the reservoir cap (photo).
3 On 3/4/5 series models, disconnect the two flexible hoses from the reservoir by prising out the plastic plugs from the master cylinder. Tie their ends above the fluid level in the reservoir to prevent fluid loss (photo).
4 On 45/55/65 models, pull the reservoir from the master cylinder and plug the open ends of the connections. Do not allow brake fluid to spill onto the paintwork – it is an effective paint stripper.
5 Unscrew the rigid pipe unions from the master cylinder and blank off their ends to prevent dirt ingress.
6 Remove the mounting nuts and withdraw the master cylinder.
7 Clean the external surfaces of the cylinder thoroughly, then dry it off and mount it in a vice.
8 Unscrew the end plug and catch the coil spring which is under it.
9 Use a rod to depress the end of the primary piston, then unscrew the stop bolts in the lower face of the cylinder. (On early models there may only be one stop bolt.)
10 The internal piston assemblies with seals and springs can now be pushed out of the cylinder body. Keep all the components in their originally fitted sequence and note in which direction the seal lips are located.
11 Inspect the surfaces of the pistons and cylinder bore. If scoring, corrosion or metal-to-metal rubbing areas are evident, renew the master cylinder complete.
12 If the components are in good condition, discard the oil seals and manipulate the new ones into position, using the fingers only.
13 Refit by reversing the removal operations; apply pressure to the piston ends so that the stop bolts can be fitted, then tighten the end plug. Make sure that the grooves in the pistons engage in the stop bolts.
14 The following adjustment procedure must now be carried out in conjunction with the brake pedal height adjustment procedure described in Section 19.

Models without vacuum servo

15 Disconnect the input rod from the bellcrank arm on the left-hand end of the brake pedal crosstube.
16 Check and adjust the brake pedal height.
17 Temporarily fit the master cylinder and the input rod and check that with the input rod connected to the bellcrank arm there is a clearance between the master cylinder piston and the end of the input rod. This is measured by checking the axial free play of the input rod which should be 0.5 mm (0.020 in).
18 Where an adjustable rod is fitted, loosen the locknuts on the fork end and adjust the rod as necessary. Tighten the locknuts on completion and recheck the clearance.



1 *Cylinder body*
2 *Spring and cup*
3 *Inlet from reservoir*
4 *Secondary piston*
5 *Seal*
6 *Fluid outlet to front brakes*
7 *Spring and cup*
8 *Inlet from reservoir*
9 *Primary piston*
10 *Seal*
12 *Stop bolts*
13 *Spacer*
14 *Springs*
15 *Seal*
16 *End plug and fluid outlet to rear brakes*

Fig. 8.6 Sectional view of master cylinder (Sec 10)

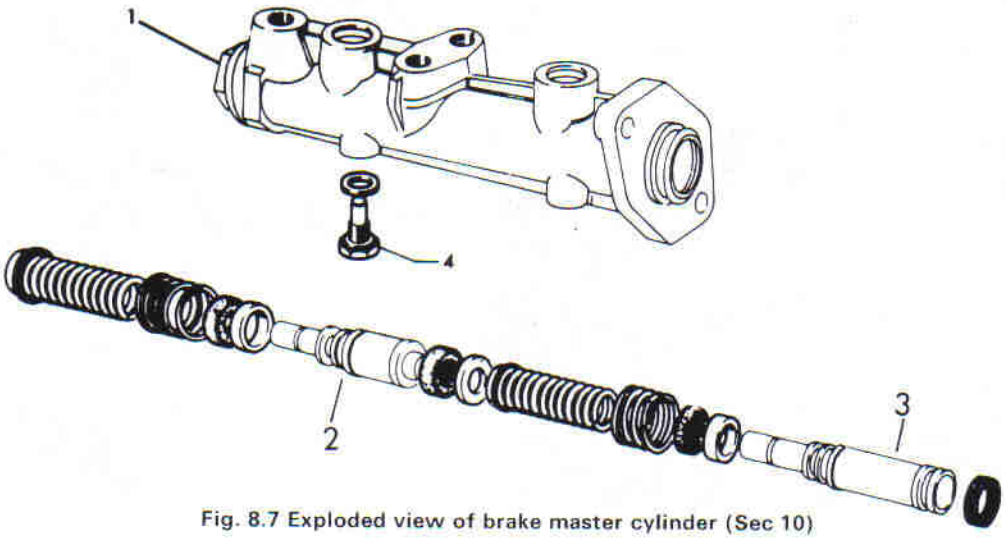
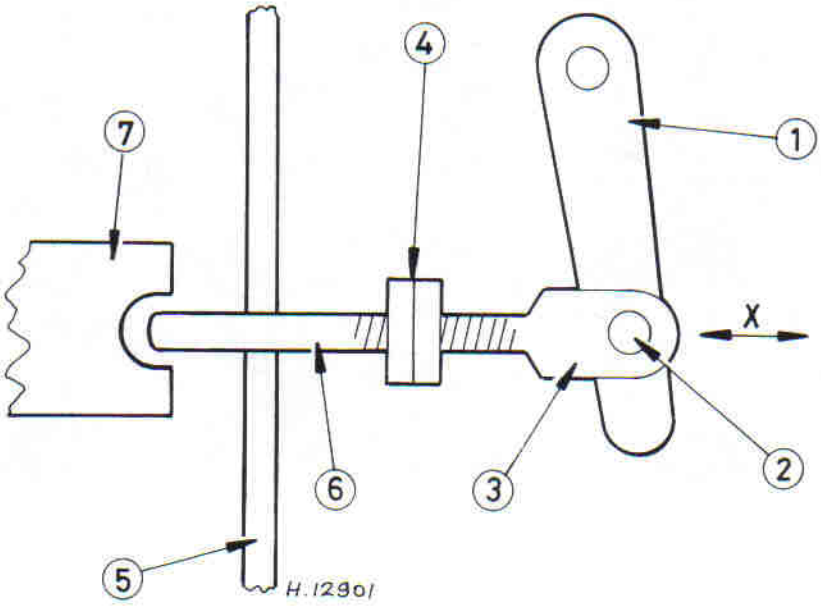


Fig. 8.7 Exploded view of brake master cylinder (Sec 10)

1 Cylinder body
2 Secondary piston
3 Primary piston
4 Stop bolt



1 Crosstube bellcrank arm
2 Fork end securing pin
3 Fork end
4 Locknuts
5 Engine bulkhead
6 Input rod
7 Master cylinder/vacuum servo
X Input rod free play

Fig. 8.8 Sectional view of master cylinder/vacuum servo input rod (Sec 10)

19 Where the input rod is not adjustable, washers can be placed between the master cylinder and the engine bulkhead to give the specified clearance.

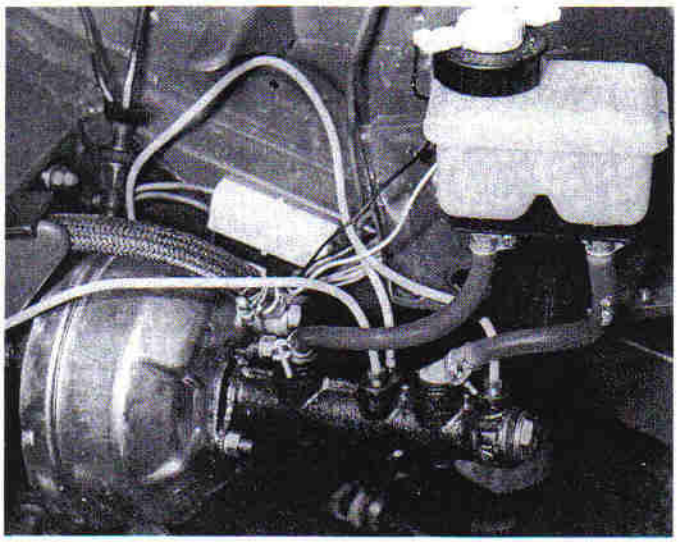
Models with vacuum servo

20 Carry out the procedure given in paragraphs 15 and 16.
21 Check and adjust the projection of the vacuum servo pushrod as described in Section 16.
22 Push the crosstube input rod into the vacuum servo until it just contacts the plunger on the inside of the servo and check that the fork end can be reconnected to the bellcrank arm without disturbing the brake pedal height.
23 Where this is not the case, on models with an adjustable input rod, undo the locknuts and adjust the fork end as necessary, tightening the locknuts on completion.
24 Where the input rod is not adjustable, washers can be placed under the vacuum servo mounting bracket to achieve the specified clearance.

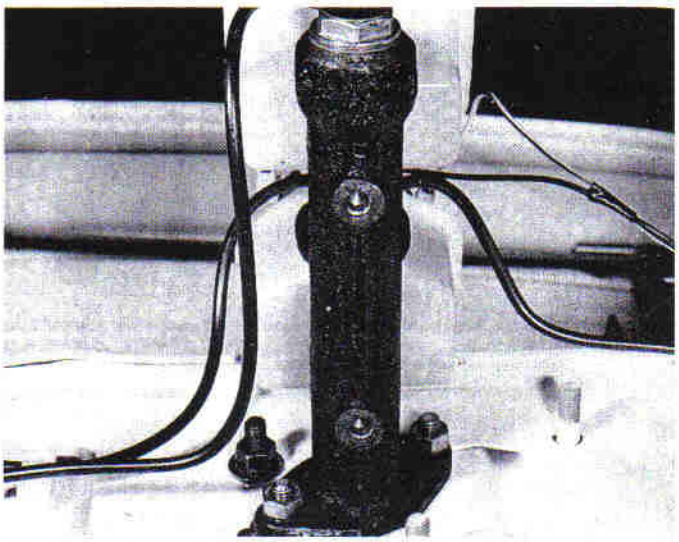
Warning: *The above adjustment procedures must be carried out accurately on all models. Failure to observe the specified clearances can result in brake pressure build up or under certain conditions can cause the input rod to drop out of the master cylinder or vacuum servo with resultant loss of braking.*

All models

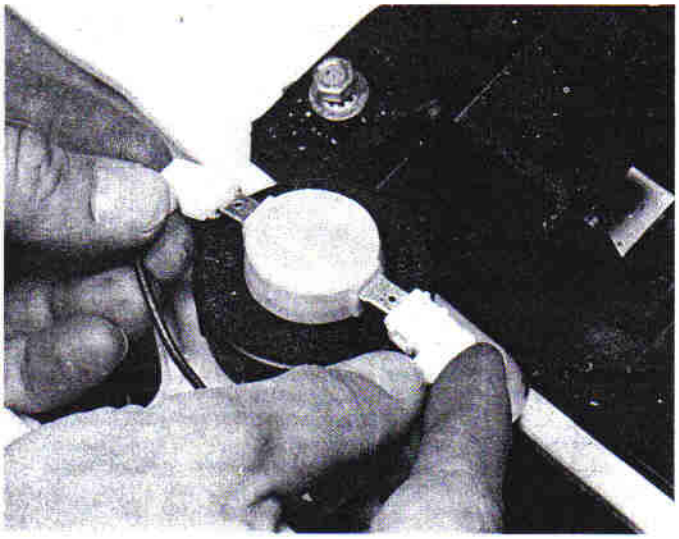
25 Fit and tighten the bolts securing the master cylinder to the bulkhead or vacuum servo as applicable. Check that the input rod locknuts are tight (where applicable) and that the fork and pin is locked to the bellcrank arm on the crosstube.
26 Further refitting is a reversal of removal.
27 On completion fill the reservoir with the specified brake fluid and bleed the hydraulic system as described in Section 14.
28 Carry out a functional check of the brake system.



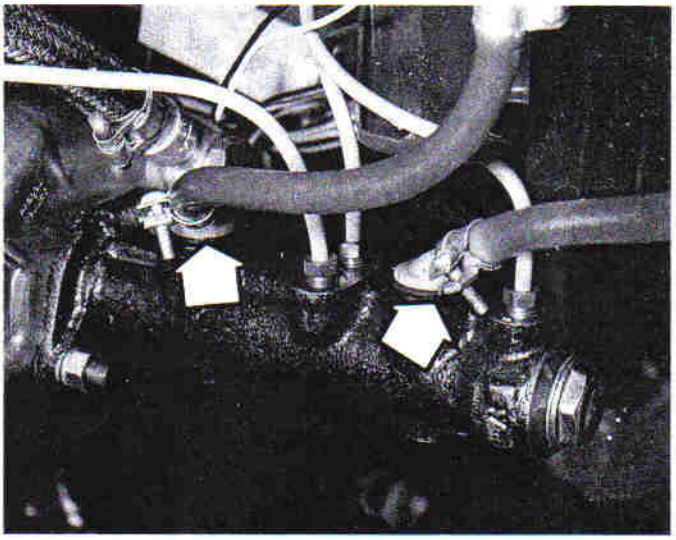
10.1A Brake master cylinder bolted to vacuum servo ...



10.1B ... and to engine bulkhead on 45 model



10.2 Disconnecting the low fluid level warning switch connections



10.3 Reservoir flexible hose connections (arrowed) on 3/4/5 series models

11 Brake pressure regulator – adjustment

1 Loosen the regulator mounting bolts (photo).
2 Disconnect the torsion rod connection where it joins the link to the suspension by pulling back the clip and pushing the rod out (photo).
3 Remove the plastic clip securing the rubber cover on the regulator and pull back the cover.
4 Pull the outer end of the torsion rod down until it is the specified distance below the box section chassis member directly above it (see Fig. 8.9).
5 Keeping the torsion rod in this position, rotate the regulator valve in its elongated mounting holes until the piston end in the valve housing makes light contact with the end of the torsion rod (photo).
6 Tighten the regulator mounting bolts and recheck the measurement.
7 Reconnect the torsion rod to the link arm.
8 Fit the rubber cover over the valve and secure with the plastic clip (photo).
9 Carry out a road test of the braking system.

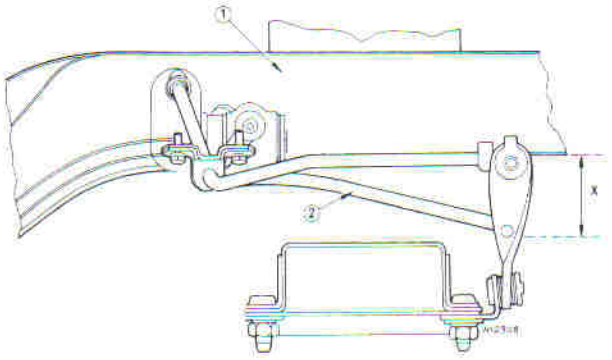
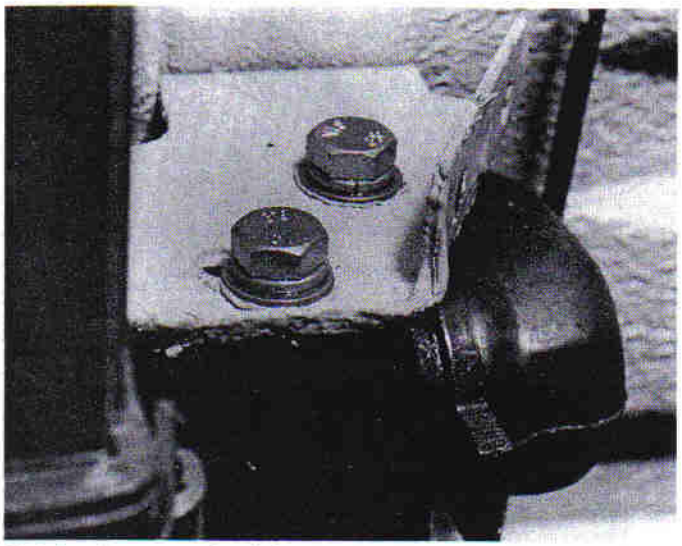
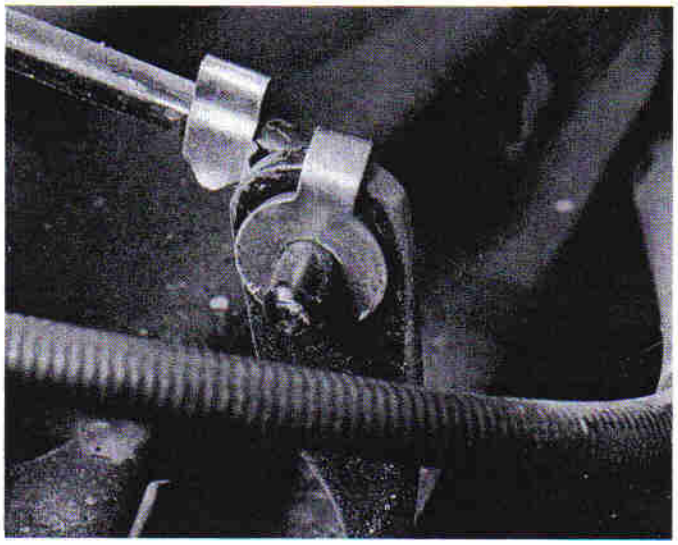


Fig. 8.9 Brake pressure regulator adjustment – viewed from rear of vehicle (Sec 11)

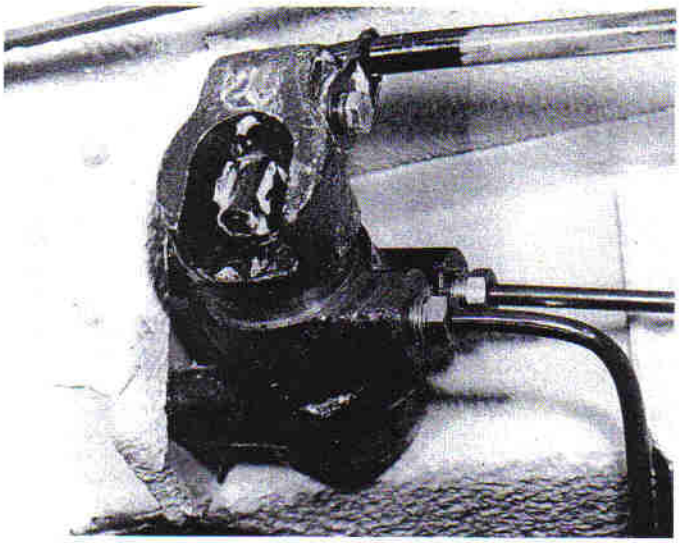
1 Chassis member
2 Torsion rod
X See Specifications



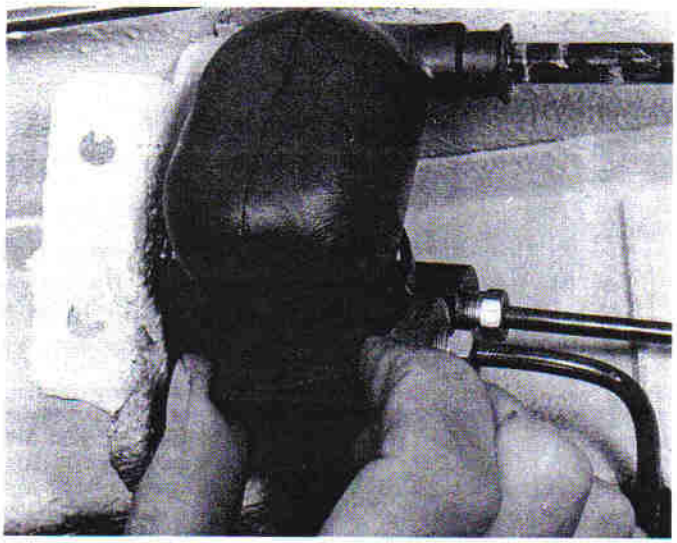
11.1 Regulator mounting bolts



11.2 Torsion rod-to-link connection



11.5 Cover removed showing torsion rod end and piston



11.8 Cover securing clip

12 Brake pressure regulator – removal and refitting

1 Disconnect the hydraulic pipelines and plug their ends.
2 Remove the clip and pull back the rubber cover from the valve body.
3 Remove the bolt from the locking plate on the torsion rod end and disconnect the torsion rod from the valve.
4 Remove the valve mounting bolts and withdraw the valve.
5 Refit in reverse order, adjusting the valve as described in Section 11.
6 Bleed the hydraulic system as described in Section 14.

13 Hydraulic hoses and pipes – inspection and renewal

Flexible hoses

1 Periodically, all brake pipes, pipe connections and unions should be completely and carefully examined.
2 First examine for signs of leakage where the pipe unions occur. Then examine the flexible hoses for signs of chafing and fraying and, of course, leakage. This is only a preliminary part of the flexible hose inspection, as exterior condition does not necessarily indicate the interior condition, which will be considered later.
3 Flexible hoses are always mounted at both ends in a rigid bracket attached to the body or a sub-assembly. To remove them, it is necessary first of all to unscrew the pipe unions of the rigid pipes which go into them. The hose ends can then be unclipped from the brackets. The mounting brackets, particularly on the body frame, are not very heavy gauge and care must be taken not to wrench them off (photo).
4 With the flexible hose removed, examine the internal bore. If it is blown through first, it should be possible to see through it. Any specks of rubber which come out, or signs of restriction in the bore, mean that the inner lining is breaking up and the pipe must be renewed.
5 When refitting the flexible hoses check they cannot be under tension, or rub, when the wheels are at the full range of suspension or steering movement.
6 Bleed the system (see Section 14) on completion.

Rigid pipes

7 Inspect the condition of the braking system rigid pipelines at frequent intervals. They must be cleaned off and examined for any signs of dents (or other percussive damage) and rust and corrosion.

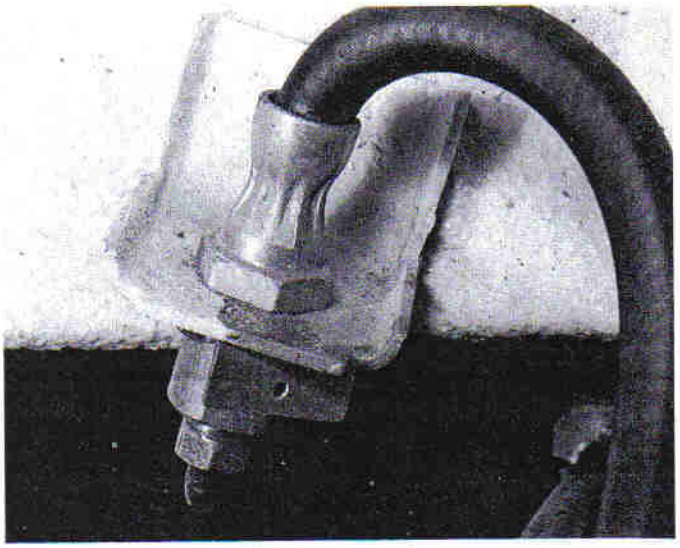
Rust and corrosion should be scraped off and, if the depth of pitting in the pipes is significant, they will need renewal. This is particularly likely in those areas underneath the car body and along the rear axle where the pipes are exposed to the full force of road and weather conditions (photo).

8 Rigid pipe removal is usually straightforward. The unions at each end are undone, the pipe and union pulled out, and the centre sections of the pipe removed from the body clips where necessary. Underneath the car, exposed unions can sometimes be very tight. As one can use only an open-ended spanner and the unions are not large, burring of the flats is not uncommon when attempting to undo them. For this reason, a self-locking grip wrench (Mole) is often the only way to remove a stubborn union.

9 Rigid pipes which need renewal can usually be purchased at any garage where they have the pipe, unions and special tools to make them up. All they need to know is the total length of the pipe, the type of flare used at each end with the union, and the length and thread of the union. Yugo is metric, remember.

10 Fitting your new pipes is a straightforward reversal of the removal procedure. If the rigid pipes have been made up, it is best to get all the set bends in them before trying to fit them. Also, if there are any acute bends ask your supplier to put these in for you on a tube bender. Otherwise, you may kink the pipe and thereby restrict the bore area and fluid flow.

11 Bleed the system (see Section 14) on completion.



13.3 Typical flexible-to-rigid pipe connection

14 Hydraulic system – bleeding

1 The hydraulic system must be kept free from air which causes sponginess of the brakes.

2 If a leak occurs, or any part of the system is dismantled, then air will enter and the system must be bled.

3 As the system is split into two circuits (front and rear), then only that system affected need be bled.

4 However, if the master cylinder is disconnected or the reservoir runs dry, then air will enter both front and rear circuits, and both must be bled. Take care therefore to keep the reservoir topped up, especially during bleeding.

5 Clean around each bleed nipple thoroughly before removing the rubber cap or undoing the nipple (photos).

6 On models fitted with a vacuum servo, destroy any vacuum remaining in the system by pumping the brake pedal up and down several times.

7 Take care not to spill any fluid onto the car paintwork and mop up any spillages immediately. Do not allow fluid to contaminate the brake pads or shoes.

Bleeding – two man method

8 Gather together a clean glass jar and a length of rubber or plastic tubing which will be a tight fit on the brake bleed nipples.

9 Engage the help of an assistant.

10 Push one end of the bleed tube onto the first bleed screw and immerse the other end of the glass jar which should contain enough hydraulic fluid to cover the end of the tube.

11 Open the bleed screw one half a turn and have your assistant depress the brake pedal fully then slowly release it. Tighten the bleed screw at the end of each pedal downstroke to obviate any chance of air or fluid being drawn back into the system.

12 Repeat this operation until clean hydraulic fluid, free from air bubbles, can be seen coming through into the jar.

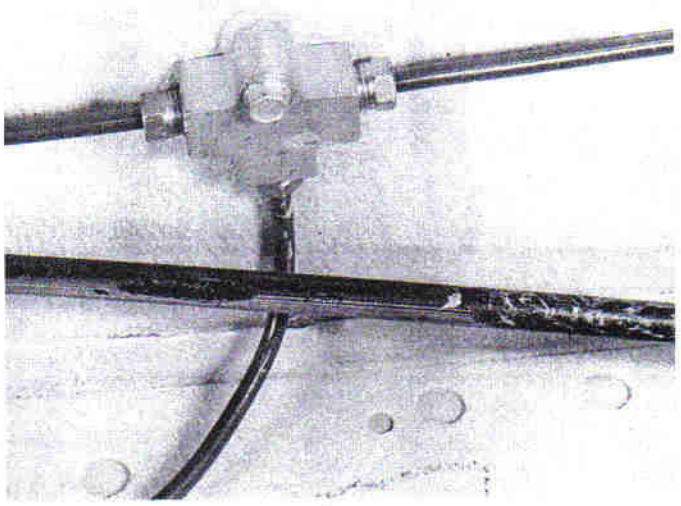
13 Tighten the bleed screw at the end of a pedal downstroke and remove the bleed tube. Bleed the remaining screws in a similar way.

Bleeding – using a one way valve kit

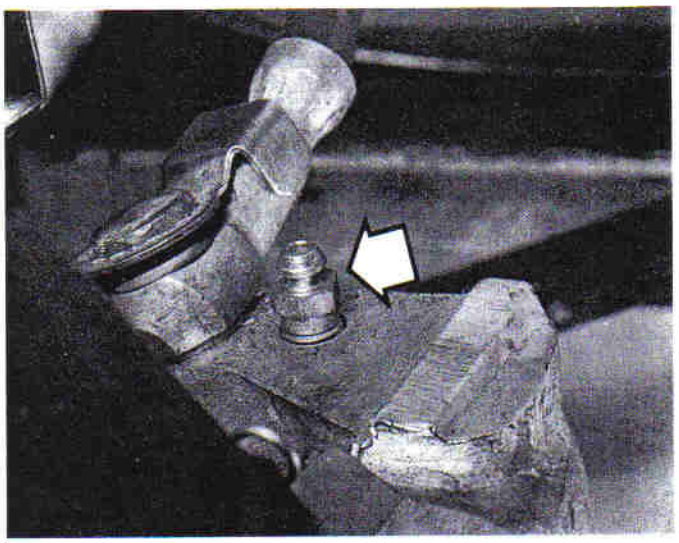
14 There are a number of one-man, one-way brake bleeding kits available from motor accessory shops. It is recommended that one of these kits is used wherever possible as it will greatly simplify the bleeding operation and also reduce the risk of air or fluid being drawn back into the system quite apart from being able to do the work without the help of an assistant.

15 To use the kit, connect the tube to the bleedscrew and open the screw one half a turn (photo).

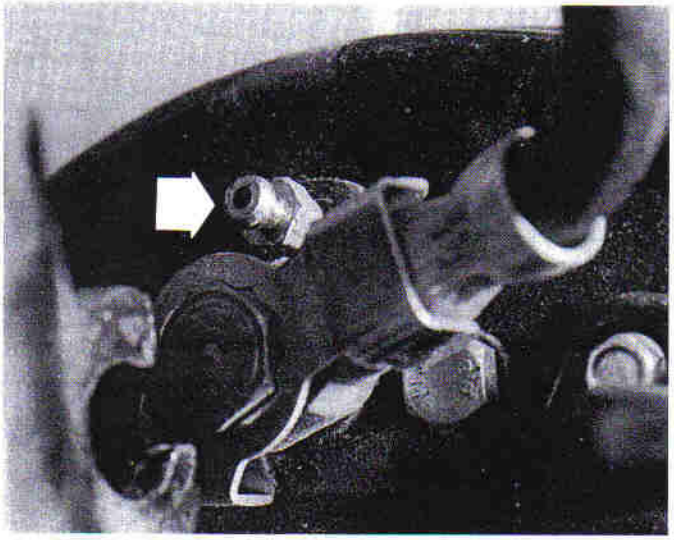
16 Depress the brake pedal fully and slowly release it. The one-way valve in the kit will prevent expelled air from returning at the end of



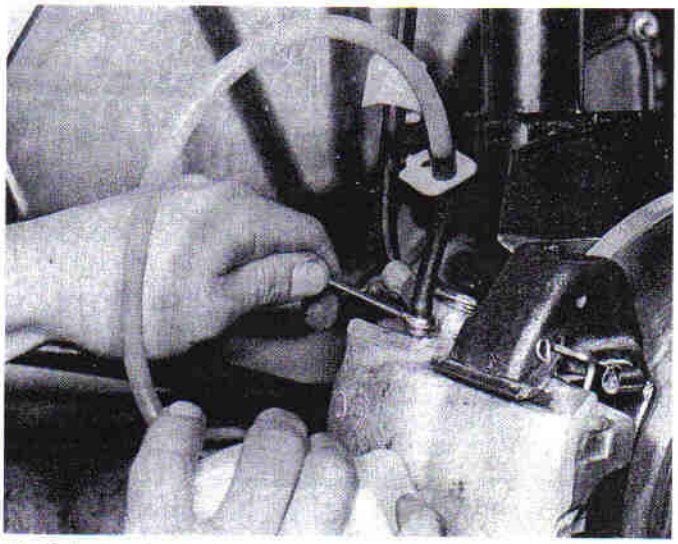
13.7 Typical rigid pipeline junction block connection



14.5A Bleed nipple on front brake ...



14.5B ... and rear brake



14.15 Connecting a one-way valve bleed kit

each pedal downstroke. Repeat this operation several times to be sure of ejecting all air from the system. Some kits include a translucent container which can be positioned so that the air bubbles can actually be seen being ejected from the system.
17 Tighten the bleed screw, remove the tube and repeat the operations on the remaining brakes.
18 On completion, depress the brake pedal. If it still feels spongy repeat the bleeding operations as air must still be trapped in the system.

Bleeding – using a pressure bleeding kit

19 These kits too are available from motor accessory shops and are usually operated by air pressure from the spare tyre.
20 By connecting a pressurised container to the master cylinder fluid reservoir, bleeding is then carried out by simply opening each bleed screw in turn and allowing the fluid to run out, rather like turning on a tap, until no air is visible in the expelled fluid.
21 By using this method, the large reserve of hydraulic fluid provides a safeguard against air being drawn into the master cylinder during bleeding which often occurs if the fluid level in the reservoir is not maintained.
22 Pressure bleeding is particularly effective when bleeding 'difficult' systems or when bleeding the complete system at time of routine fluid renewal.

All methods

23 When bleeding is completed, check and top up the fluid level in the master cylinder reservoir.
24 Check the feel of the brake pedal. If it feels at all spongy, air must still be present in the system and further bleeding is required. Failure to bleed satisfactorily after a reasonable period of the bleeding operation, may be due to worn master cylinder seals.
25 Discard brake fluid which has been expelled. It is almost certain to be contaminated with moisture, air and dirt making it unsuitable for further use. Clean fluid should always be stored in an airtight container as it absorbs moisture readily (hygroscopic) which lowers its boiling point and could affect braking performance under severe conditions.

15 Vacuum servo unit – description

A vacuum servo unit is fitted into the brake hydraulic circuit on most models in series with the master cylinder, to provide assistance to the driver when the brake pedal is depressed. This reduces the effort required by the driver to operate the brakes under all braking conditions.

The unit operates by vacuum obtained from the induction manifold and comprises basically a booster diaphragm and non-return valve. The servo unit and hydraulic master cylinder are connected together so that the servo unit piston rod acts as the master cylinder pushrod. The driver's braking effort is transmitted through another pushrod to the servo unit piston and its built-in control system. The servo unit piston does not fit tightly into the cylinder, but has a strong diaphragm to keep its edges in constant contact with the cylinder wall, so assuring an air tight seal between the two parts. The forward chamber is held under vacuum conditions created in the inlet manifold of the engine and, during periods when the brake pedal is not in use, the controls open a passage to the rear chamber so placing it under vacuum conditions as well. When the brake pedal is depressed, the vacuum passage to the rear chamber is cut off and the chamber opened to atmospheric pressure. The consequent rush of air pushes the servo piston forward in the vacuum chamber and operates the main pushrod to the master cylinder.

The controls are designed so that assistance is given under all conditions and, when the brakes are not required, vacuum in the rear chamber is established when the brake pedal is released. All air from the atmosphere entering the rear chamber is passed through a small air filter.

Under normal operating conditions, the vacuum servo unit is very reliable and does not require overhaul except at very high mileages. In this case, it is far better to obtain a service exchange unit, rather than repair the original unit.

It is emphasised that the servo unit assists in reducing the braking effort required at the foot pedal and in the event of its failure, the hydraulic braking system is in no way affected except that the need for higher pressures will be noticed.

16 Vacuum servo unit – removal and refitting

1 Syphon as much fluid as possible out of the master cylinder reservoir.
2 Disconnect the electrical leads from the terminals in the reservoir cap, then uncouple the pipelines from the master cylinder body. Be prepared to catch leaking fluid and plug the open ends of the pipelines.
3 The master cylinder can be unbolted now from the servo unit, or detached later when the complete assembly is withdrawn.
4 Working inside the car, disconnect the servo pushrod from the pedal crosstube bellcrank arm.
5 Remove the servo mounting nuts (photo).
6 Withdraw the servo assembly from the engine compartment, then remove it to the bench. If the master cylinder is still attached, cover the wings with protective sheeting, in case brake fluid is spilled during removal.
7 Refitting is a reversal of the removal procedure, but adjust the servo pushrod by undoing the locknut on its end and screwing in or out to obtain the projection specified in Fig. 8.10.
8 After refitting the vacuum servo, refer to Sections 19 and 10 for further adjustments to the brake pedal and master cylinder operating linkage.
9 After refitting the master cylinder as described in Section 10, fill and bleed the hydraulic system as described in Section 14.

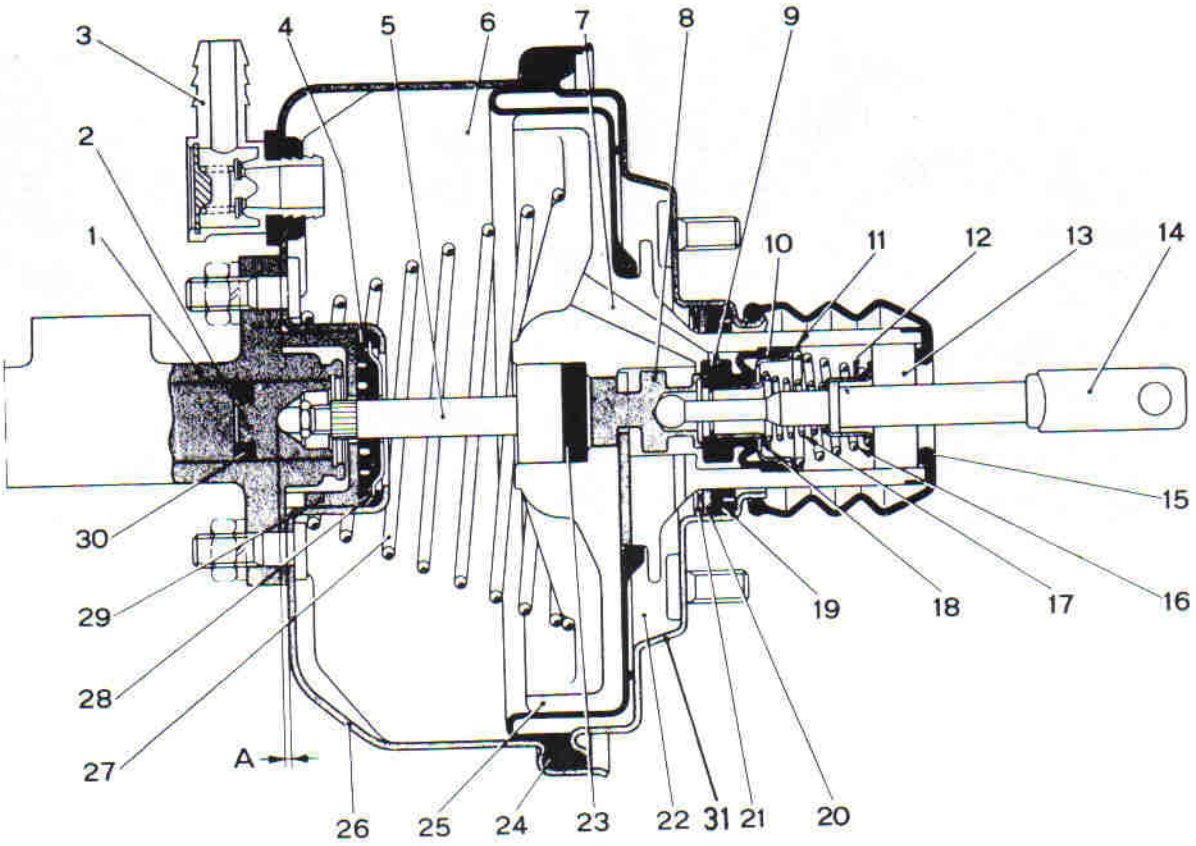
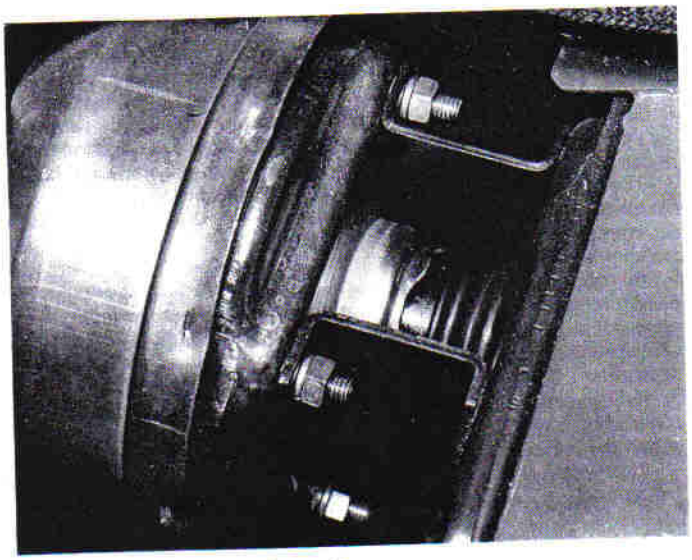


Fig. 8.10 Sectional view of vacuum servo unit (Sec 16)

1 *Master cylinder*
2 *Master cylinder primary piston*
3 *Non-return valve*
4 *Front seal*
5 *Pushrod*
6 *Front chamber*
7 *Vacuum port*
8 *Plunger*
9 *Seal centraliser*
10 *Valve*
11 *Spring cup*
12 *Spring cup*
13 *Filter*
14 *Pushrod*
15 *Dust excluding boot*
16 *Return spring*
17 *Valve spring*
18 *Valve cup*
19 *Rear seal*
20 *Seal*
21 *Cup*
22 *Rear chamber*
23 *Backing plate*
24 *Diaphragm*
25 *Vacuum piston*
26 *Front shell*
27 *Return spring*
28 *Cup*
29 *Guide bush*
30 *Seal*
31 *Rear shell*

A = 0.825 to 1.025 mm (0.032 to 0.040 in)



16.5 Vacuum servo mounting nuts

17 Vacuum servo unit – servicing and testing

1 Regularly, check that the vacuum hose which runs between the servo unit and the inlet manifold is in good condition and is a tight fit at both ends.
2 If the efficiency of the servo unit is suspect, it can be checked out in the following way.
3 Run the engine, then switch off the ignition. Depress the footbrake pedal; the distinctive in-rush of air into the servo should be clearly heard. It should be possible to repeat this operation several times before the vacuum in the system is exhausted.
4 Start the engine and have an assistant apply the footbrake pedal and hold it down. Disconnect the vacuum hose from the servo. There should not be any in-rush of air into the servo through the connecting stub. If there is, the servo diaphragm is probably faulty. During this test, expect the engine to idle roughly, unless the open end of the hose to the inlet manifold is plugged. Reconnect the hose.
5 With the engine off, depress the brake pedal fully. Start the engine with the brake pedal still depressed; the pedal should be felt to go down fractionally.
6 If the results of these tests are not satisfactory, remove the unit and fit a new one as described in Section 16.

18 Brake and clutch pedals – removal and refitting

1 Refer to Chapter 11 and remove the centre console and left-hand parcel tray.
2 Remove the split pin and disconnect the brake master cylinder/vacuum servo pushrod at the left-hand end of the pedal crosstube (photo).
3 Remove the bolts securing the crosstube left-hand support bracket, taking note of any washers fitted between the bracket and the bulkhead.
4 On some models the bracket may be attached to the bulkhead by studs instead of bolts, and the nuts must be undone from inside the engine compartment.
5 Refer to Chapter 9 and remove the steering column and lower shaft.
6 Unhook the brake pedal return spring (photo).
7 Disconnect the brake light switch and disconnect the flasher unit, or remove it from the pedal bracket.
8 Disconnect the clutch cable from the clutch pedal.
9 Remove the nuts from the securing studs on the right-hand pedal support bracket.
10 Remove the three screws securing the steering column bulkhead seal and turn the seal to clear the pedal bracket (photo).
11 Lift the pedals, crosstube and bracket assembly out of the vehicle. It may be necessary on some models to disconnect wiring looms in order to achieve this.
12 Remove the circlip from the right-hand end of the crosstube (photo).
13 Remove the screw and locking plate from the left-hand side of the right-hand pedal bracket (photo).
14 The crosstube may now be withdrawn from the brackets to release the brake and clutch pedals.
15 Inspect the bushings and crosstube for wear and renew as necessary.
16 Reassembly is a reversal of removal, using a general purpose grease on all pivot points.
17 Note that if the left-hand support bracket is not in line with the

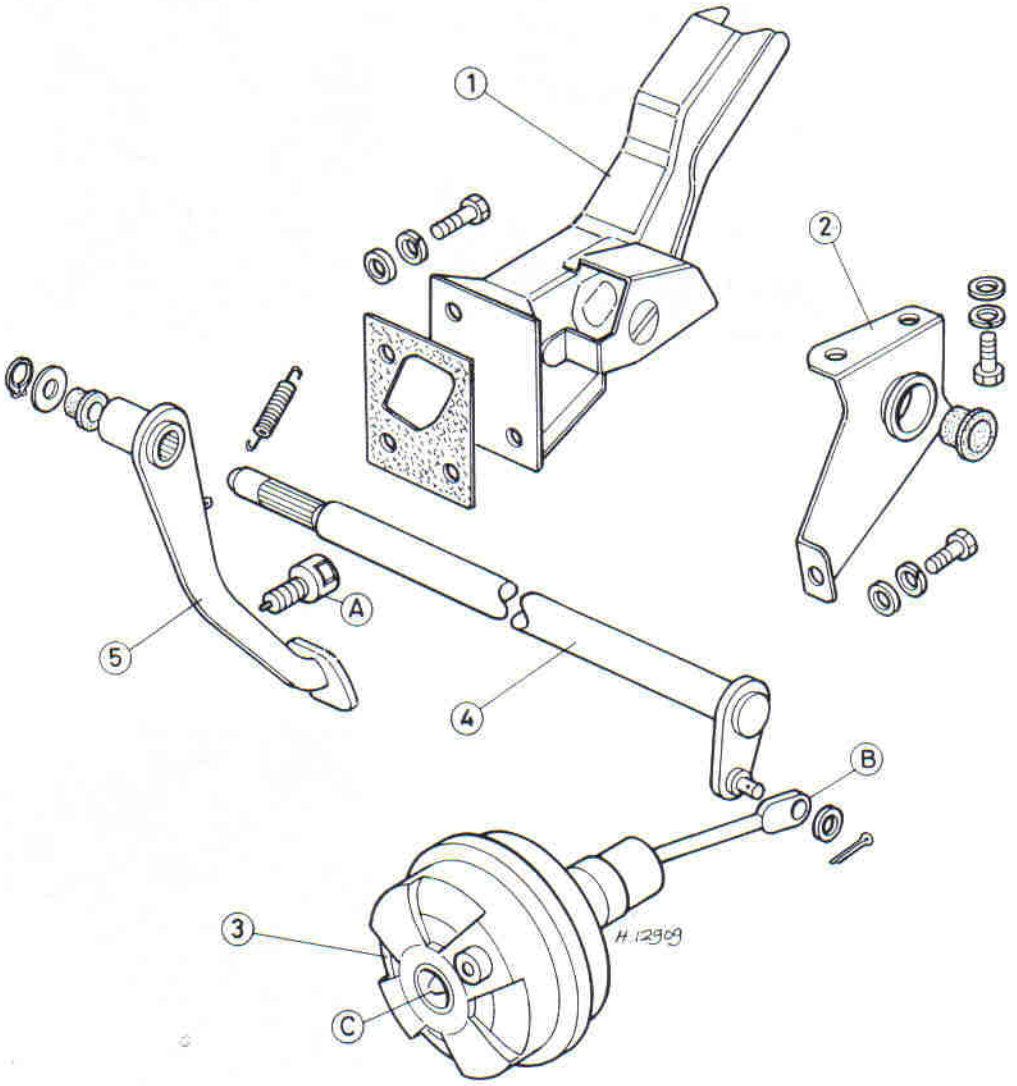
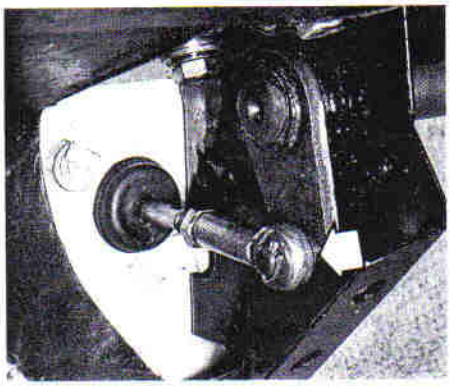
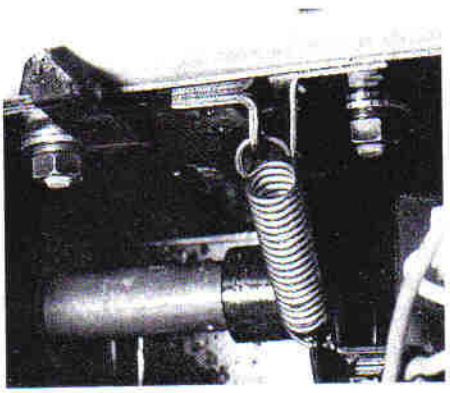


Fig. 8.11 Brake pedal, crosstube and vacuum servo assembly (Sec 18)

1 Right-hand support bracket
2 Left-hand support bracket
3 Vacuum servo
4 Crosstube
5 Brake pedal
A Brake light switch
B Servo pushrod
C Master cylinder mounting

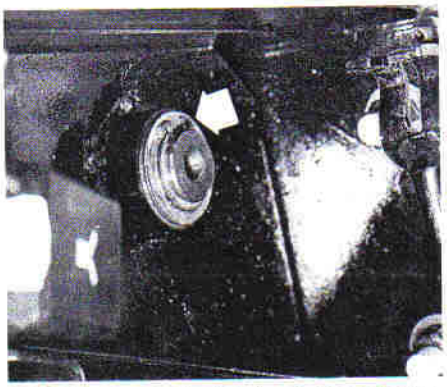


18.2 Brake master cylinder/vacuum servo pushrod connection (arrowed)

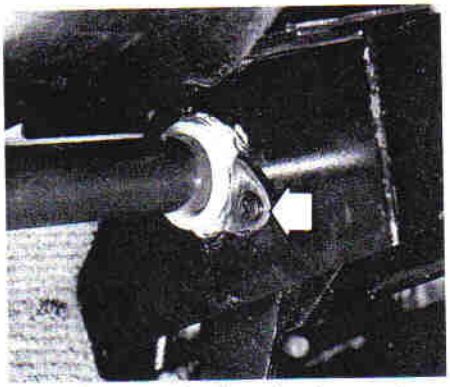


18.6 Brake pedal return spring

18.10 Steering column seal retaining screws (arrowed)



18.12 Circlip at right-hand end of crosstube



18.13 Screw and locking plate (arrowed)

right-hand bracket, binding of the crosstube can occur and the brake pedal will stick in the 'on' position. This can be remedied by inserting washers between the left-hand bracket and the engine bulkhead to line up the two brackets.

18 On completion check and adjust the clutch pedal free play and the brake pedal height.

19 Brake pedal height – adjustment

1 The brake pedal is maintained at the specified height by screwing the brake light switch mounted on the brake pedal support bracket in or out as necessary.

2 To do this, disconnect the leads on the switch, undo the locknuts and screw the switch in to decrease pedal height and out to increase it (photo).

3 On completion, tighten the locknuts and reconnect the leads.

4 Whenever the brake pedal height is adjusted the brake master cylinder input rod clearance must be checked and adjusted as described in Section 10.

20 Handbrake – adjustment

1 Adjustment of the handbrake is normally automatic, but if due to stretch in the cables it requires excessive movement of the handbrake lever to apply the brakes, the handbrake should be adjusted as described in the following paragraphs. Normally the rear brakes should be fully applied when the handbrake lever has been pulled up by three to four clicks of the ratchet.

2 Ensure that the automatic adjusters on the rear brake shoes are not seized before attempting the adjustment. This is a frequent fault and can be remedied by removing the rear brake shoes as described in Section 5 and cleaning and greasing the adjusters.

3 To adjust the handbrake, first operate the footbrake pedal several times to settle the rear brake shoes and pistons.

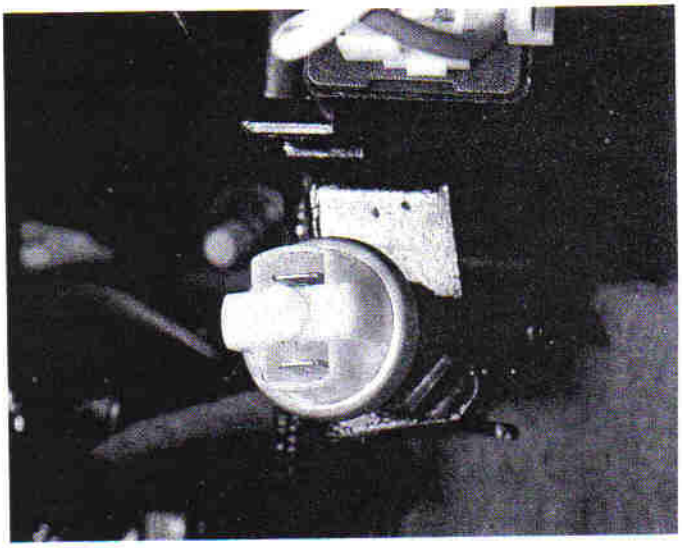
4 Raise the rear of the vehicle onto axle stands.

5 Pull the handbrake lever on by three clicks of the ratchet.

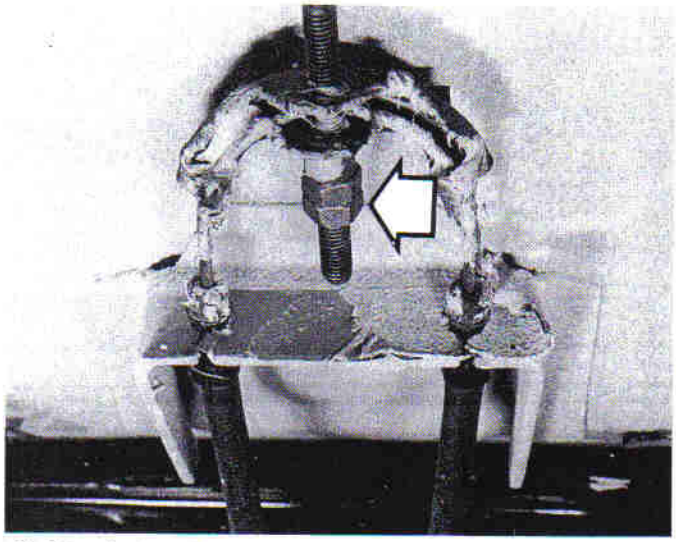
6 Loosen the locknuts on the cable tensioner, then turn the inner nut to tighten the cables until both rear brakes are fully applied (photo).

7 If the brakes do not operate evenly, check each individual cable for freedom of movement.

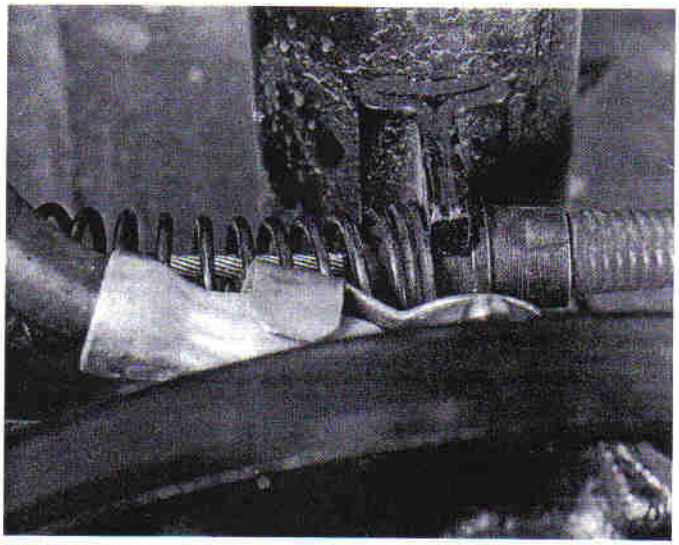
8 Tighten the outer locknut on the adjuster.



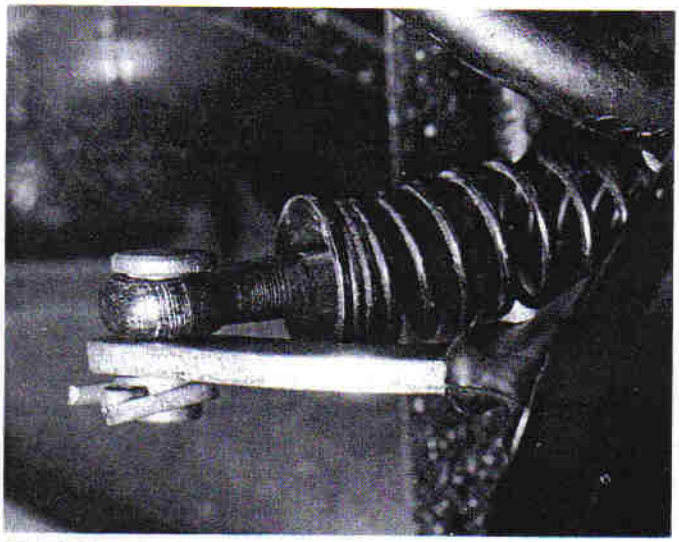
19.2 Brake light switch



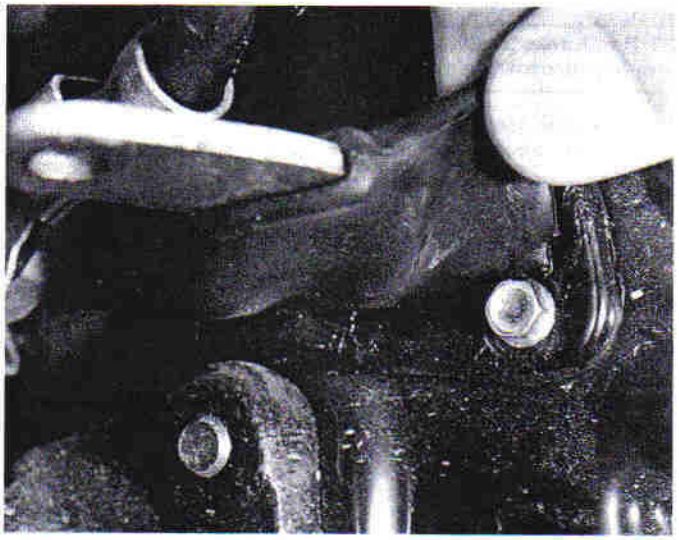
20.6 Handbrake cable tensioner locknuts (arrowed)



21.4 Cable grommet and spring on rear shock absorber



21.5 Cable-to-brake shoe lever connection



21.8 Rubber boot over brake shoe lever

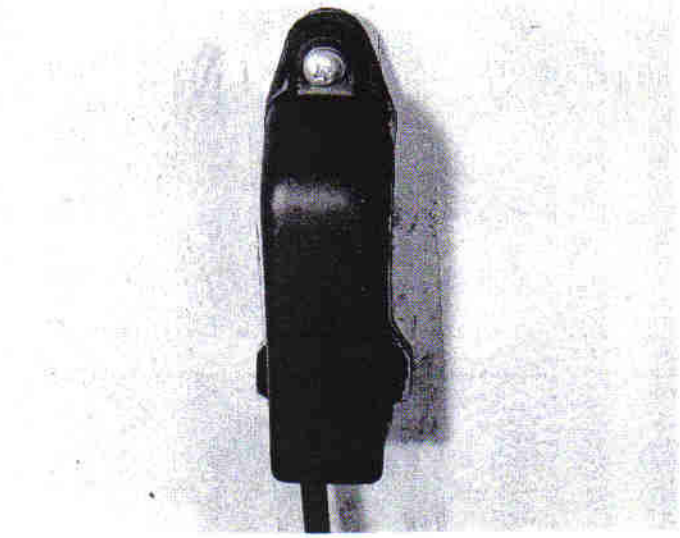
9 Apply the handbrake several times and check that the rear brakes are fully applied after the handbrake lever is pulled up by three to four clicks.
10 Check also that with the handbrake lever released the rear brakes are free to turn without binding on the drum.
11 Remove the vehicle from the stands.

21 Handbrake cable – renewal

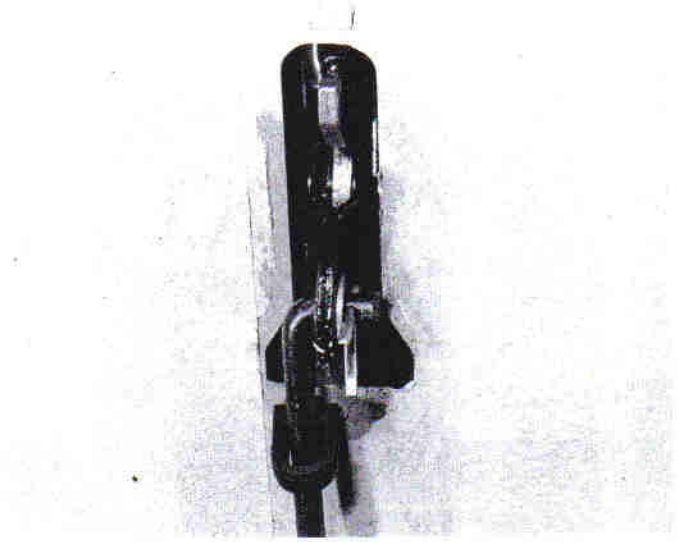
1 Raise the rear of the vehicle onto axle stands.
2 Release the handbrake lever.
3 Remove the locknuts from the adjuster rod and pull the equaliser bracket from the rod.
4 Pull back the spring to ease the tension and release the cable grommet from the bracket on the rear shock absorber (photo).
5 Remove the split pin from the cotter pin on the rear brake shoe lever and disconnect the cable from the lever (photo).
6 Release the cable from the grommets, from the front bracket and from the support clips on the suspension leaf spring, and remove the cable. Repeat the procedure on the opposite side of the vehicle.
7 Refitting is a reversal of removal, adjusting the handbrake as described in Section 20 on completion.
8 *Note:* Periodically inspect the rubber boots covering the levers on the brake backplates. Renew them if they are split or perished by removing the bolts and disconnecting the handbrake cable (photo).

22 Handbrake lever – removal and refitting

1 To remove the handbrake lever, on models with a one-piece front carpet it is necessary to remove the front seats and centre floor console in order to lift the carpet to gain access to the lever bolts. Alternatively the carpet could be cut adjacent to the handbrake lever.
2 When access to the handbrake lever bolts has been obtained, undo and remove them from the floorpan.
3 Underneath the vehicle remove the plastic cover from the base of the lever (photo). It is secured by a screw.
4 Remove the split pin and disconnect the rod from the lever (photo).
5 Remove the handbrake lever from inside the car.
6 Refitting is a reversal of removal, adjusting the cables as described in Section 20.



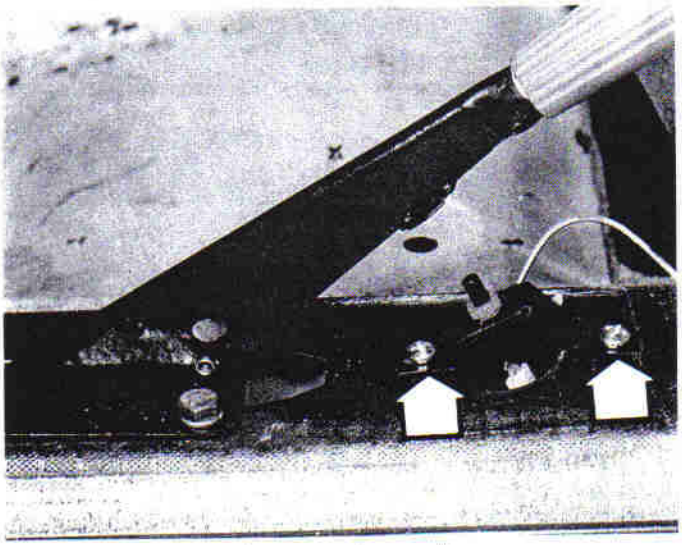
22.3 Plastic cover and retaining screw at base of handbrake lever



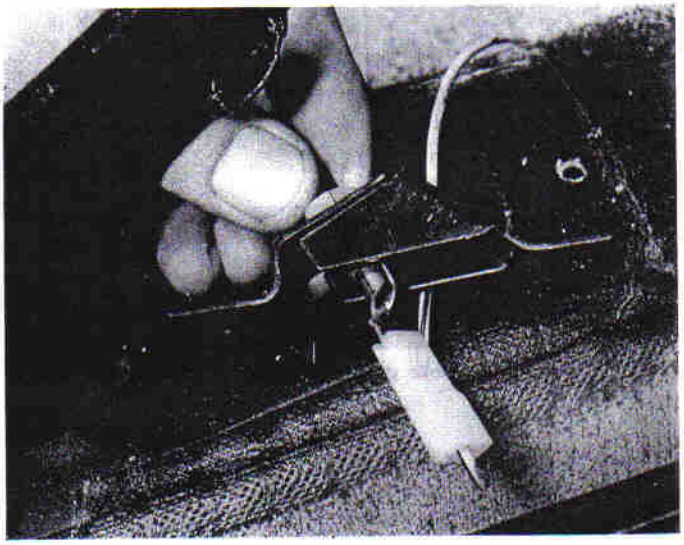
22.4 Handbrake lever-to-rod connection

23 Handbrake 'on' warning microswitch – removal, refitting and adjustment

1 Proceed as described in paragraph 1 of Section 22.
2 Remove the screws securing the microswitch bracket to the floorpan (photo).
3 Disconnect the electrical lead to the switch, undo the locknut and withdraw the switch from the bracket (photo).
4 Refit in reverse order, adjusting the switch using the locknut so that the warning light comes on as the handbrake lever is pulled up.



23.2 Microswitch mounting screws (arrowed)



23.3 Withdrawing the switch from the bracket

24 Fault diagnosis – braking system

Symptom	Reason(s)
Excessive pedal travel	Pads or shoes excessively worn Incorrect pedal or servo/master cylinder pushrod adjustment Automatic adjusters faulty Seized wheel cylinder or caliper piston Master cylinder seals worn
Pedal feels spongy or soggy	Air in hydraulic system Low fluid level Loose connections Flexible hose perished Defective wheel cylinder or caliper seal

Symptom	Reason(s)
Pedal feels springy	New pads or linings not bedded-in Master cylinder mounting loose
Excessive effort required to stop car	Worn or contaminated linings or pads Incorrect grade of lining or pad material Servo vacuum hose leaking or disconnected Faulty servo (where applicable) Seized caliper or wheel cylinder piston One circuit defective on dual circuit hydraulic system
Brakes pull to one side	Friction linings contaminated on one side of car Seized hydraulic piston on one side of car Different types of linings fitted on different sides of car, or new linings on one side only Seized automatic adjuster on one side of car
Pedal vibrates when brakes applied	Discs or drums distorted Friction linings excessively worn Loose backplate or caliper mounting bolts Wear in steering or suspension components
Brakes drag	Handbrake linkage overadjusted or seized Seized caliper or wheel cylinder piston
Brakes squeal	Drums or discs rusty or damp (temporary fault - no action necessary) Dust or grit in brake drums Linings excessively worn
Brake pedal binds or sticks in 'on' position	Brake pedal crosstube out of alignment (see Section 18)
Brake judder	Incorrect hub/drum size fitted (see Section 9)

Chapter 9 Steering

Contents

Specifications

General

Type	Rack-and-pinion
Number of turns lock-to-lock	3.4
Turning circle:	
45/55/65 models	9.5 m (31.2 ft)
3/4/5 series models	10.3 m (33.8 ft)
Front wheel alignment (laden)*	0 ± 1.0 mm (0 ± 0.04 in)

**Four occupants plus 40 kg (88.0 lb) of baggage (approximately), tyres at specified pressures*

Steering rack lubricant

Stammat type	150.0 g (5.3 oz) of lithium based grease (Duckhams LB 10)
TRW type	140.0 cc (0.25 pint) of SAE 90EP gear oil (Duckhams Hypoid 90S)

Torque wrench settings

	Nm	lbf ft
Steering wheel nut	49	36
Steering column universal joint pinch bolts	26	19
Steering rack mounting bolts	26	19
Steering tie-rod balljoint nut	49	36
Tie-rod locknut	34	25

1 General description

The steering gear on all models is similar, and is of rack-and-pinion type.

The upper steering column incorporates a column lock with the ignition switch and has an inner shaft running in two bearings contained within the column outer tube.

The lower shaft is solid with two universal joints and is connected to the steering rack pinion.

Two alternative types of steering rack may be found fitted depending on model. They are of Stammat or TRW make. They can be identified by the letters ST (Stammat) or TRW stamped on the rack housing.

Stammat type racks are lubricated with grease and TRW types with oil.

The steering tie-rods are adjustable, and have 'lubricated for life' balljoints.

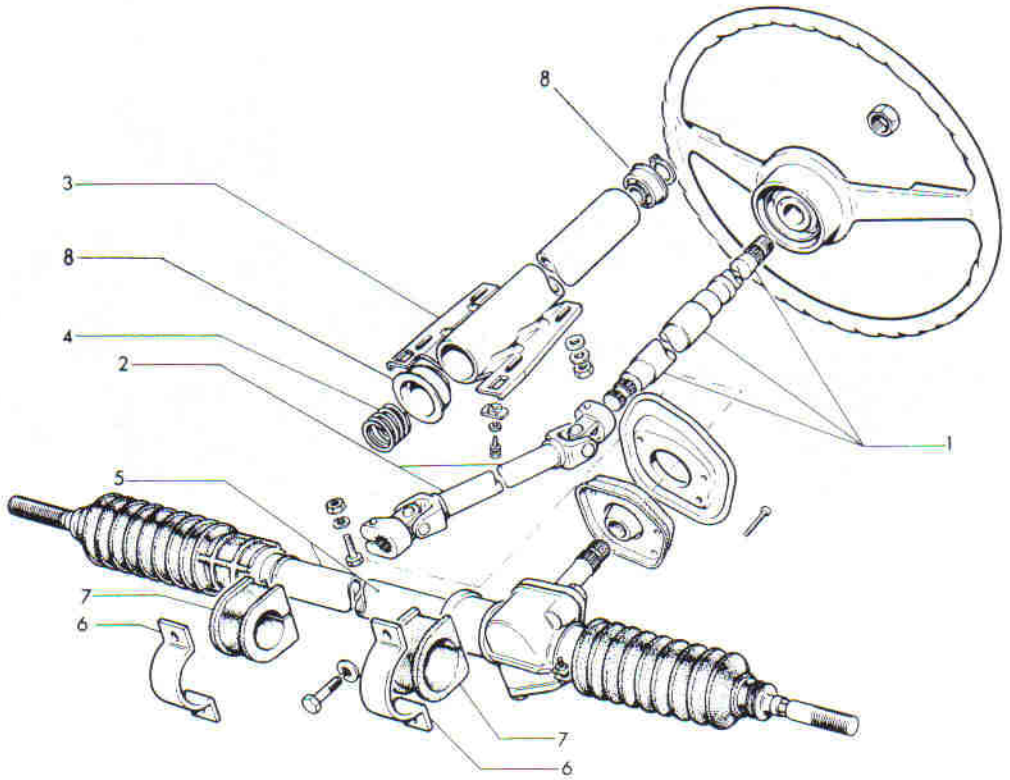


Fig. 9.1 Exploded view of the steering gear (Sec 1)

1 Upper column
2 Lower shaft
3 Outer tube
4 Bearing spring (not fitted to all models)
5 Rack
6 Mounting clamps
7 Rubber bushing
8 Upper and lower column bearings

2 Routine maintenance

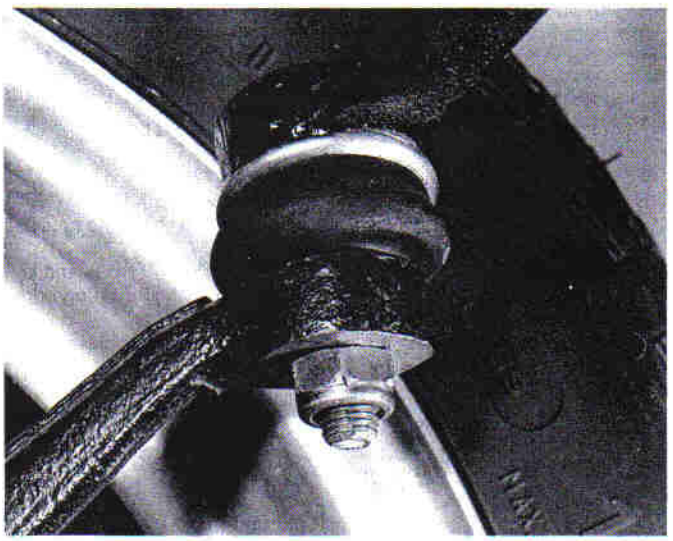
At the intervals given in the *'Routine maintenance'* Section at the beginning of this manual, carry out the following:

Inspect the steering tie-rod balljoint rubber boots and steering rack rubber gaiters for splits, cracking and perishing and renew as necessary (Sections 3 and 4)
Check all steering components for wear, security and leaks
Check the front wheel alignment (Section 10)

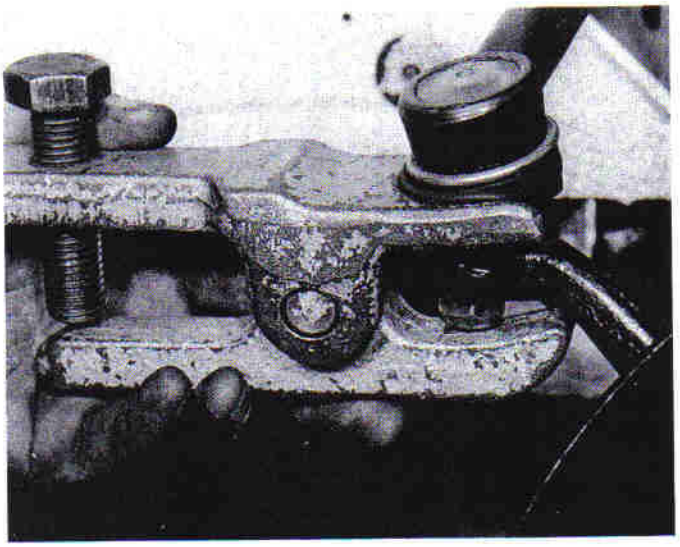
3 Tie-rod end balljoints – checking and renewal

Note: *A balljoint separator tool will be required for renewal of the balljoints.*

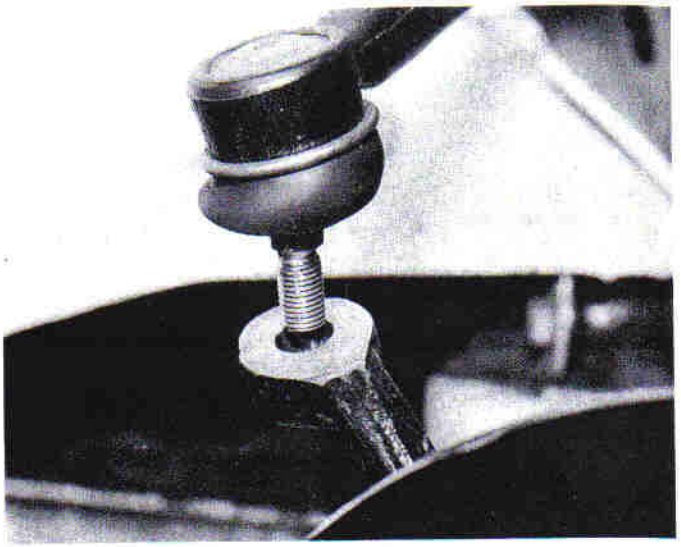
1 The tie-rod end balljoints can be checked for wear by raising the front of the vehicle onto axle stands. Using a stout lever prise the balljoint up and down and in and out.
2 If there is any appreciable play, or if the rubber boot is damaged, the balljoint must be renewed as follows.
3 Remove the roadwheel.
4 Unscrew the nut from the bottom of the balljoint taper pin (photo).
5 Use a balljoint separator to disconnect the balljoint from the steering arm (photos).
Note: *Where the tie-rod is only being disconnected for other servicing purposes, leave the balljoint taper pin nut on the end of the pin to prevent thread damage by the separator.*
6 There are two types of tie-rod in use. Where the balljoint is threaded into the outer end of the tie-rod, undo the locknut and unscrew the balljoint, counting the number of turns required to remove it from the tie-rod.
7 Screw the new balljoint on by the same number of turns and tighten the locknut.
8 Where the balljoint is integral with the tie-rod end, the complete tie-rod and balljoint assembly must be renewed.
9 Undo the locknut at the inner end and unscrew the tie-rod from the steering rack, again taking note of the number of turns required to remove it.
10 Fit the new tie-rod/balljoint, screwing it on by the exact number of turns counted on removal of the old assembly. Tighten the locknut.
11 Reconnect the balljoint to the steering arm and tighten the balljoint taper pin nut to the specified torque.



3.4 Tie-rod end balljoint



3.5A Balljoint separator in use



3.5B Disconnecting the balljoint from the steering arm

12 If the procedure has been followed accurately, the steering angles will not have been unduly altered, but in any case the front wheel alignment should be checked and adjusted as described in Section 10.
13 Refit the roadwheel and remove the vehicle from stands on completion.

4 Steering rack gaiters – renewal

1 If the steering rack gaiters are found to be split, or there is evidence of leakage from them, they must be renewed immediately or serious damage to the steering rack may occur due to dirt ingress or lack of lubricant.
2 To renew the gaiters first remove the rack as described in Section 5.
3 Remove the gaiters from the rack ends by undoing the clips securing the gaiters to the rack and sliding the gaiters off. Be prepared for oil spillage on TRW type racks. Note also that both ends of the gaiters are secured with clips on early racks, but on later racks the outer end is self-sealing and no clip is used.
4 Fit the replacement gaiters as follows.

Stammat type (grease lubricated)

5 Thoroughly clean off all the old grease from the rack, moving it from left to right over its full range of travel to do this.
6 Smear a quantity of the specified grease over the exposed ends of the rack, again moving it over its full range of travel. Do not apply too much grease or the gaiters may split under certain conditions due to pressure build up inside the rack. As a guide, when a dry rack is being re-greased the total amount of grease used must not exceed 150.0 g (5.3 oz), but remember that this applies to a dry rack. When renewing a gaiter, a certain amount of grease will have remained inside the rack.
7 Also smear the inside of the gaiters lightly with the same grease to ease their fitment to the rack.
8 Fit the gaiters to the rack, sliding them over the tie-rods and over the ends of the rack, being careful not to damage their sealing edges, especially where self-sealing gaiters are used.
9 Fit and tighten the clips where used. Refit the rack as described in Section 5.

TRW type (oil lubricated)

10 Follow the same basic procedure as for the Stammat type observing the following.
11 Oil the rack ends and the insides of the gaiters and allow them to drain.
12 Fit the gaiters, but leave off the outer clip if used.
13 Tilting the rack first one way and then the other, inject the specified amount of oil into the rack, inserting the end of a syringe under the outer lip of the gaiter.
14 Again there is a danger of the gaiters splitting under pressure if too much oil is used. A dry rack uses 140.0 cc, and discretion will have to be exercised.
15 Fit and tighten the outer gaiter clips where used. Refit the rack as described in Section 5.

5 Steering rack – checking, removal and refitting

1 Wear in the steering rack can be detected by grasping a front roadwheel and turning it sharply in and out.
2 Any sloppiness in the rack will be felt through the wheel, but make sure that the tie-rod balljoints and suspension lower balljoints are not also partly to blame.
3 Adjustment of the steering rack damper as described in Section 6 may alleviate the problem, but if not renew the steering rack as follows.
4 Set the steering in the straight-ahead position.
5 Working inside the vehicle, disconnect the steering shaft lower coupling by removing the pinch bolt (photo).
6 Disconnect the tie-rod end balljoints from the steering arms as described in Section 3.

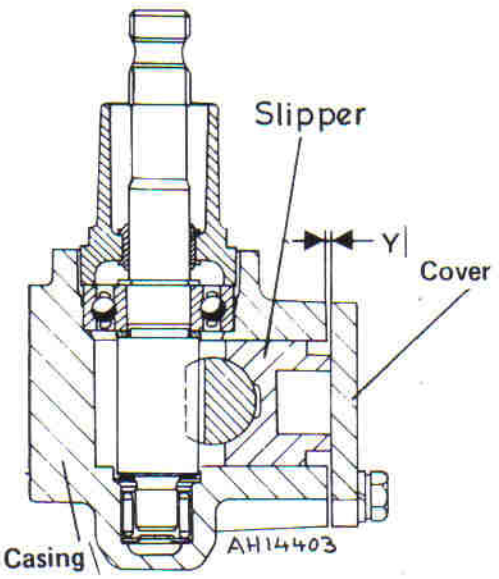
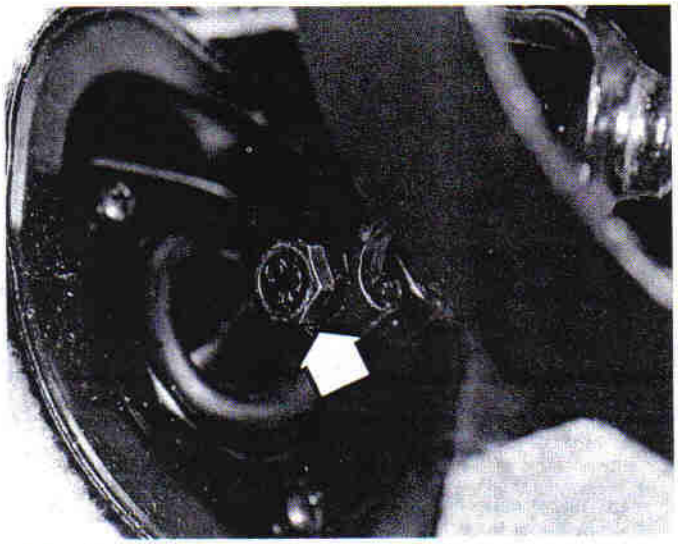


Fig. 9.2 Sectional view of steering rack damper (Sec 6)



5.5 Steering shaft lower coupling pinch bolt (arrowed)

7 Remove the rack clamp bolts and clamps and withdraw the rack from the crossmember (photo).
8 Refit in reverse order, and check the front wheel alignment as described in Section 10 on completion.

6 Steering rack – overhaul and adjustment

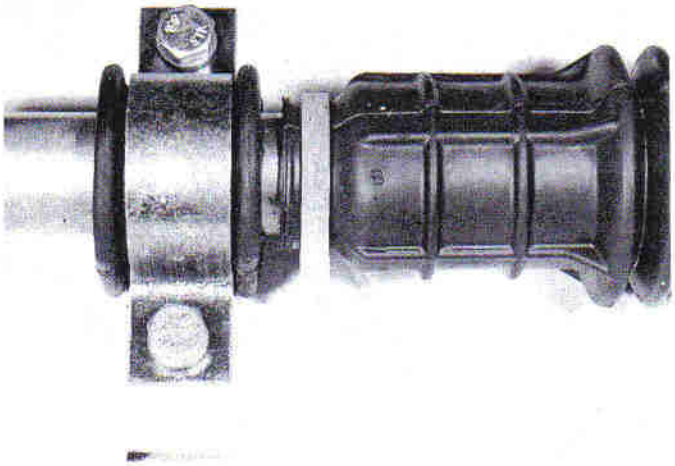
1 A worn steering rack should not be overhauled, but a new or factory reconditioned unit fitted.
2 After a high mileage, the following adjustment may be needed however.

Rack damper – adjustment

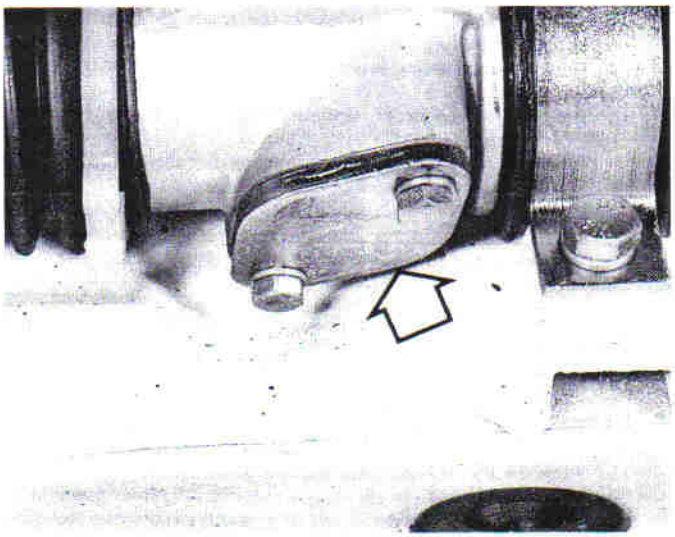
3 The slipper in the rack housing presses the rack into mesh with the pinion. This cuts out any backlash between the gears. Also, due to its pressure, it introduces some stiffness into the rack, which cuts out excessive reaction from the road to the steering wheel.
4 In due course, wear reduces the pressures exerted by the slipper. The pressure is controlled by the cover plate and a spring.
5 The need for resetting of the slipper is not easy to detect. On bumpy roads, the shock induced through the steering will give a feeling of play, and sometimes faint clonking can be heard. In extreme cases, free play in the steering may be felt, though this is rare. If the steering is compared with that of a new rack on another car, the lack of friction damping is quite apparent in the ease of movement of the steering wheel of the worn one.
6 Centralise the steering rack. Do this by counting the number of turns lock-to-lock and then turning the steering wheel from one lock through half the number of turns counted.
7 Take the cover plate off the damping slipper, being prepared for spillage on oil filled types (photo).
8 Temporarily refit the cover plate, tightening the bolts just enough to hold the slipper against the rack.
9 Measure the gap 'Y' in Fig. 9.2, using feeler blades.
10 Select shims from those available (0.10 and 0.15 mm/0.004 and 0.006 in) to provide a shim pack between 0.05 and 0.13 mm (0.002 and 0.005 in) thicker than the measured gap.
11 Refit the cover using the shims under the cover and fitting a new sealing ring to the slipper if leakage in this area has been a problem.
12 If the steering rack is oil filled, then the oil will have to be replenished as described in Section 4.
13 This presents a problem with the rack in-situ, but could be done by tilting the vehicle using jacks alternately at each side.

7 Steering wheel – removal and refitting

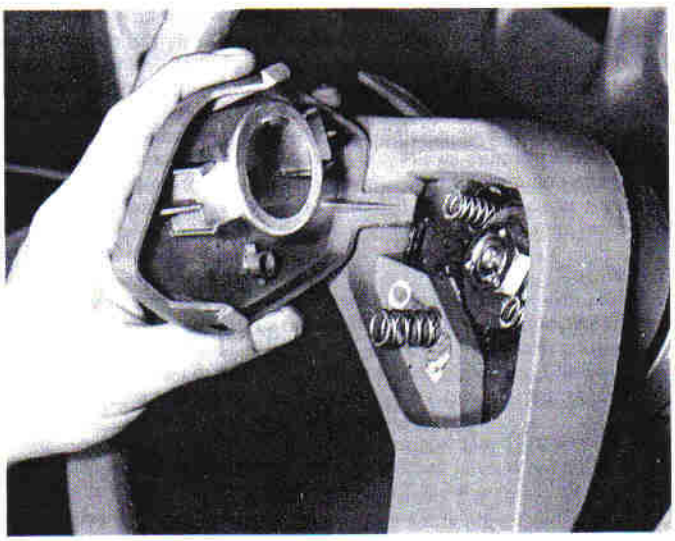
1 Set the steering in the straight-ahead position.
2 Prise off the horn push. On all models, the horn push is held by plastic clips (photos).



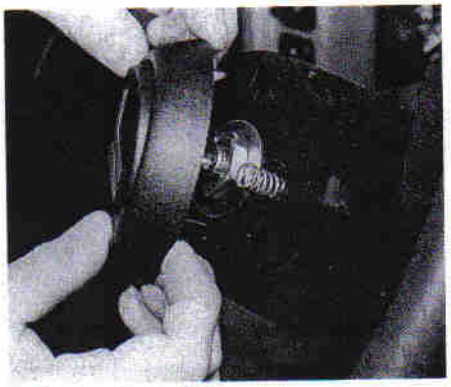
5.7 One of the steering rack clamps



6.7 Steering rack damper cover plate (arrowed)



7.2A Removing the horn push on a 45 model ...



7.2B ... and on a 311 model

7.8 Fitting the steering wheel washer and nut

7.9 Make sure the springs fit inside the guide recesses

3 Do not lose the horn push springs.
4 Slacken the steering wheel nut and unscrew it almost to the end of the shaft threaded portion.
5 Mark the relationship of the steering wheel to the shaft.
6 Sit in the front seat, then give the steering wheel a sharp clout under each side of the rim using the open palms of the hands to dislodge the steering wheel.
7 Remove the steering wheel nut and washer and lift off the steering wheel.
8 Refit in reverse order, tightening the steering wheel nut to the specified torque (photo).
9 When refitting the horn push, ensure that the springs fit inside the guide recesses in the steering wheel (photo).

8 Steering column – removal, overhaul and refitting

Note: *The procedure given here is for 45 series models. The procedure for other models is very similar.*

Removal

1 Disconnect the battery negative lead.
2 Remove the steering wheel as described in Section 7.
3 Refer to Chapter 3 and remove the choke cable.
4 Remove the screws securing the steering column shroud panels and remove the panels. On some models the lower panel is secured under the brake light switch which must be removed to free the panel. On refitting, adjust the brake light switch as described in Chapter 8.
5 Disconnect the wiring plugs for the combination and ignition switches (photo).
6 Slacken the clamp screw for the combination switch and lift the switch from the column (photo). If it is only desired to remove the combination switch for servicing or renewal, the switch can be removed without taking off the panels by loosening the clamp screw through the access hole in the lower panel (photo).
7 Mark the relationship of the steering column shaft to the universal joint, then remove the pinch bolt from the universal joint (photo). The pinch bolt must be completely withdrawn to disengage the joint.
8 Remove the nuts securing the column bracket to the framework, lower the column and pull it from the universal joint (photos). Take care not to lose the spring fitted between the steering column and universal joint.

Overhaul

9 It is unlikely that the column bearings will need renewal, but if they do, on early models they can be removed as described in the following paragraphs. However on some later models the bearings cannot be removed and the complete column must be renewed.
10 Secure the column in a vice. Grip the column by the column bracket.
11 Remove the circlip securing the top bearing.
12 Relieve the staking in the lower tube end which secures the lower bearing.
13 Gently tap the inner steering shaft downwards out of the column tube, which will also push out the lower bearing.
14 The upper bearing can now be prised out of the upper end of the tube.
15 Reassembly of the new bearings to the column is a reversal of removal, not forgetting to stake the lower bearing in position.

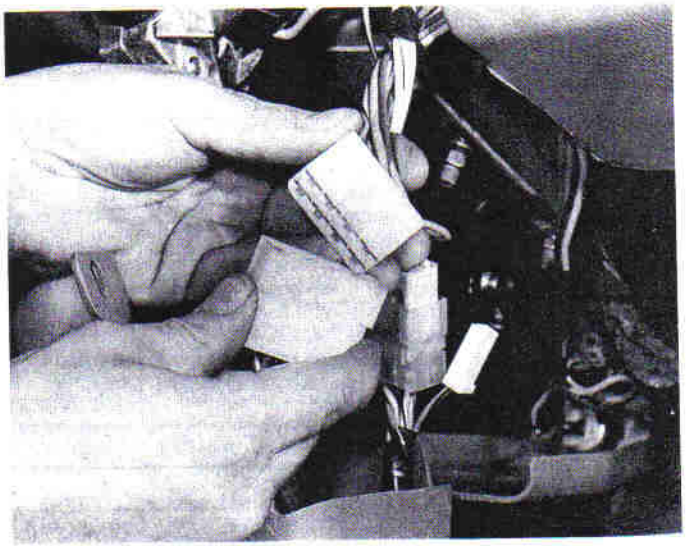
Refitting

16 Refitting of the steering column is a reversal of removal, but make sure that the spring under the lower bearing is fitted between the steering column and universal joint.
17 Note that the universal joint pinch bolt will not enter the joint unless the groove in the shaft is perfectly lined up with the pinch bolt hole in the joint.

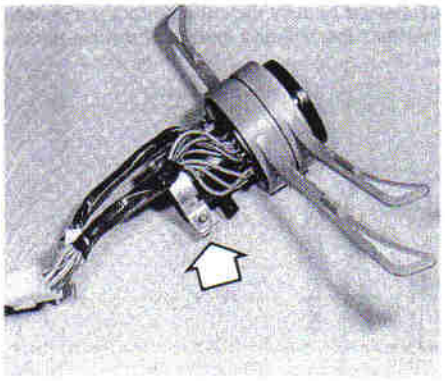
9 Ignition switch and steering lock – removal and refitting

Note: *The ignition switch and steering lock can be removed in-situ, but the task is made much easier with the column removed as described in Section 8. The procedure described here assumes that the column has been removed.*

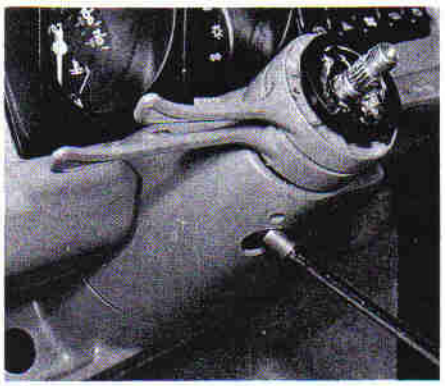
1 The ignition switch is secured to the column lock by two small screws, and can be renewed independently of the column lock (photo).
2 The steering column lock is secured to the steering column by two shear-head bolts (photos).
3 The heads of these bolts must be drilled out in order to remove the two halves of the column lock from the column.
4 Fit the new lock ensuring that the lock pin enters the groove in the steering column.
5 Fit and tighten the shear-head bolts until the bolt heads shear off.
6 Refit the steering column as described in Section 8.



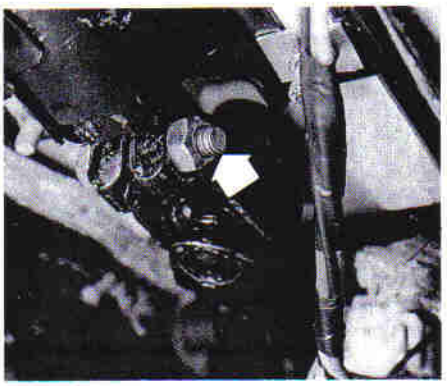
8.5 Disconnecting the wiring plugs



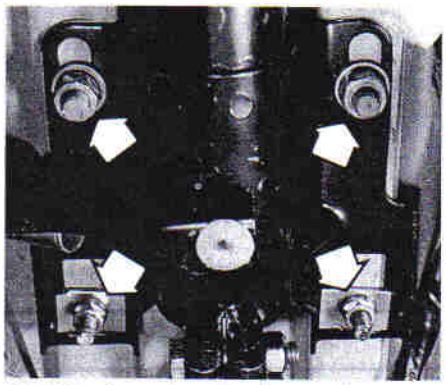
8.6A Combination switch removed showing the clamp screw



8.6B Undoing the clamp screw through the access hole in the shroud panel

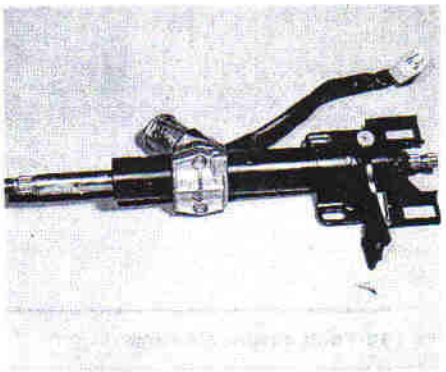


8.7 Upper universal joint pinch bolt (arrowed)

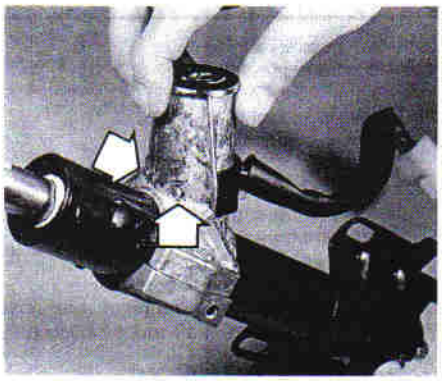


8.8A Steering column bracket securing nuts (arrowed)

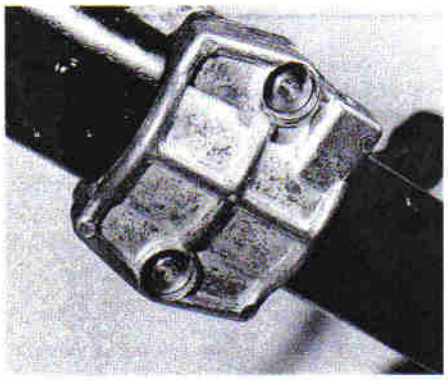
8.8B Pulling the column from the universal joint



8.8C Steering column removed



9.1 Ignition switch on column lock (securing screws arrowed)



9.2 Steering column lock shear-head bolts

10 Steering angles and front wheel alignment

Note: *See also Chapter 10, Section 12.*

General

1 The angle at which the front wheels 'meet' the road is vital to good handling and tyre wear. If the angle is incorrectly set the front wheels 'scrub' along the road with resultant rapid tyre wear.

2 Where the front wheels point inward at their front edge they are deemed to toe-in and where they point outward they are deemed to toe-out.

3 The checking and adjustment of wheel alignment is best left to a dealer who has the necessary alignment equipment, although reasonably accurate alignment gauges are now available from accessory shops.

Adjustment

4 Toe can be defined as the amount by which the distance between the front of the inner wheel rims differs from the same distance measured between the rear of the inner wheel rims, measured at hub height (see Fig. 9.3).

5 With this in mind, measurement and adjustment can be carried out as follows.

6 Ensure that both tie-rods are of equal length.

7 If they are not, loosen the locknut on one of the tie-rods either on the balljoint end or at the steering rack end (as applicable), disconnect the balljoint from the steering arm and screw the balljoint in or out as necessary to achieve equal lengths. Temporarily refit the balljoint to the steering arm.

8 Measure distance 'Y' in Fig. 9.3.

9 Push the vehicle forward to turn the roadwheels through 180

degrees (half a turn), then measure distance 'X'.
10 Check that distance 'X' differs from distance 'Y' by the specified amount.
11 If not, adjust each tie-rod equally until the correct toe is achieved.
12 On completion, tighten the balljoint nuts and tie-rod locknuts to the specified torque.

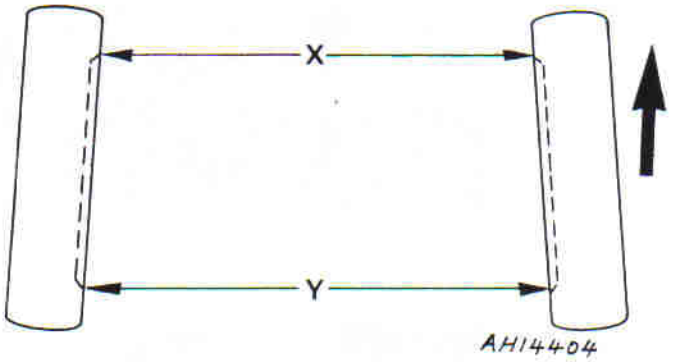


Fig. 9.3 Front wheel alignment diagram (Sec 10)

X Front dimension
Y Rear dimension
Y minus X = Toe in

11 Fault diagnosis – steering

Note: *Before diagnosing steering faults, be sure that trouble is not due to incorrect or uneven tyre pressures, inappropriate tyre combinations, or braking system or suspension defects*

Symptom	Reason(s)
Car pulls to one side	Incorrect steering angles Collision damage
Car wanders when driven straight-ahead	Play in steering rack Wear in steering balljoints
Heavy or stiff steering	Lack of lubricant in steering rack or balljoints Incorrect steering angles Collision damage
Play at steering wheel	Wear in steering rack or balljoints Loose steering shaft coupling pinch-bolt or worn splines Worn steering column/shaft universal joints
Vibration at steering wheel	Roadwheels out of balance or loose Tyre damage Loose driveshaft-to-hub nuts
Rattles from steering when traversing rough surfaces	Steering damper defective or in need of adjustment Loose steering column mounting bolts Loose steering column/shaft coupling pinch-bolts Loose steering rack housing mounting bolts Worn steering shaft bushes
Excessive or uneven tyre wear	Incorrect steering angles Worn steering components Collision damage

Chapter 10 Suspension

Contents

Specifications

Front suspension

Type	Independent by control arms and MacPherson struts with integral coil springs and telescopic shock absorbers
Front suspension angles*:	
Camber:	
45/55/65 models	1° ± 30' positive
3/4/5 series models	1° 25' ± 30' positive
Castor:	
45/55/65 models	2° 15' ± 30' positive
3/4/5 series models	2° 15' ± 30' positive

***Note:** *All suspension angles are given for a vehicle in the fully laden condition: ie four adults (approximately 280 kg/617 lbs) plus 40 kg (88 lbs) of luggage*

Rear suspension

Type	Independent with transverse leaf spring, control arms and hydraulic shock absorbers
Rear suspension angles*:	
Camber:	
45/55/65 models	3° ± 45' negative
3/4/5 series models	3° ± 45' negative
Rear wheel toe:	
45/55/65 models	4.0 mm ± 2.0 mm toe-in
3/4/5 series models	4.0 mm ± 2.0 mm toe-in

***Note:** *All suspension angles are given for a vehicle in the fully laden condition: ie four adults (approximately 280 kg/617 lbs) plus 40 kg (88 lbs) of luggage*

Torque wrench settings

	Nm	lbf ft
Front suspension		
Control arm-to-body mounting nut	26	20
Hub carrier-to-control arm balljoint nut	54	41
Anti-roll bar-to-control arm mounting nut	59	43
Anti-roll bar bracket-to-body bolts	29	22
Shock absorber top mounting centre nylock nut	59	43
Suspension strut-to-body nuts	25	18
Rear suspension		
Leaf spring-to-control arm bracket nuts	29	22
Control arm pivot-to-body mounting nuts	49	36
Control arm pivot-to-control arm nuts	49	36
Shock absorber-to-hub carrier lower bolt	78	58
Shock absorber-to-hub carrier upper bolt	59	43
Shock absorber upper mounting nut (in boot)	25	18

1 General description

The front suspension is independent by control arm and MacPherson struts with integral telescopic shock absorbers and coil springs.

All models have a front anti-roll bar.

Front wheel castor is adjusted by shims under the anti-roll bar-to-control arm mounting. The front wheel camber angle is pre-set and cannot be adjusted.

The rear suspension consists of a transverse leaf spring with two or three leaves depending on model which also acts as an anti-roll bar, control arms and telescopic shock absorbers.

Adjustment of the rear wheel camber and toe-in is by shims placed under the control arm pivot attachment bolts.

The suspension on all models is very similar and the procedures given in this Chapter cover all models. Where major differences between models do occur these are pointed out in the text.

2 Routine maintenance

1 At the intervals specified in the *'Routine maintenance'* Section at the beginning of this manual carry out the following.

2 Check all suspension components for wear, security and leaks.

3 Any fluid seepage from around the shock absorbers will mean that renewal is necessary.

4 The front suspension balljoints can be checked for wear by raising the vehicle onto stands, then using a stout lever prise the joints back and forth and up and down. Anything more than barely perceptible movement means that the joints must be renewed.

5 Check all rubber bushes and mountings. These must be in good condition, free from signs of hardening, cracking or perishing, and must not be swollen due to contamination by solvent fluids (petrol, oil etc).

6 It is emphasised that any wear in the suspension components will affect handling and cause rapid tyre wear, and must be rectified as soon as possible.

7 Check the front and rear suspension angles (Section 12).

3 Front suspension strut – removal and refitting

1 Raise the front of the vehicle onto axle stands and remove the front wheels.

2 Disconnect the brake hydraulic hose at the bracket on the suspension strut and plug both open ends of the hose/pipe to minimise fluid loss.

3 Open the bonnet and remove the nuts securing the strut top mounting to the inner wing. There are two nuts on 45/55/65 models and three on 3/4/5 series models (photos). **Do not** attempt to undo the centre nut.

4 Remove the bolts securing the lower end of the strut to the hub carrier and pull the hub carrier down and the strut inwards to separate them (photo).

5 Remove the complete suspension strut from under the wing.

6 Refitting is a reversal of removal.

7 Bleed the front brake circuit as described in Chapter 8 on completion.

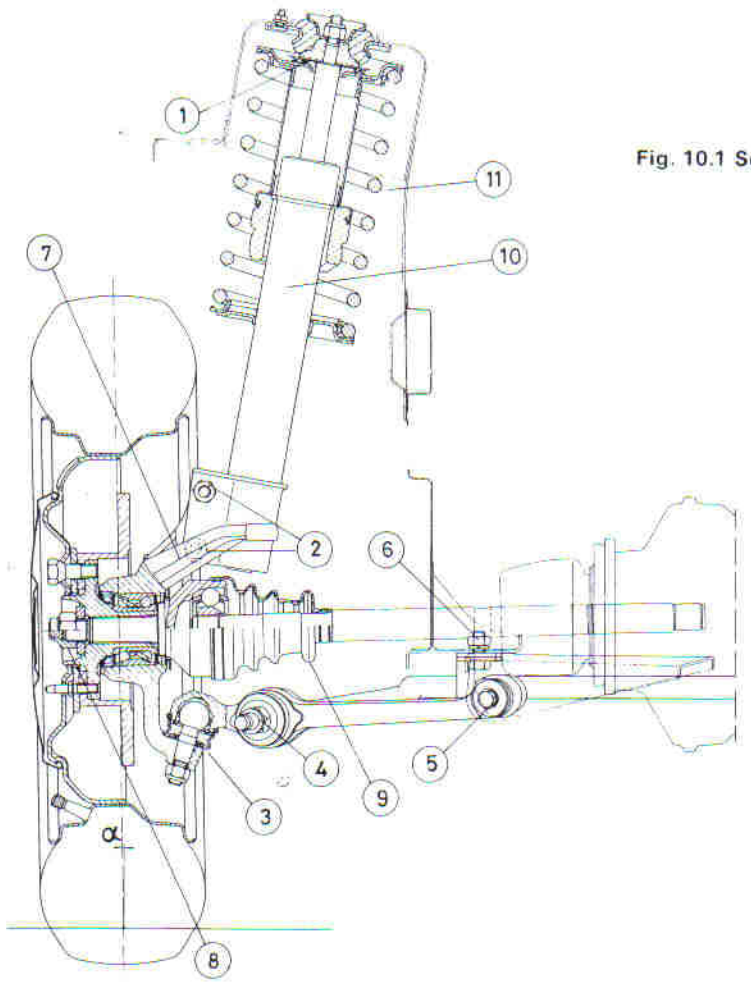
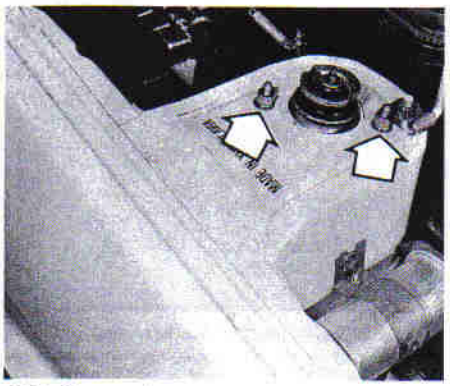
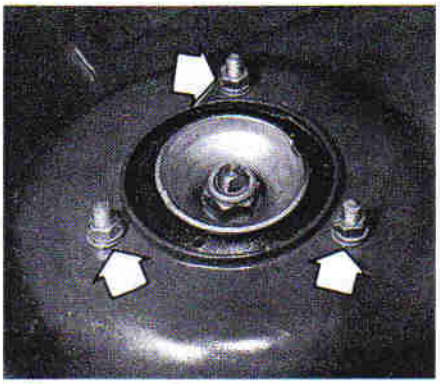


Fig. 10.1 Sectional view through front suspension assembly (Sec 3)

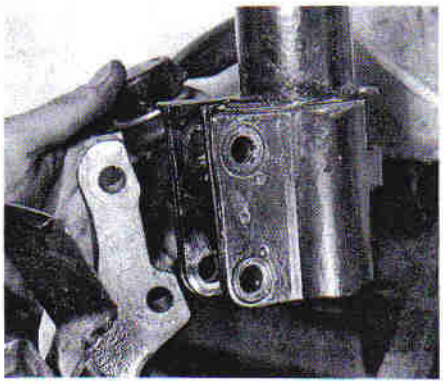
1 Suspension strut top mounting and bearing
2 Strut-to-hub carrier bolts
3 Control arm-to-hub carrier balljoint
4 Anti-roll bar-to-control arm mounting
5 Control arm-to-body mounting
6 Anti-roll bar-to-body mounting
7 Steering arm
8 Wheel hub and bearing
9 Driveshaft
10 Shock absorber
11 Coil spring
α Camber angle



3.3A Suspension strut top mounting nuts on a 45 model ...



3.3B ... and on a 311 model



3.4 Removing the hub carrier from the suspension strut

4 Front suspension strut – overhaul

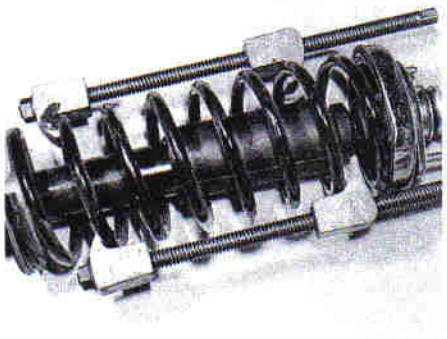
Note: *Suitable coil spring compressor tools will be required to remove the coil spring from the strut.*

1 Remove the strut as described in Section 3.
2 Fit spring compressors to restrain the spring (photo).
3 Undo the centre nut on the top mounting. The strut is actually an extension of the piston rod and it may be necessary to prevent it from turning by using a spanner on the flats provided while the nut is undone.
4 Remove the components of the upper mounting and bearing, noting their order of removal.
5 Remove the top spring plate.
6 Lift off the spring.
7 Remove the rubber cover from the shock absorber.
8 Slowly and progressively release the spring compressors from the spring.
9 Inspect the spring for cracks, distortion and corrosion. The spring rate performance can be checked by a dealer with the necessary equipment.
10 If the springs need renewing, note that they are colour coded in order to match their performance and the same colour springs must be used on both sides of the vehicle. In any case, both springs must be renewed at the same time even if one appears to be in reasonable condition, in order to maintain the suspension and handling characteristics of the car.
11 The shock absorbers too can be checked by a dealer for performance, but a worn shock absorber can be detected by pushing down hard on the wing of the car, quickly releasing it, and observing the 'bounce'. The wing should rebound once and return to rest.
12 Shock absorbers must be renewed if there is any sign of leakage from the piston gland.
13 As with springs, shock absorbers too must be renewed in pairs.
14 Clean and dry off the top bearing assembly and inspect the rollers for wear, renewing the bearing as necessary.
15 Commence reassembly by fitting the nylon spring carrier (photo).
16 Slide on the rubber cover (photo).
17 Compress the spring as during removal, and fit it to the shock absorber, ensuring its end is a snug fit in the nylon carrier (photo).
18 Fit the upper spring plate (photo).
19 Make sure the bearing is well greased and fit it to the recess in the upper spring plate (photo).
20 Fit the bearing cover (photo).
21 Fit the washer, followed by the upper housing, ensuring the spigots locate correctly in the holes (photos).
22 Finally, fit the dished cup and tighten a new nylock nut, to the specified torque (photos).
23 Remove the spring compressors and refit the suspension strut to the vehicle as described in Section 3.

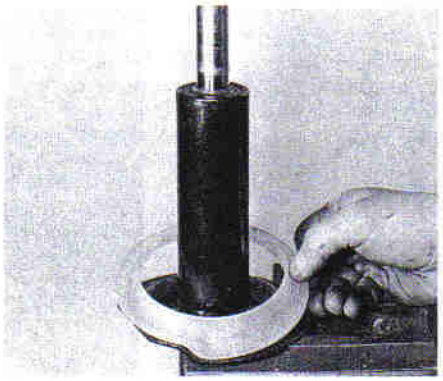
5 Front hub carrier – removal and refitting

Note: *A balljoint separator tool will be required during the following procedure.*

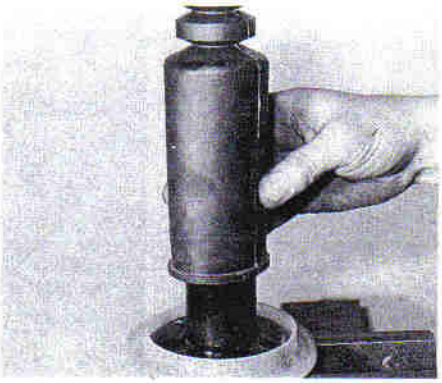
1 Remove the driveshaft as described in Chapter 7.
2 Remove the brake caliper from the hub carrier as described in Chapter 8 and tie it up out of the way.
3 Disconnect the steering tie-rod balljoint as described in Chapter 9.
4 Remove the two bolts securing the suspension strut lower end to the hub carrier (photo).
5 Remove the nut from the control arm balljoint, then use a balljoint separator tool to disconnect the balljoint (photo).
6 Pull the hub carrier complete with hub and brake disc away from the suspension strut (photo).
7 Refit in reverse order.



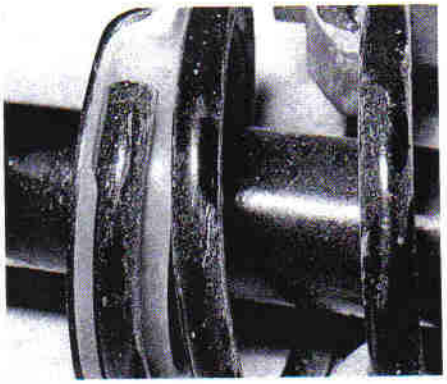
4.2 Coil spring compressors in use



4.15 Fit the nylon spring carrier



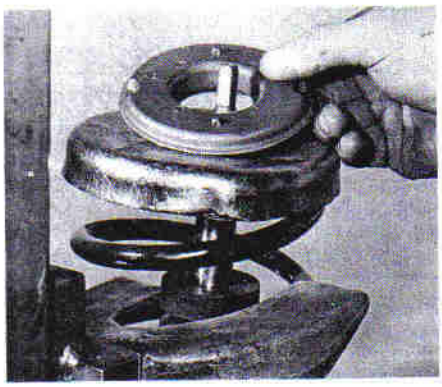
4.16 Slide on the rubber cover



4.17 Ensure the spring fits snugly in the nylon carrier

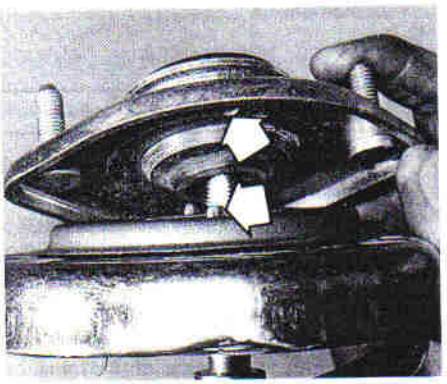
4.18 Fitting the upper spring plate

4.19 Grease and fit the bearing ...



4.20 ... bearing cover ...

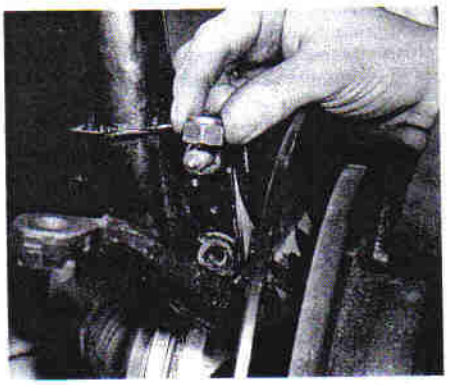
4.21A ... washer ...



4.21B ... and upper housing (locating spigot and hole arrowed)

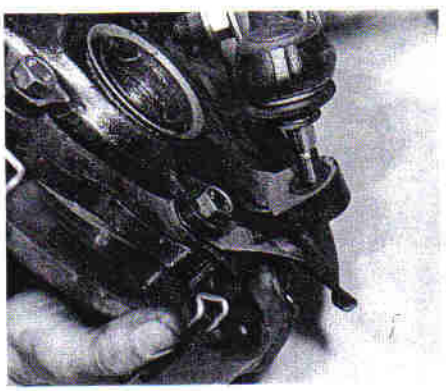
4.22A Fitting the dished cup ...

4.22B ... and nylock nut

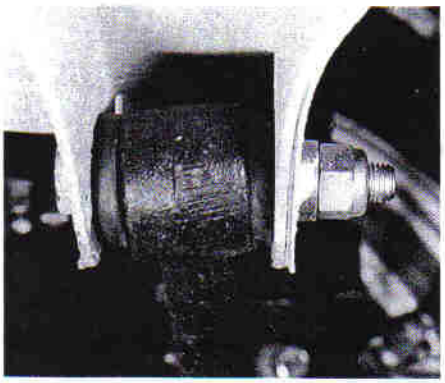


5.4 Removing the suspension strut-to-hub carrier nuts and bolts

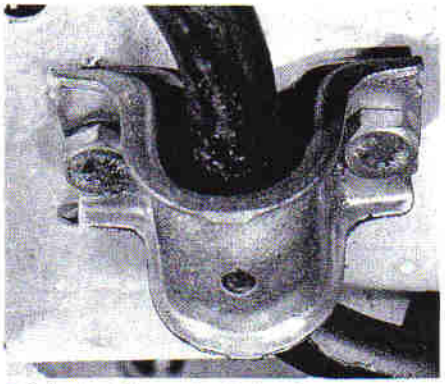
5.5 Control arm balljoint nut



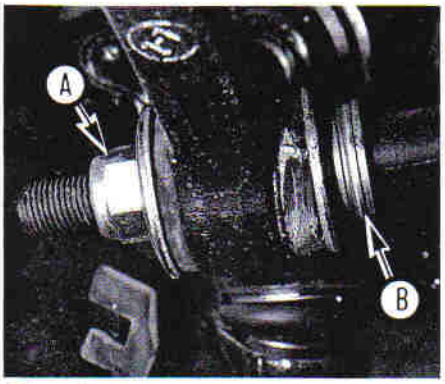
5.6 Removing the hub carrier



6.2 Control arm-to-body bracket mounting



7.2 Anti-roll bar-to-body bracket



7.4 Anti-roll bar-to-control arm mounting
A Securing nut
B Adjustment shims

6 Front control arm – removal and refitting

1 Raise the front of the vehicle onto axle stands and remove the driveshaft as described in Chapter 7.
2 Remove the nut from the control arm-to-body bracket, then push out the retaining bolt (photo).
3 Disconnect the anti-roll bar from the control arm (see Section 7).
4 Refer to Section 5 and disconnect the control arm balljoint.
5 Remove the control arm.
6 Inspect the rubber bush at the inner end of the arm. If it is worn, split, perished or swollen due to oil contamination it must be renewed. Do this by pressing the old bush out and a new bush in.
7 The balljoint is lubricated for life and if excessive play has been noticed or the rubber boot is damaged in any way (see Section 2), the complete control arm must be renewed.
8 Refitting is a reversal of removal.

7 Anti-roll bar – removal and refitting

1 Raise the front of the vehicle onto axle stands.
2 Undo the bolts securing the anti-roll bar brackets to the bodywork (photo).
3 Remove the nuts from the ends of the anti-roll bar.
4 Count the number of shims between the anti-roll bar and the control arm before removing the anti-roll bar. These shims control the castor angle of the front wheels and the same number as removed must be refitted in the same place (photo).
5 Inspect the rubber bushes for hardening, cracking, perishing or swelling and renew as necessary.
6 Refitting is a reversal of removal.

8 Rear suspension – general

1 The following points should be taken into account before attempting overhaul of the rear suspension components.
2 The rear shock absorbers must be renewed as a pair to maintain the suspension and handling characteristics.
3 If the control arm bushes need renewing it should be realised that although removal and refitting of the control arm is fairly straightforward, the bushes themselves present a problem in that they must be pressed out and the new bushes pressed in.
4 Special tools and presses are used by Yugo dealers to do this, although suitable alternatives could be made up using lengths of tubing and long bolts and washers.
5 However, as the camber and toe-in angles of the rear wheels will be affected by the new components, and the angles are set by shims under the control arm pivot attachment bolts, requiring specialist measuring equipment for accurate setting, it is suggested that problems in this area are best dealt with by a Yugo dealer.
6 Incorrectly set wheel alignment can affect handling and cause rapid tyre wear.
7 If overhaul is undertaken by the home mechanic, the wheel alignment must be checked and adjusted as necessary by a dealer, using the correct equipment, at the earliest opportunity.

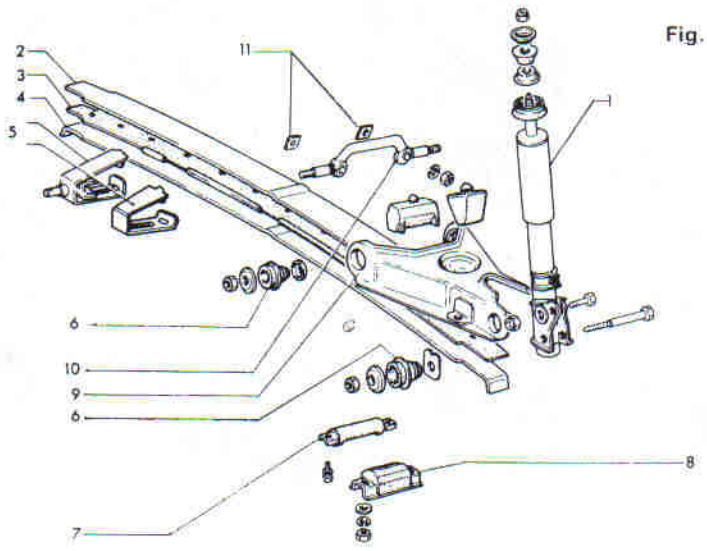


Fig. 10.2 Components of the rear suspension – 2-leaf spring (Sec 8)

1 Shock absorber
2 Top spring leaf
3 Inter-leaf shim lining
4 Lower spring leaf
5 Spring clamp brackets
6 Control arm inner bushes
7 Spring-to-body securing pad and bracket
8 Spring-to-control arm pad and bracket
9 Control arm
10 Control arm pivot
11 Control arm pivot shims

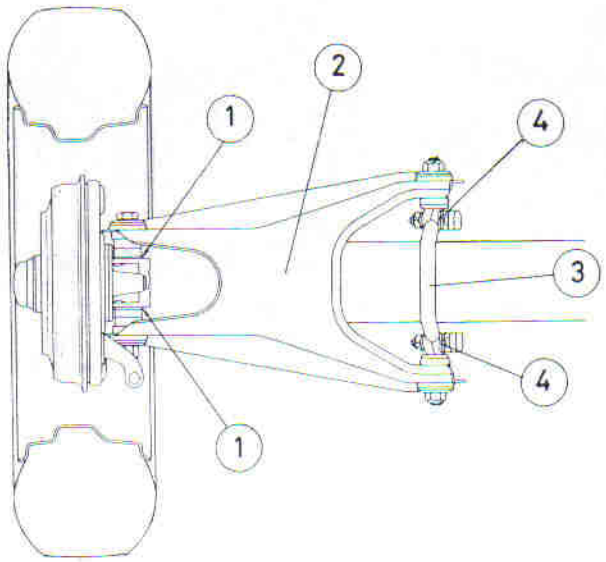


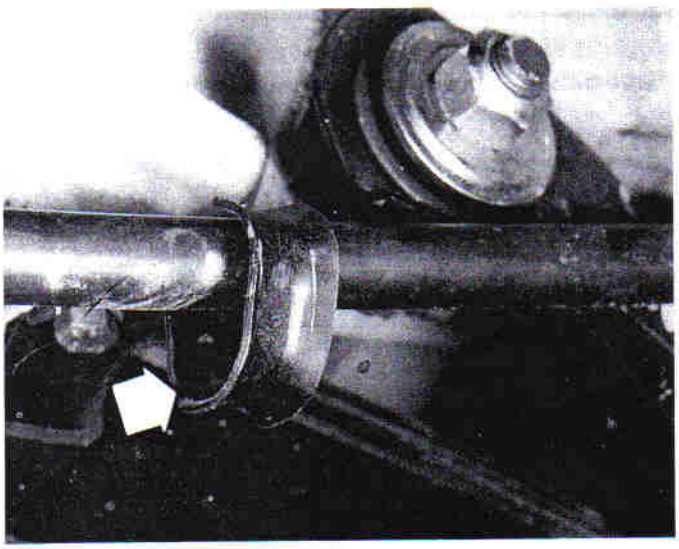
Fig. 10.3 Adjustment shim locations on rear suspension (Sec 8)

1 Shock absorber lower mounting shims
2 Control arm
3 Control arm pivot
4 Control arm pivot shims

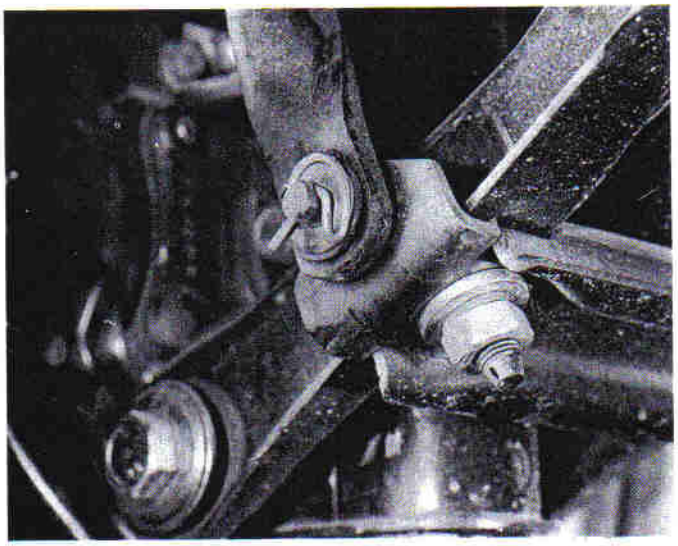
9 Rear suspension assembly – removal and refitting

Note: *Refer to Section 8 before proceeding.*

1 Jack up the rear of the vehicle and support on axle stands under the rear body jacking points.
2 Remove the roadwheels.
3 Position a jack under the left-hand end of the transverse leaf spring and gently take the load off the suspension.
4 Unbolt and remove the handbrake cable support bracket from the leaf spring (photo).
5 Undo the two nuts and remove the rubber pad and bracket which locates the end of the leaf spring on the control arm. Note that the front nut also secures the brake pressure regulator valve tension rod link (photo).
6 Gently lower the jack supporting the leaf spring, and allow the end of the spring to hang free.
7 Disconnect the flexible brake hose union from the rigid pipe and plug the hose and pipe ends to prevent fluid loss and dirt ingress.
8 Release the handbrake and disconnect the cable end from the lever on the brake, as described in Chapter 8. Tie the cable up out of the way.
9 From inside the luggage compartment remove the plastic cover from the shock absorber top mounting (photo).
10 Support the control arm, and undo the shock absorber top mounting nut. Use a spanner on the flats of the shock absorber piston rod to prevent the rod turning as the nut is undone (photo).
11 Undo the nuts securing the control arm pivot to the body, noting the shims on the studs under the pivot (photo). The shims must be refitted in the same positions from which they were removed.
12 The complete assembly of hub, brake drum, control arm and shock absorber can now be removed from the vehicle.
13 Repeat the operations on the right-hand side of the vehicle, but ignore the reference to the brake pressure regulator valve.
14 The leaf spring can now be removed from the vehicle by undoing the bolts and removing the two brackets securing it to the vehicle underside.
15 Refitting of all components is a reversal of removal, bearing in mind the following points.
16 Refit the shims to the control arm pivot studs in the positions from which they were removed.
17 Final tightening of all fixings should be left until the weight of the vehicle is resting on the suspension, with the vehicle fully laden.
18 Bleed the rear brake circuit on completion as described in Chapter 8.
19 Have the rear wheel alignment checked by a dealer at the earliest opportunity.

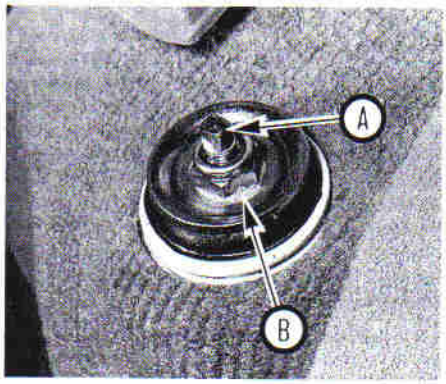


9.4 Handbrake cable support bracket (arrowed)

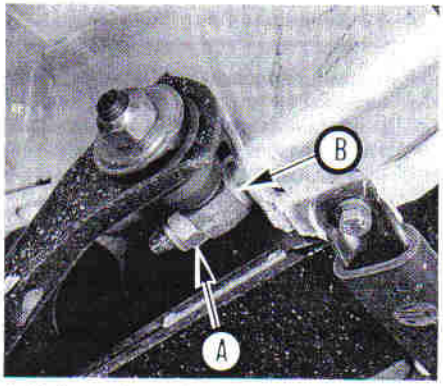


9.5 Brake pressure regulator valve torsion rod link secured by leaf spring-to-control arm bracket nut

9.9 Removing the plastic cover



9.10 Shock absorber top mounting
A Piston rod flats
B Mounting nut



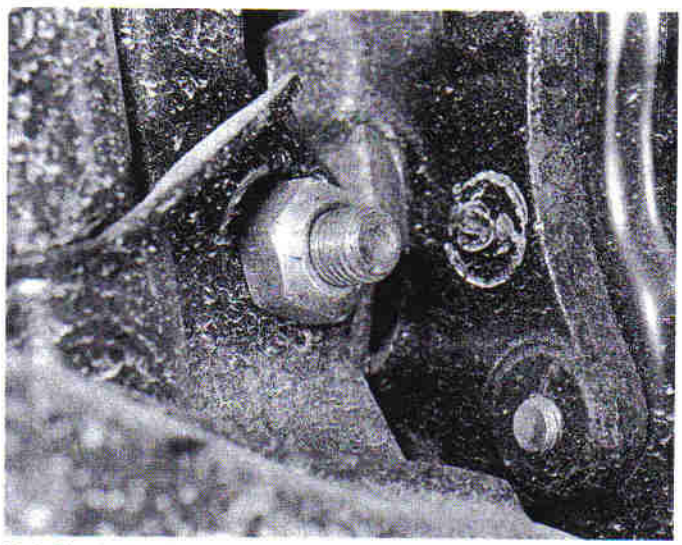
9.11 Control arm pivot mounting
A Nut
B Adjustment shims

10 Rear suspension assembly – overhaul

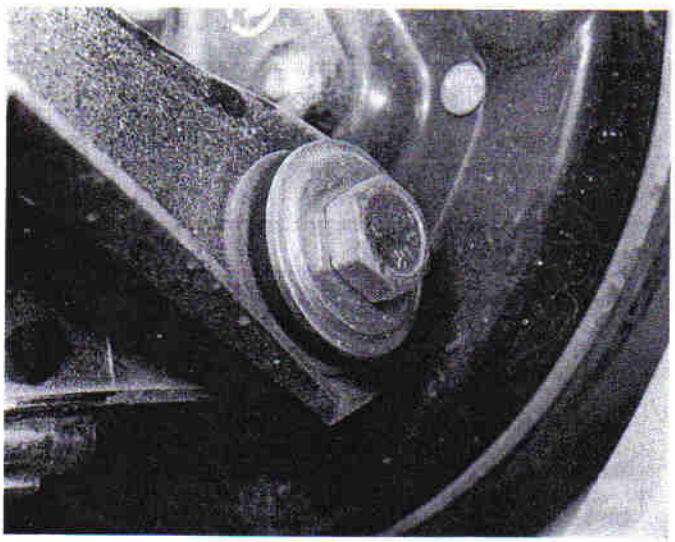
1 Remove the suspension assembly as described in Section 9.
2 Refer to Chapter 7 and remove the hub, and to Chapter 8 and remove the brake drum assembly.
3 Remove the upper bolt securing the shock absorber to the hub carrier (photo).
4 Remove the nut from the bolt securing the lower end of the shock absorber to the hub carrier and control arm (photo).
5 Take careful note of the positions of the shims and washers either side of the shock absorber lower mounting (they must be refitted in the same positions), then push out the bolt to separate the shock absorber, hub carrier and control arm. Retrieve the shims and washers.
6 If the shock absorber is leaking from around the gland seal it must be renewed. Remember that the shock absorbers must be renewed in pairs.
7 If it has been decided to renew the control arm bushes (refer to Section 8) the following procedure should be followed.
8 Press the control arm pivot partially out one way to partly remove one bush.
9 Press the control arm pivot in the opposite direction and press the other bush right out.
10 Remove the remaining bush and the pivot.
11 The bushes at the other end of the control arm can now be pressed out.
12 Reassembly of the new bushes to the control arm and reassembly of the suspension components is a reversal of removal, but ensure that the shims and washers either side of the shock absorber lower mounting are repositioned in the same place from which they were removed. The thickness of the shims should be equal on both sides of the shock absorber.
13 Refit the assembly to the vehicle as described in Section 9.

11 Rear suspension leaf spring – removal and refitting

1 The leaf spring can be removed without removing the other components of the suspension as follows.
2 Follow the procedure given in Section 9, paragraphs 1 to 6.
3 Repeat the procedure on the right-hand side of the vehicle, but ignore the reference to the brake pressure regulator valve.
4 The leaf spring can now be removed from the vehicle by undoing the bolts and removing the two brackets securing it to the vehicle underside.
5 Inspect the spring for cracking and corrosion. If the spring shows signs of weakening, indicated by the rear suspension sagging, it should be renewed. Also inspect the inter-leaf shims and renew them if they show signs of wear.
6 Refitting is a reversal of removal, but final tightening of all fixings should be left until the weight of the vehicle is resting on the suspension, with the vehicle fully laden.



10.3 Shock absorber-to-hub carrier upper nut and bolt



10.4 Lower bolt securing shock absorber to control arm and hub carrier

12 Suspension angles – general

1 Accurate wheel alignment in both horizontal and vertical planes is essential for good road holding and long tyre life.
2 Before attempting to measure or adjust any of the suspension angles, ensure that the tyres are inflated to the correct pressures and that all suspension components are in good condition.
3 Toe-in of the front wheels is dealt with in Chapter 9, Section 10.
4 The remaining angles to be dealt with are castor and camber of the front wheels and camber and toe of the rear wheels.
5 Castor is the angle at which the suspension strut (and therefore the axis of the wheel) deviates from the vertical when viewed from the side of the vehicle.
6 Camber is the angle at which the wheel deviates from the vertical when viewed from the front or rear of the vehicle.
7 The castor angle of the front wheels is pre-set by the position of the top suspension strut mounting and cannot be adjusted. Camber of the front wheels is adjusted by adding or removing shims at the anti-roll bar-to-control arm connection (see Section 7).
8 Camber and toe of the rear wheels is adjusted by adding or removing shims from the control arm pivot-to-body securing studs (see Section 9).
9 Serious collision damage can greatly affect these angles, and if this has occurred the vehicle should be checked on a body alignment jig by a Yugo dealer.

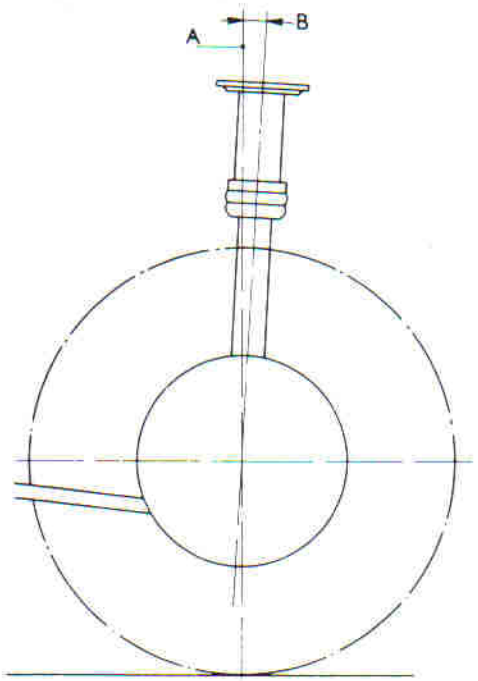


Fig. 10.4 Castor angle (Sec 12)

A Vertical
B Castor angle (positive in this case)

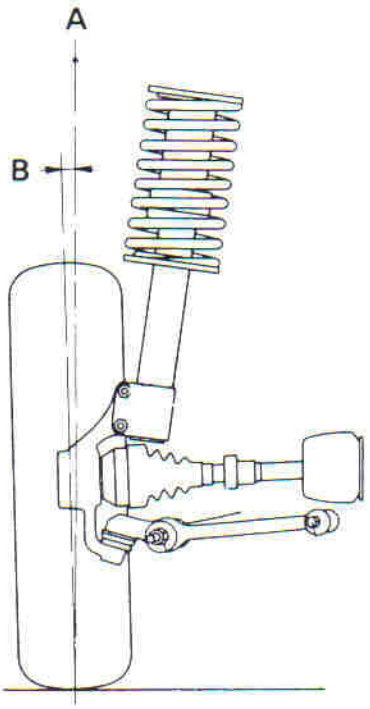


Fig. 10.5 Camber angle (Sec 12)

A Vertical
B Camber angle (positive in this case)

13 Fault diagnosis – suspension

Note: *Before diagnosing steering faults, be sure that trouble is not due to incorrect or uneven tyre pressures*

Symptom	Reason(s)
Car pulls to one side	Worn or weak shock absorbers or struts on one side
Excessive roll on corners	Weak shock absorbers or struts Leaf spring weak or cracked
Car wanders or skips on rough surfaces	Defective shock absorbers or struts
Vibration and wheel wobble	Loose or defective shock absorbers or struts
Excessive or uneven tyre wear	Worn suspension components
Car sags at rear	Cracked, broken or weak leaf spring

Chapter 11 Bodywork and fittings

Contents

1 General description

All models in the current Yugo range are of all steel, unitary construction.

A PVC coating is applied to the underside of sills and valances and the main body sections are wax injected.

To complete the rust-proofing process a multi-layer zinc phosphate primer and electrophoretic paint finish is applied.

The Section headings throughout this Chapter apply to all models except where specifically stated otherwise.

2 Maintenance – bodywork and underframe

1 The general condition of a vehicle's bodywork is the one thing that significantly affects its value. Maintenance is easy but needs to be regular. Neglect, particularly after minor damage, can lead quickly to further deterioration and costly repair bills. It is important also to keep watch on those parts of the vehicle not immediately visible, for instance the underside, inside all the wheel arches and the lower part of the engine compartment.

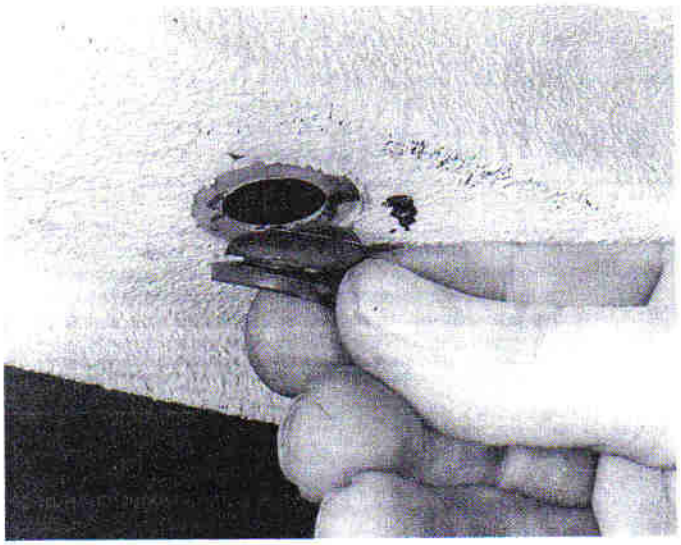
2 The basic maintenance routine for the bodywork is washing – preferably with a lot of water, from a hose. This will remove all the loose solids which may have stuck to the vehicle. It is important to flush these off in such a way as to prevent grit from scratching the finish. The wheel arches and underframe need washing in the same way to remove any accumulated mud which will retain moisture and tend to encourage rust. Paradoxically enough, the best time to clean the underframe and wheel arches is in wet weather when the mud is thoroughly wet and soft. In very wet weather the underframe is usually cleaned of large accumulations automatically and this is a good time for inspection.

3 Periodically, except on vehicles with a wax-based underbody protective coating, it is a good idea to have the whole of the underframe of the vehicle steam cleaned, engine compartment included, so that a thorough inspection can be carried out to see what minor repairs and renovations are necessary. Steam cleaning is available at many garages and is necessary for removal of the accumulation of oily grime which sometimes is allowed to become thick in certain areas. If steam cleaning facilities are not available, there are one or two excellent grease solvents available, such as Holts Engine Cleaner or Holts Foam-brite, which can be brush applied. The dirt can then be simply hosed off. Note that these methods should not be used on vehicles with wax-based underbody protective coating or the coating will be removed. Such vehicles should be inspected annually, preferably just prior to winter, when the underbody should be washed down and any damage to the wax coating repaired using Holts Undershield. Ideally, a completely fresh coat should be applied. It would also be worth considering the use of such wax-based protection for injection into door panels, sills, box sections, etc, as an additional safeguard against rust damage where such protection is not provided by the vehicle manufacturer.

4 After washing paintwork, wipe off with a chamois leather to give an unspotted clear finish. A coat of clear protective wax polish, like the many excellent Turtle Wax polishes, will give added protection against chemical pollutants in the air. If the paintwork sheen has dulled or oxidised, use a cleaner/polisher combination such as Turtle Extra to restore the brilliance of the shine. This requires a little effort, but such dulling is usually caused because regular washing has been neglected. Care needs to be taken with metallic paintwork, as special non-abrasive cleaner/polisher is required to avoid damage to the finish. Always check that the door and ventilator opening drain holes and pipes are completely clear so that water can be drained out (photo). Bright work should be treated in the same way as paint work. Windscreens and windows can be kept clear of the smeary film which often appears by the use of a proprietary glass cleaner like Holts Mixra. Never use any form of wax or other body or chromium polish on glass.

3 Maintenance – upholstery and carpets

Mats and carpets should be brushed or vacuum cleaned regularly to keep them free of grit. If they are badly stained remove them from the vehicle for scrubbing or sponging and make quite sure they are dry before refitting. Seats and interior trim panels can be kept clean by wiping with a damp cloth and Turtle Wax Carisma. If they do become stained (which can be more apparent on light coloured upholstery) use a little liquid detergent and a soft nail brush to scour the grime out of the grain of the material. Do not forget to keep the headlining clean in the same way as the upholstery. When using liquid cleaners inside the vehicle do not over-wet the surfaces being cleaned. Excessive damp could get into the seams and padded interior causing stains, offensive odours or even rot. If the inside of the vehicle



2.4 Removing a rubber drain plug from a chassis member

gets wet accidentally it is worthwhile taking some trouble to dry it out properly, particularly where carpets are involved. *Do not leave oil or electric heaters inside the vehicle for this purpose.*

4 Minor body damage - repair

The photographic sequences on pages 178 and 179 illustrate the operations detailed in the following sub-sections.

Note: *For more detailed information about bodywork repair, the Haynes Publishing Group publish a book by Lindsay Porter called The Car Bodywork Repair Manual. This incorporates information on such aspects as rust treatment, painting and glass fibre repairs, as well as details on more ambitious repairs involving welding and panel beating.*

Repair of minor scratches in bodywork

If the scratch is very superficial, and does not penetrate to the metal of the bodywork, repair is very simple. Lightly rub the area of the scratch with a paintwork renovator like Turtle Wax New Color Back, or a very fine cutting paste like Holts Body + Plus Rubbing Compound to remove loose paint from the scratch and to clear the surrounding bodywork of wax polish. Rinse the area with clean water.

Apply touch-up paint, such as Holts Dupli-Color Color Touch or a paint film like Holts Autofilm, to the scratch using a fine paint brush; continue to apply fine layers of paint until the surface of the paint in the scratch is level with the surrounding paintwork. Allow the new paint at least two weeks to harden: then blend it into the surrounding paintwork by rubbing the scratch area with a paintwork renovator or a very fine cutting paste, such as Holts Body + Plus Rubbing Compound or Turtle Wax New Color Back. Finally, apply wax polish from one of the Turtle Wax range of wax polishes.

Where the scratch has penetrated right through to the metal of the bodywork, causing the metal to rust, a different repair technique is required. Remove any loose rust from the bottom of the scratch with a penknife, then apply rust inhibiting paint, such as Turtle Wax Rust Master, to prevent the formation of rust in the future. Using a rubber or nylon applicator fill the scratch with bodystopper paste like Holts Body + Plus Knifing Putty. If required, this paste can be mixed with cellulose thinners, such as Holts Body + Plus Cellulose Thinners, to provide a very thin paste which is ideal for filling narrow scratches. Before the stopper-paste in the scratch hardens, wrap a piece of smooth cotton rag around the top of a finger. Dip the finger in cellulose thinners, such as Holts Body + Plus Cellulose Thinners, and then quickly sweep it across the surface of the stopper-paste in the scratch; this will ensure that the surface of the stopper-paste is slightly hollowed. The scratch can now be painted over as described earlier in this Section.

Repair of dents in bodywork

When deep denting of the vehicle's bodywork has taken place, the first task is to pull the dent out, until the affected bodywork almost attains its original shape. There is little point in trying to restore the original shape completely, as the metal in the damaged area will have stretched on impact and cannot be reshaped fully to its original contour. It is better to bring the level of the dent up to a point which is about $\frac{1}{4}$ in (3 mm) below the level of the surrounding bodywork. In cases where the dent is very shallow anyway, it is not worth trying to pull it out at all. If the underside of the dent is accessible, it can be hammered out gently from behind, using a mallet with a wooden or plastic head. Whilst doing this, hold a suitable block of wood firmly against the outside of the panel to absorb the impact from the hammer blows and thus prevent a large area of the bodywork from being 'belled-out'.

Should the dent be in a section of the bodywork which has a double skin or some other factor making it inaccessible from behind, a different technique is called for. Drill several small holes through the metal inside the area - particulary in the deeper section. Then screw long self-tapping screws into the holes just sufficiently for them to gain a good purchase in the metal. Now the dent can be pulled out by pulling on the protruding heads of the screws with a pair of pliers.

The next stage of the repair is the removal of the paint from the damaged area, and from an inch or so of the surrounding 'sound' bodywork. This is accomplished most easily by using a wire brush or abrasive pad on a power drill, although it can be done just as effectively by hand using sheets of abrasive paper. To complete the preparation for filling, score the surface of the bare metal with a screwdriver or the tang of a file, or alternatively, drill small holes in the affected area. This will provide a really good 'key' for the filler paste.

To complete the repair see the Section on filling and re-spraying.

Repair of rust holes or gashes in bodywork

Remove all paint from the affected area and from an inch or so of the surrounding 'sound' bodywork, using an abrasive pad or a wire brush on a power drill. If these are not available a few sheets of abrasive paper will do the job just as effectively. With the paint removed you will be able to gauge the severity of the corrosion and therefore decide whether to renew the whole panel (if this is possible) or to repair the affected area. New body panels are not as expensive as most people think and it is often quicker and more satisfactory to fit a new panel than to attempt to repair large areas of corrosion.

Remove all fittings from the affected area except those which will act as a guide to the original shape of the damaged bodywork (eg headlamp shells etc). Then, using tin snips or a hacksaw blade, remove all loose metal and any other metal badly affected by corrosion. Hammer the edges of the hole inwards in order to create a slight depression for the filler paste.

Wire brush the affected area to remove the powdery rust from the surface of the remaining metal. Paint the affected area with rust inhibiting paint like Turtle Wax Rust Master; if the back of the rusted area is accessible treat this also.

Before filling can take place it will be necessary to block the hole in some way. This can be achieved by the use of aluminium or plastic mesh, or aluminium tape.

Aluminium or plastic mesh or glass fibre matting, such as the Holts Body + Plus Glass Fibre Matting, is probably the best material to use for a large hole. Cut a piece to the approximate size and shape of the hole to be filled, then position it in the hole so that its edges are below the level of the surrounding bodywork. It can be retained in position by several blobs of filler paste around its periphery.

Aluminium tape should be used for small or very narrow holes. Pull a piece off the roll and trim it to the approximate size and shape required, then pull off the backing paper (if used) and stick the tape over the hole; it can be overlapped if the thickness of one piece is insufficient. Burnish down the edges of the tape with the handle of a screwdriver or similar, to ensure that the tape is securely attached to the metal underneath.

Bodywork repairs - filling and re-spraying

Before using this Section, see the Sections on dent, deep scratch rust holes and gash repairs.

Many types of bodyfiller are available, but generally speaking those proprietary kits which contain a tin of filler paste and a tube of resin hardener are best for this type of repair, like Holts Body + Plus or Holts No Mix which can be used directly from the tube. A wide, flexible plastic or nylon applicator will be found invaluable for imparting a

smooth and well contoured finish to the surface of the filler.

Mix up a little filler on a clean piece of card or board – measure the hardener carefully (follow the maker's instructions on the pack) otherwise the filler will set too rapidly or too slowly. Alternatively, Holts No Mix can be used straight from the tube without mixing, but daylight is required to cure it. Using the applicator apply the filler paste to the prepared area; draw the applicator across the surface of the filler to achieve the correct contour and to level the filler surface. As soon as a contour that approximates to the correct one is achieved, stop working the paste – if you carry on too long the paste will become sticky and begin to 'pick up' on the applicator. Continue to add thin layers of filler paste at twenty-minute intervals until the level of the filler is just proud of the surrounding bodywork.

Once the filler has hardened, excess can be removed using a metal plane or file. From then on, progressively finer grades of abrasive paper should be used, starting with a 40 grade production paper and finishing with 400 grade wet-and-dry paper. Always wrap the abrasive paper around a flat rubber, cork, or wooden block – otherwise the surface of the filler will not be completely flat. During the smoothing of the filler surface the wet-and-dry paper should be periodically rinsed in water. This will ensure that a very smooth finish is imparted to the filler at the final stage.

At this stage the 'dent' should be surrounded by a ring of bare metal, which in turn should be encircled by the finely 'feathered' edge of the good paintwork. Rinse the repair area with clean water, until all of the dust produced by the rubbing-down operation has gone.

Spray the whole repair area with a light coat of primer, either Holts Body + Plus Grey or Red Oxide Primer – this will show up any imperfections in the surface of the filler. Repair these imperfections with fresh filler paste or bodystopper, and once more smooth the surface with abrasive paper. If bodystopper is used, it can be mixed with cellulose thinners to form a really thin paste which is ideal for filling small holes. Repeat this spray and repair procedure until you are satisfied that the surface of the filler, and the feathered edge of the paintwork are perfect. Clean the repair area with clean water and allow to dry fully.

The repair area is now ready for final spraying. Paint spraying must be carried out in a warm, dry, windless and dust free atmosphere. This condition can be created artificially if you have access to a large indoor working area, but if you are forced to work in the open, you will have to pick your day very carefully. If you are working indoors, dousing the floor in the work area with water will help to settle the dust which would otherwise be in the atmosphere. If the repair area is confined to one body panel, mask off the surrounding panels; this will help to minimise the effects of a slight mis-match in paint colours. Bodywork fittings (eg chrome strips, door handles etc) will also need to be masked off. Use genuine masking tape and several thicknesses of newspaper for the masking operations.

Before commencing to spray, agitate the aerosol can thoroughly, then spray a test area (an old tin, or similar) until the technique is mastered. Cover the repair area with a thick coat of primer; the thickness should be built up using several thin layers of paint rather than one thick one. Using 400 grade wet-and-dry paper, rub down the surface of the primer until it is really smooth. While doing this, the work area should be thoroughly doused with water, and the wet-and-dry paper periodically rinsed in water. Allow to dry before spraying on more paint.

Spray on the top coat using Holts Dupli-Color Autospray, again building up the thickness by using several thin layers of paint. Start spraying in the centre of the repair area and then, with a single side-to-side motion, work outwards until the whole repair area and about 2 inches of the surrounding original paintwork is covered. Remove all masking material 10 to 15 minutes after spraying on the final coat of paint.

Allow the new paint at least two weeks to harden, then, using a paintwork renovator or a very fine cutting paste such as Turtle Wax New Color Back or Holts Body + Plus Rubbing Compound, blend the edges of the paint into the existing paintwork. Finally, apply wax polish.

Plastic components

With the use of more and more plastic body components by the vehicle manufacturers (eg bumpers, spoilers, and in some cases major body panels), rectification of more serious damage to such items has become a matter of either entrusting repair work to a specialist in this field, or renewing complete components. Repair of such damage by the DIY owner is not really feasible owing to the cost of the equipment and materials required for effecting such repairs. The basic technique involves making a groove along the line of the crack in the plastic using a rotary burr in a power drill. The damaged part is then welded back together by using a hot air gun to heat up and fuse a plastic filler rod into the groove. Any excess plastic is then removed and the area rubbed down to a smooth finish. It is important that a filler rod of the correct plastic is used, as body components can be made of a variety of different types (eg polycarbonate, ABS, polypropylene).

Damage of a less serious nature (abrasions, minor cracks etc) can be repaired by the DIY owner using a two-part epoxy filler repair material like Holts Body + Plus or Holts No Mix which can be used directly from the tube. Once mixed in equal proportions (or applied direct from the tube in the case of Holts No Mix), this is used in similar fashion to the bodywork filler used on metal panels. The filler is usually cured in twenty to thirty minutes, ready for sanding and painting.

If the owner is renewing a complete component himself, or if he has repaired it with epoxy filler, he will be left with the problem of finding a suitable paint for finishing which is compatible with the type of plastic used. At one time the use of a universal paint was not possible owing to the complex range of plastics encountered in body component applications. Standard paints, generally speaking, will not bond to plastic or rubber satisfactorily, but Holts Professional Spraymatch paints to match any plastic or rubber finish can be obtained from dealers. However, it is now possible to obtain a plastic body parts finishing kit which consists of a pre-primer treatment, a primer and coloured top coat. Full instructions are normally supplied with a kit, but basically the method of use is to first apply the pre-primer to the component concerned and allow it to dry for up to 30 minutes. Then the primer is applied and left to dry for about an hour before finally applying the special coloured top coat. The result is a correctly coloured component where the paint will flex with the plastic or rubber, a property that standard paint does not normally possess.

5 Major body damage – repair

Major body damage repair should be left to a Yugo dealer or local bodywork repair specialist.

Special body jigs and alignment gauges are required to check body alignment, especially after serious impact, which if left unattended can affect steering and suspension characteristics, and can render the vehicle unsafe to drive.

6 Radiator grille – removal and refitting

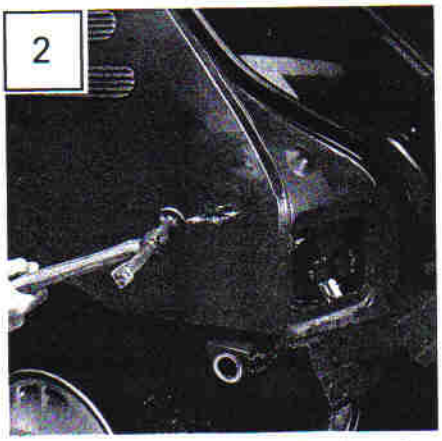
1 The radiator grille on all models is secured by self-tapping screws.
2 Remove the screws and lift out the grille (photos).
3 Note that the headlamp surround is secured in place by two of the screws.

7 Bonnet – removal and refitting

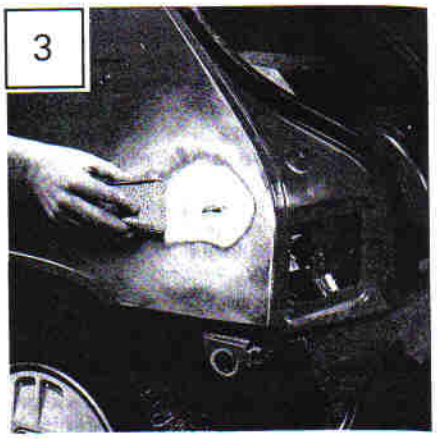
45/55/65 models

1 The bonnet is hinged at the rear.
2 Prop the bonnet in the open position.
3 Make alignment marks across the hinge and bonnet assemblies so that the bonnet can be realigned when refitting.
4 With an assistant working on the opposite side, undo the bonnet-to-hinge bolts and lift the bonnet away, detaching the prop as you do so (photo). Lay the bonnet on protective matting to avoid damage to the paintwork.
5 The hinge assemblies are bolted to the bodywork. Periodically apply a little grease to the hinge pivots.
6 Refitting is a reversal of removal, noting that the hinge bolt holes are elongated to allow for adjustment.
7 The rubber buffers at the front corners of the front panel screw in or out to provide support for the bonnet in the closed position (photo).
8 The prop is secured to the inner wing by a bracket and nut and the prop clip is secured by a self-tapping screw.
9 The air inlet duct grille is secured to the bonnet by clips and nuts (photo).

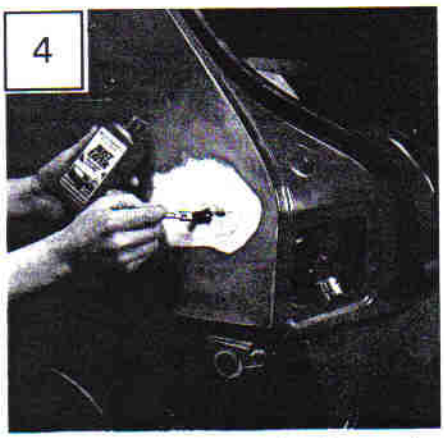
This photographic sequence shows the steps taken to repair the dent and paintwork damage shown above. In general, the procedure for repairing a hole will be similar; where there are substantial differences, the procedure is clearly described and shown in a separate photograph.



First remove any trim around the dent, then hammer out the dent where access is possible. This will minimise filling. Here, after the large dent has been hammered out, the damaged area is being made slightly concave.

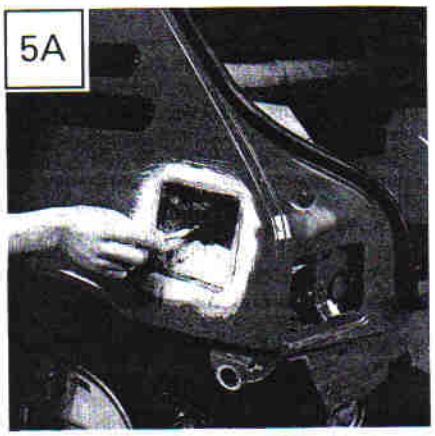


Next, remove all paint from the damaged area by rubbing with coarse abrasive paper or using a power drill fitted with a wire brush or abrasive pad. 'Feather' the edge of the boundary with good paintwork using a finer grade of abrasive paper.



Where there are holes or other damage, the sheet metal should be cut away before proceeding further. The damaged area and any signs of rust should be treated with Turtle Wax Hi-Tech Rust Eater, which will also inhibit further rust formation.

For a large dent or hole mix Holts Body Plus Resin and Hardener according to the manufacturer's instructions and apply around the edge of the repair. Press Glass Fibre Matting over the repair area and leave for 20-30 minutes to harden. Then ...



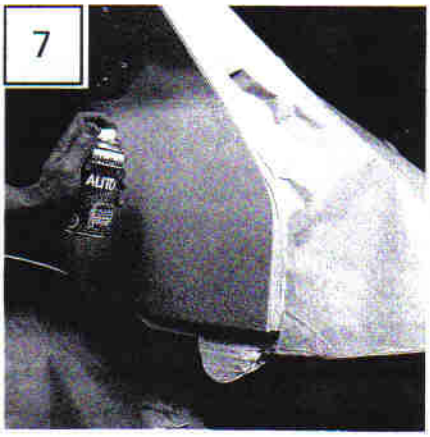
... brush more Holts Body Plus Resin and Hardener onto the matting and leave to harden. Repeat the sequence with two or three layers of matting, checking that the final layer is lower than the surrounding area. Apply Holts Body Plus Filler Paste as shown in Step 5B.

For a medium dent, mix Holts Body Plus Filler Paste and Hardener according to the manufacturer's instructions and apply it with a flexible applicator. Apply thin layers of filler at 20-minute intervals, until the filler surface is slightly proud of the surrounding bodywork.

For small dents and scratches use Holts No Mix Filler Paste straight from the tube. Apply it according to the instructions in thin layers, using the spatula provided. It will harden in minutes if applied outdoors and may then be used as its own knifing putty.

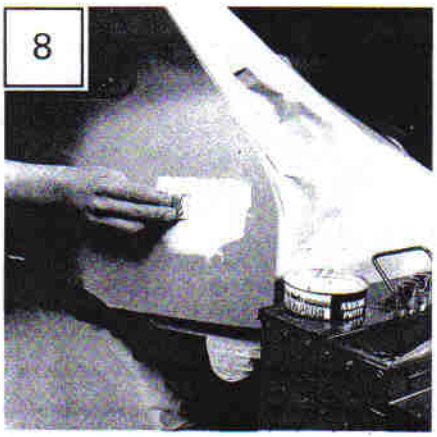
Use a plane or file for initial shaping. Then, using progressively finer grades of wet-and-dry paper, wrapped round a sanding block, and copious amounts of clean water, rub down the filler until glass smooth. 'Feather' the edges of adjoining paintwork.

7



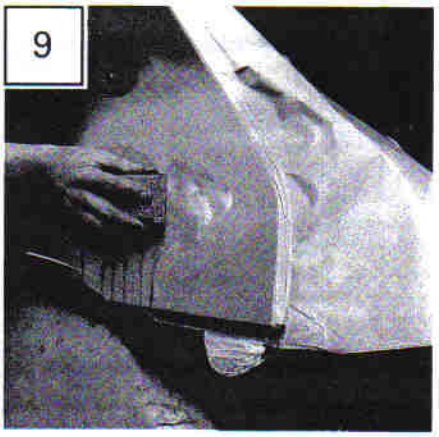
Protect adjoining areas before spraying the whole repair area and at least one inch of the surrounding sound paintwork with Holts Dupli-Color primer.

8



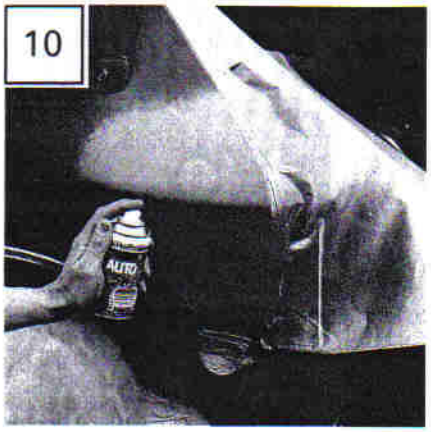
Fill any imperfections in the filler surface with a small amount of Holts Body Plus Knifing Putty. Using plenty of clean water, rub down the surface with a fine grade wet-and-dry paper – 400 grade is recommended – until it is really smooth.

9



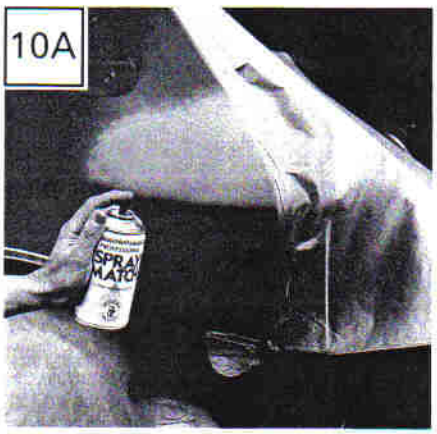
Carefully fill any remaining imperfections with knifing putty before applying the last coat of primer. Then rub down the surface with Holts Body Plus Rubbing Compound to ensure a really smooth surface.

10



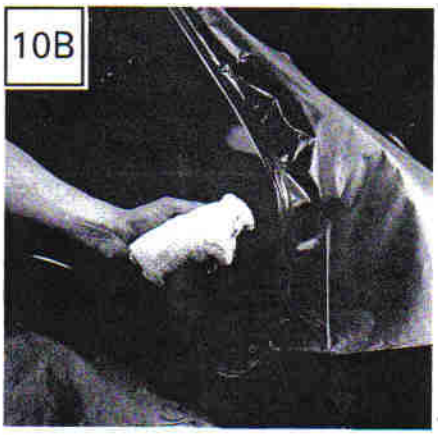
Protect surrounding areas from overspray before applying the topcoat in several thin layers. Agitate Holts Dupli-Color aerosol thoroughly. Start at the repair centre, spraying outwards with a side-to-side motion.

10A



If the exact colour is not available off the shelf, local Holts Professional Spraymatch Centres will custom fill an aerosol to match perfectly.

10B



To identify whether a lacquer finish is required, rub a painted unrepaired part of the body with wax and a clean cloth.

11

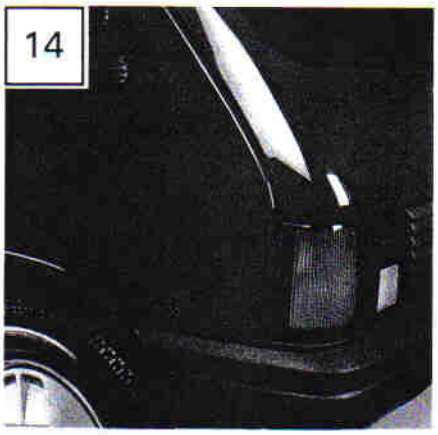
If *no* traces of paint appear on the cloth, spray Holts Dupli-Color clear lacquer over the repaired area to achieve the correct gloss level.

12

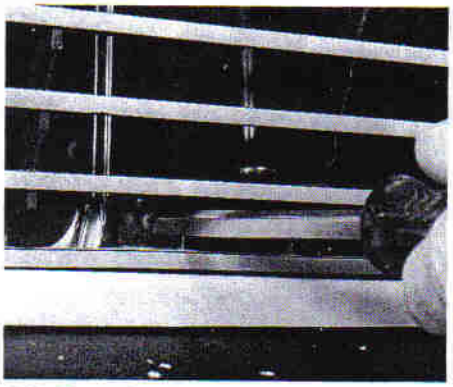
13

The paint will take about two weeks to harden fully. After this time it can be 'cut' with a mild cutting compound such as Turtle Wax Minute Cut prior to polishing with a final coating of Turtle Wax Extra.

14



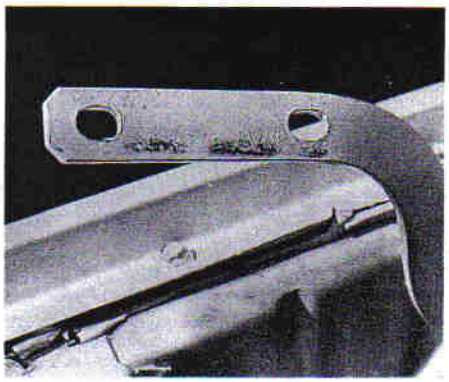
When carrying out bodywork repairs, remember that the quality of the finished job is proportional to the time and effort expended.



6.2A Removing the screws from a 45A model radiator grille ...

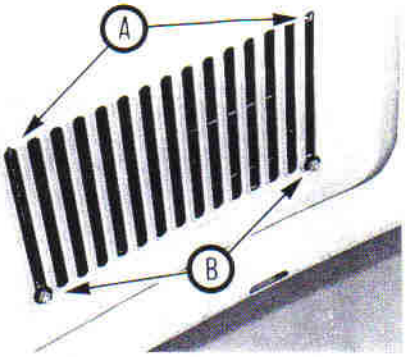
6.2B ... and a 513 model

7.4 Lifting off the bonnet on a 45A model



7.6 Bolt holes are elongated

7.7 Rubber buffer screwed into front panel (45/55/65 models)



7.9 Air inlet duct grille clips (A) and nuts (B)

3/4/5 series models

10 The bonnet is hinged at the front.
11 Follow the procedure given for 45/55/65 models with the following differences.
12 Remove the radiator grille as described in Section 6.
13 Open the bonnet and compress the lower ends of the prop inwards to release the stay from the bracket (photo).
14 Remove the bolts securing the hinge assemblies to the front panel and lift off the bonnet.
15 Refitting is a reversal of removal.

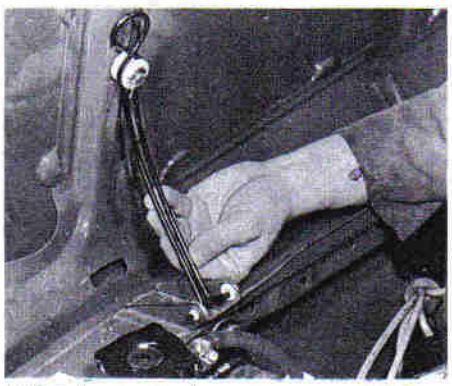
8 Bonnet lock assembly – removal and refitting

45/55/65 models

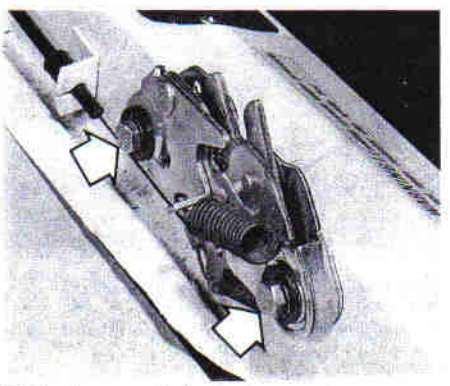
1 Open the bonnet.
2 Remove the two bolts securing the lock assembly to the front panel (photo).
3 Note that the bolt holes in the lock are larger than the bolts to allow for adjustment.
4 If the lock needs renewing, the lead seal securing the cable must be cut through to release the cable, and the cable must be crimped with a new seal on refitting.
5 Refitting is a reversal of removal, adjusting the lock so that the bonnet closes without having to slam it, but is held firmly closed.
6 The striker is welded to the bonnet.
7 The exterior release catch is bolted to the front panel (photo).
8 After the bonnet has been released using the interior release handle the exterior catch must be operated to release the bonnet.
9 Removal and refitting are self explanatory.

3/4/5 series models

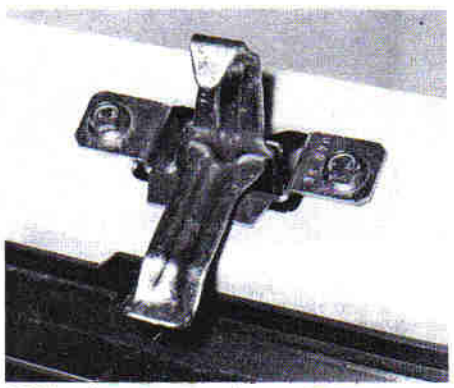
10 The same procedure applies as for the 45/55/65 models, but the lock assembly is bolted to the spare wheel support bracket by two bolts (photo).



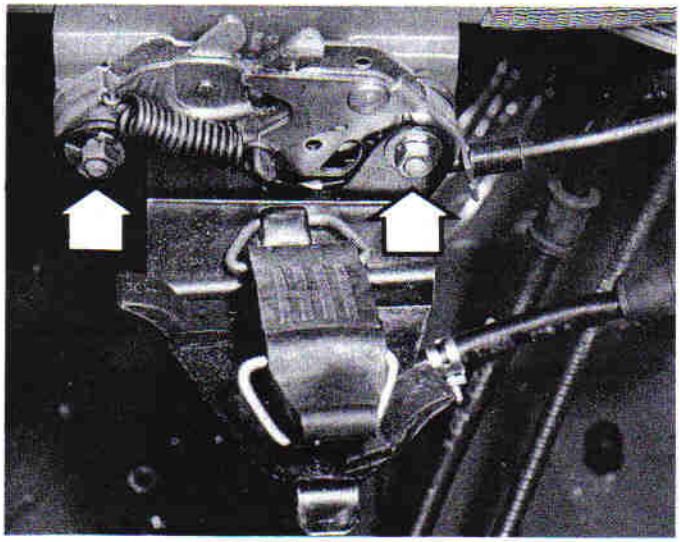
7.13 Releasing the bonnet stay on a 3/4/5 series model



8.2 Lock assembly bolts (arrowed)



8.7 Exterior release catch on a 45/55/65 model

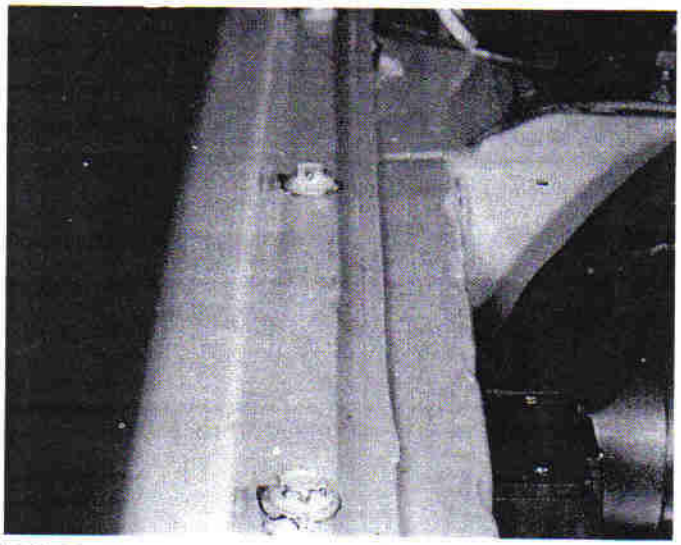


8.10 Bonnet lock assembly on a 3/4/5 series model

9.2 Removing the plastic pin from the bonnet release handle

9 Bonnet release cable – renewal

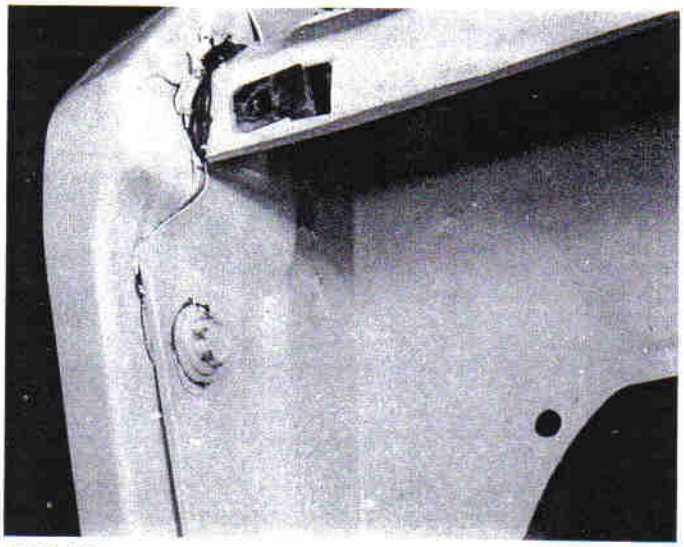
1 Should the bonnet release cable break, it can be renewed as follows.
2 Remove the plastic pin from the release handle by prising it out (photo).
3 Release the cable from the handle.
4 On 45/55/65 models remove the radiator grille and release the bonnet catch by prising with a screwdriver.
5 On 3/4/5 series models this is a bit more difficult. Access will have to be gained from underneath the engine.
6 Once the bonnet is open, cut through the cable where it is attached to the lock.
7 Pull the cable through the bulkhead into the engine compartment.
8 Feed the new cable through the bulkhead into the vehicle interior and attach it to the release handle.
9 Refit the handle pivot pin.
10 Feed the other end of the cable to the lock mechanism, hook it around the release lever and crimp the lead seal around it having pulled the cable almost taught.
11 Check the operation of the cable and release mechanism on completion.



10.6A Top row of bolts securing the wing to the body

10 Front wing – removal and refitting

1 The front wings are bolted on on all models. The procedure given here is specific to a Yugo 45, but the general procedure to be followed is similar on all models, although the securing bolts may not all be in the same positions.
2 Remove the front air dam where fitted, and the front bumper.
3 Disconnect the side repeater light (see Chapter 12).
4 Remove the headlamp (see Chapter 12).
5 Remove the wheel arch panels.
6 Work around the wing removing the securing bolts/screws which hold the wing to the body (photos). There are bolts in the door recess and also one accessible only from inside the vehicle after removing the front carpet from the footwell.
7 Cut around the sealing mastic and gently pull the wing clear of the vehicle (photo).
8 Apply protective underseal to the inside surface of the new wing.
9 Repair any paintwork damage on the vehicle inner wing and apply a bead of mastic where the wing fits.
10 Fit the new wing and secure in place with the retaining bolts and screws.
11 Apply matching paint finish to the wing and sealant bead.
12 Refit those components removed in earlier paragraphs.

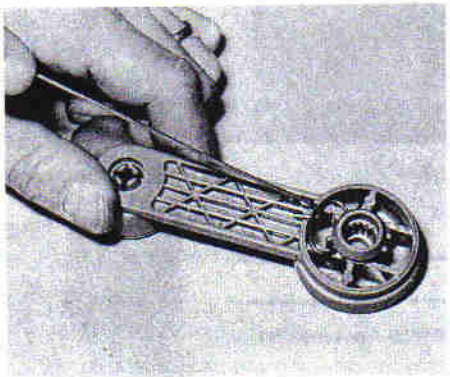


10.6B Wiring securing bolt inside headlamp housing (45/55/65 model)

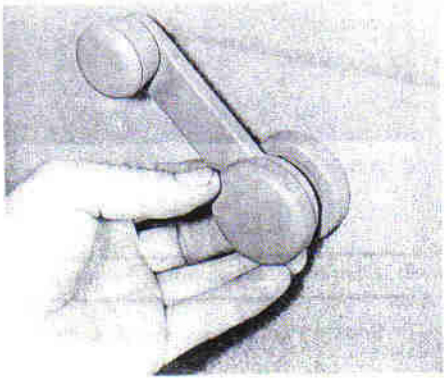
11 Door trim panels – removal and refitting

1 The front and rear door trim panels are similar on all models and the following procedure applies equally to all models.
2 Open the door and remove the armrest securing screws.
3 Pull the rear end of the armrest away and disengage the front end from the door release handle.
4 If fitted, remove the screws from the door bin and withdraw the bin. On some models this incorporates a speaker which must be disconnected.
5 Remove the spring clip from the window winder handle using a length of stout wire bent into a hook. The photograph shows this being done with the handle already removed to demonstrate the operation (photo).
6 Pull off the handle and trim plate (photos).
7 Pull the ashtray from its holder, then remove the plastic screw securing the holder to the door and remove the holder (photo).
8 The trim panel is secured to the door by self-tapping screws and/or plastic plugs. Unscrew the screws and use circlip pliers or a forked tool as shown to remove the plugs. These are easily broken and it is as well to have a supply of replacements available (photos).
9 Lift off the trim panel, disengaging it from the release handle, and disconnecting the speaker wires if door-mounted speakers are fitted (photos).
10 Under the trim panel, a plastic moistureproof sheet will be found, and it is important that the sheet is kept intact for refitting. It is stuck to the door with mastic and should be peeled off carefully. Note that the lower edge of the sheet is tucked inside the lower door frame when refitting.
11 Refitting of the trim panel is a reversal of removal.

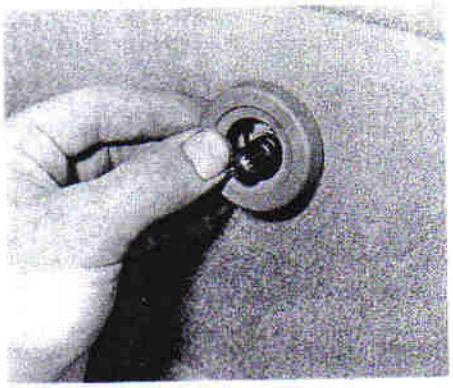
10.7 Lifting the wing from a 45 model



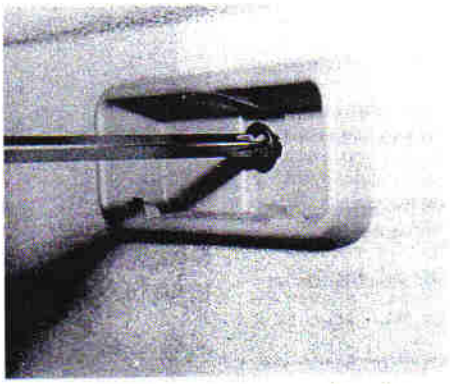
11.5 Pulling out the spring clip from a window winder handle (handle removed for clarity)



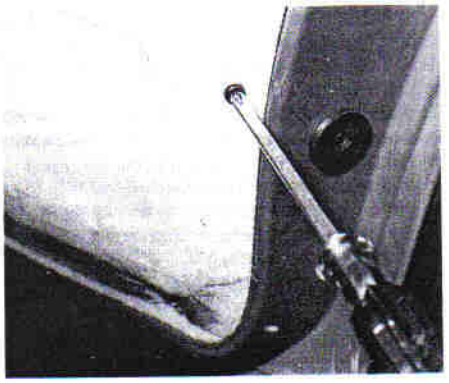
11.6A Pull off the handle ...



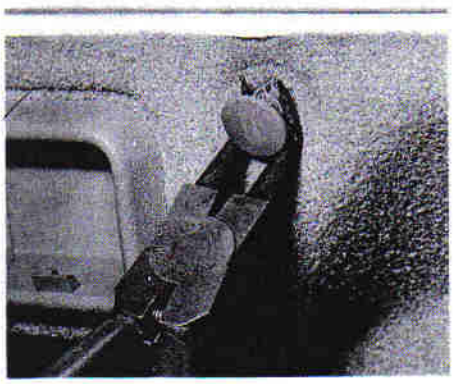
11.6B ... and trim plate



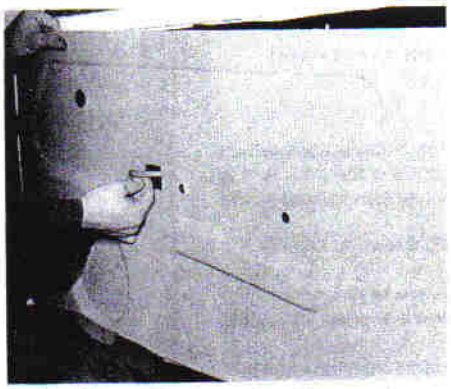
11.7 Removing the plastic screw from the ashtray holder



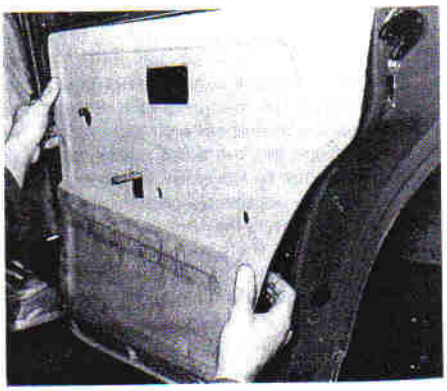
11.8A Removing a self-tapping screw from a door trim panel



11.8B Using circlip pliers to remove plastic plugs



11.9A Lifting off a front door trim panel ...



11.9B ... and a rear door trim panel

12 Doors – removal and refitting

1 Open the door and support it on a jack with a padded head.
2 Where fitted, disconnect the speaker leads.
3 Remove the bolts from the door check spring in the door, then compress the spring to release it from the bodyside bracket (photos).
4 With the door supported by an assistant, undo the hinge bolts from the upper and lower hinges and remove the door (photo).
5 Once the door is removed, the bolts securing the hinges to the bodywork can be undone and the hinges removed.
6 If the hinges are worn it is best to renew the complete hinge assemblies.
7 Refitting is a reversal of removal, adjusting the door lock striker so that the door closes firmly without slamming.

13 Door fittings – dismantling and reassembly

1 Remove the door interior trim panel as described in Section 11.

Lock striker plate

2 Before removing the striker plate make an alignment mark across it and the door frame.
3 Extract the screws securing the plate to the bodywork and withdraw the plate. Use an impact driver if they are tight (photo).
4 Refitting is a reversal of removal, lining the plate up with the marks made previously.
5 If the striker plate needs adjusting, loosen the securing screws and move it accordingly so that the door closes without slamming but is held firmly closed.

Door latch

6 Disconnect the lock and lock button operating rods.
7 Remove the screws from the interior release handle and withdraw the handle (see paragraph 10).
8 Remove the screws securing the latch assembly to the door. There are two screws on 45/55/65 models and three on 3/4/5 series models. Use an impact driver if they are tight (photos).
9 The assembly, including the release handle rod can now be removed from the door.
10 Refitting is a reversal of removal.

Interior release handle

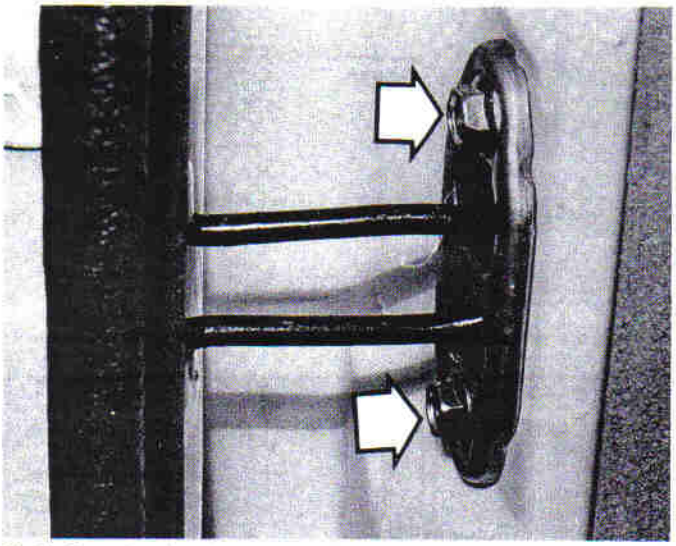
11 Remove the handle securing screw (photo).
12 Pull the handle and backplate forwards and twist the handle to release it from the backplate (photos).
13 The handle can then be withdrawn through the lower, larger aperture.
14 The latch end of the rod can only be disconnected after removal of the latch as described earlier.
15 When refitting, adjust the tension in the operating rod by moving the handle assembly backwards or forwards in the elongated screw hole (photo).
16 Refitting is a reversal of removal.

Lock button

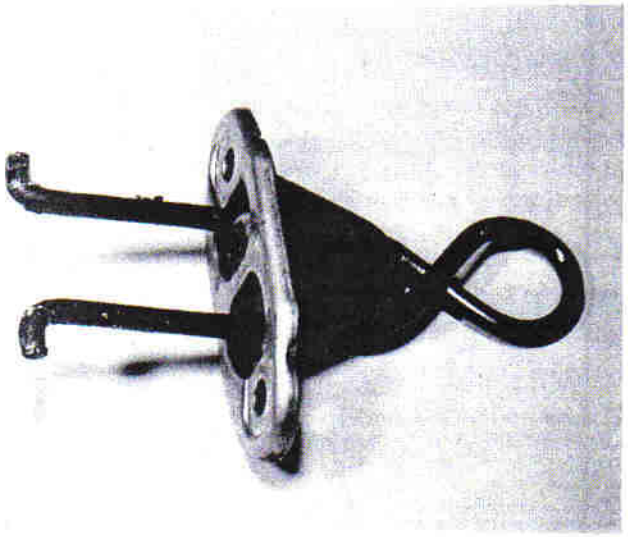
17 On 45/55/65 models, disconnect the operating rod at its lower end by unclipping the nylon clasp (photo).
18 Prise the lock button assembly and remove it along with the rod (photo).
19 On 3/4/5 series models, disconnect the lower end of the rod as described previously, unscrew the lock button and withdraw the rod.
20 Refitting is a reversal of removal.

Exterior handle and door lock

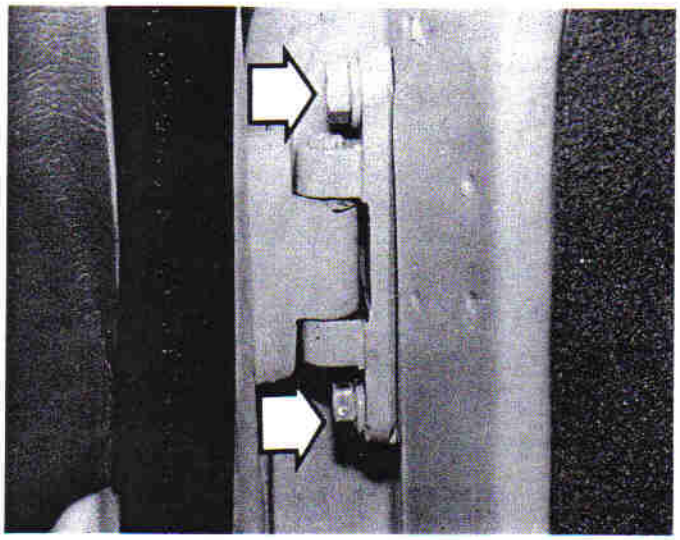
21 Disconnect the lock operating rod by pulling off the plastic ball end fitting (photo).
22 Remove the two nuts on the inside of the door skin and withdraw the handle and lock assembly.
23 If the lock is defective, renew the complete handle.
24 If a new key is needed, the lock serial number can be found on the inside of the lock barrel (photo).
25 Refitting is a reversal of removal.



12.3A Door check spring securing bolts (arrowed)



12.3B Door check spring removed



12.4 Front door hinge bolts (arrowed)

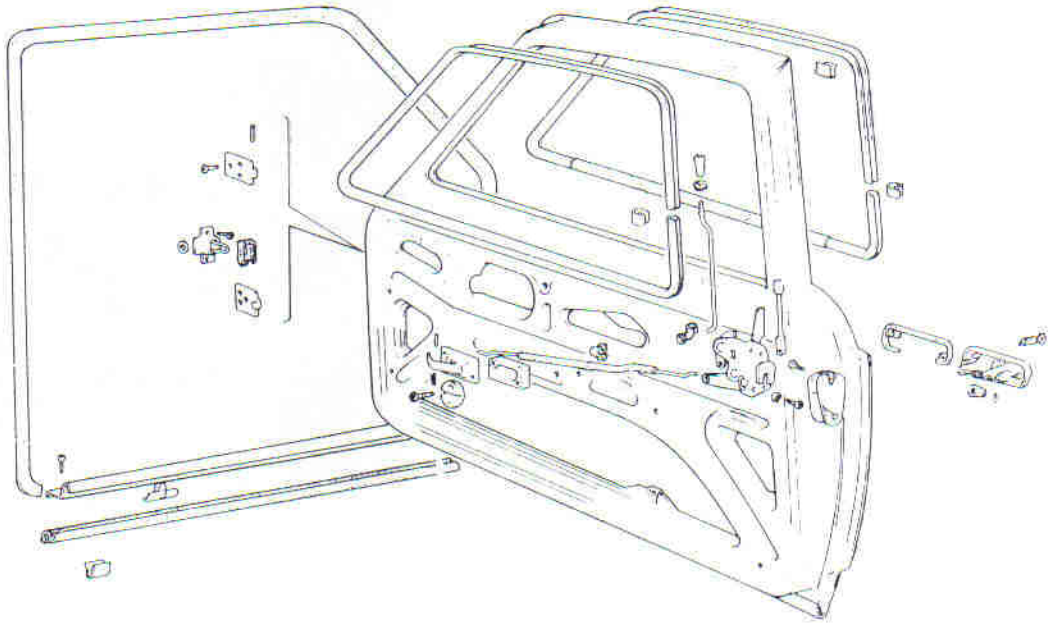


Fig. 11.1 Typical front door fittings (Sec 13)

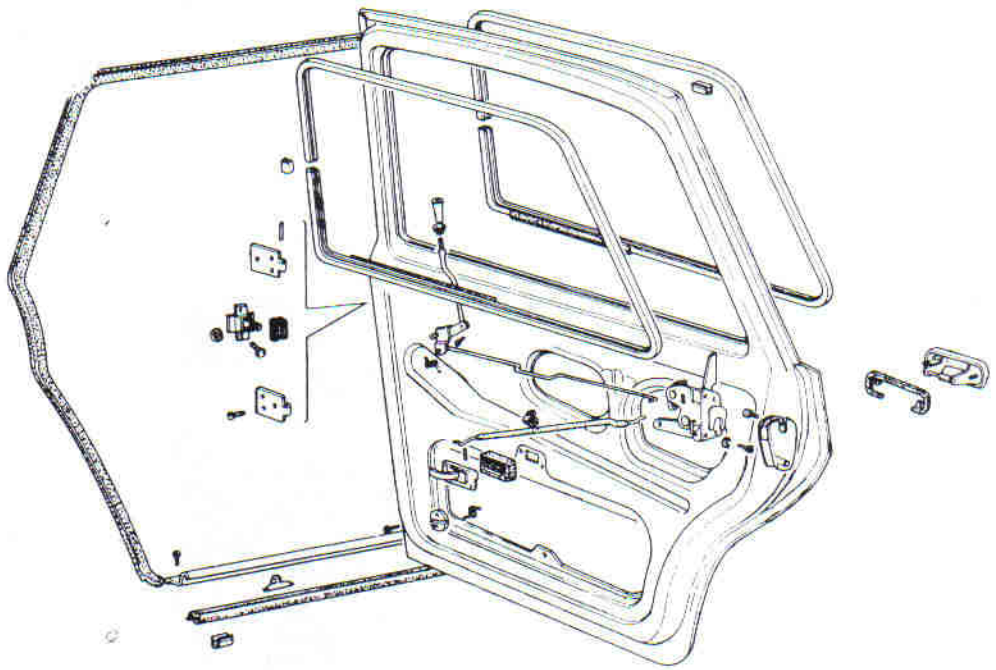
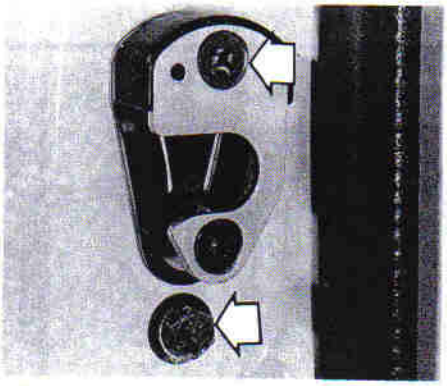
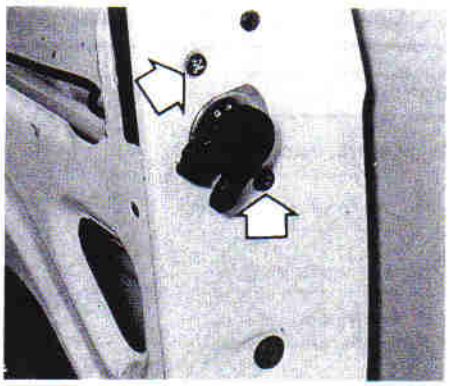


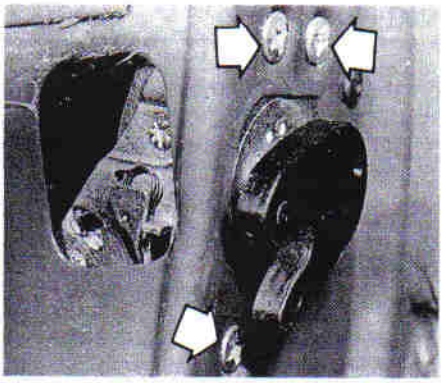
Fig. 11.2 Typical rear door fittings (Sec 13)



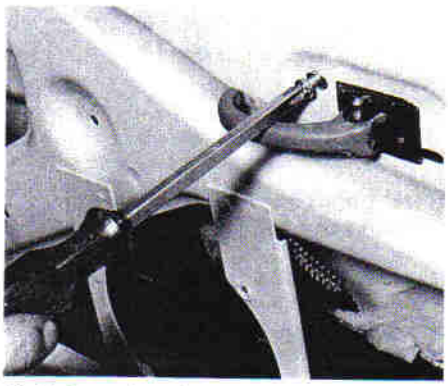
13.3 Striker plate retaining screws (arrowed)



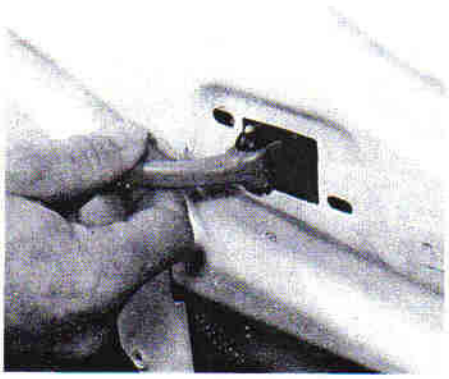
13.8A Door latch securing screws (arrowed) on a 45/55/65 model ...



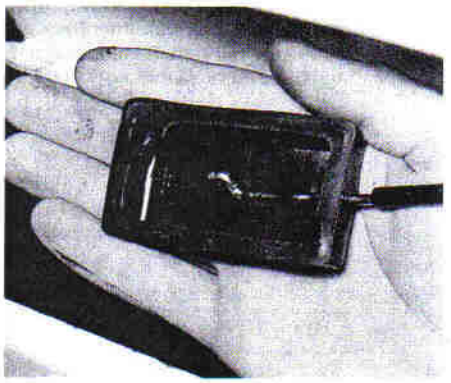
13.8B ... and on a 3/4/5 series model



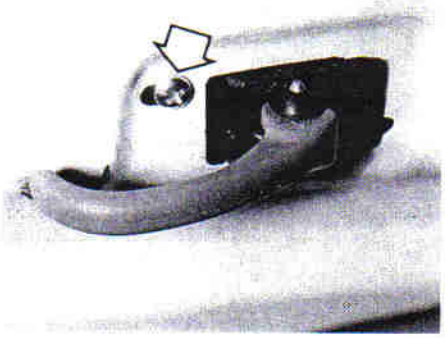
13.11 Removing the handle securing screw



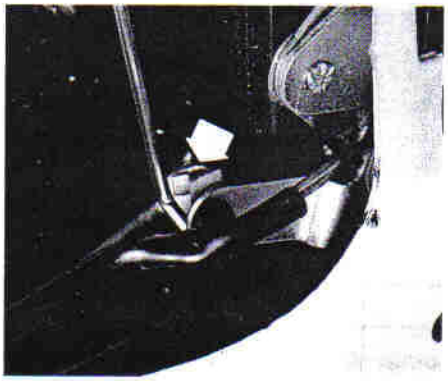
13.12A Pull the handle forward and twist ...



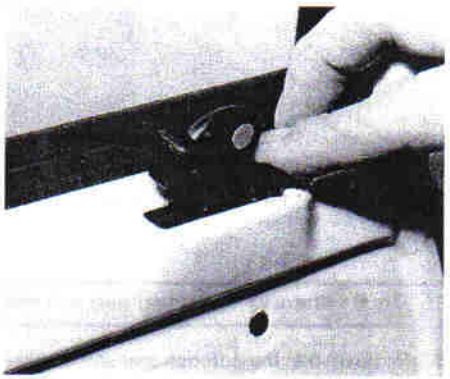
13.12B ... to release it from the backplate



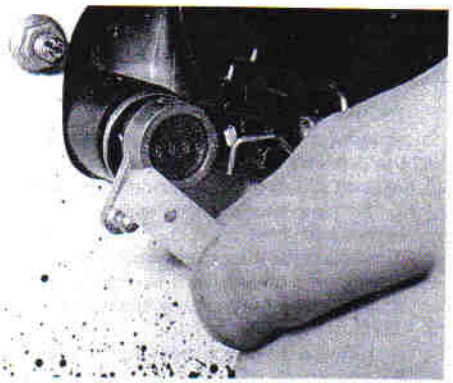
13.15 Elongated screw hole (arrowed) for adjusting the operating rod tension



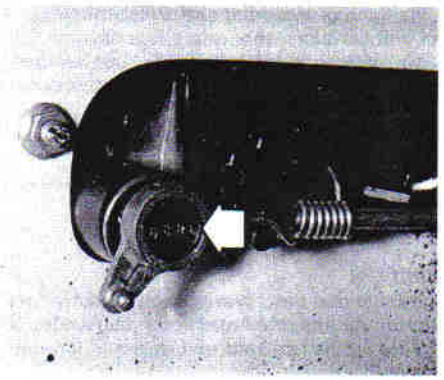
13.17 Unclip the nylon clasp (arrowed)



13.18 Prise out the lock button



13.21 Pulling the plastic ball end fitting from the lock



13.24 Lock serial number (arrowed)

14 Door quarterlights – removal and refitting

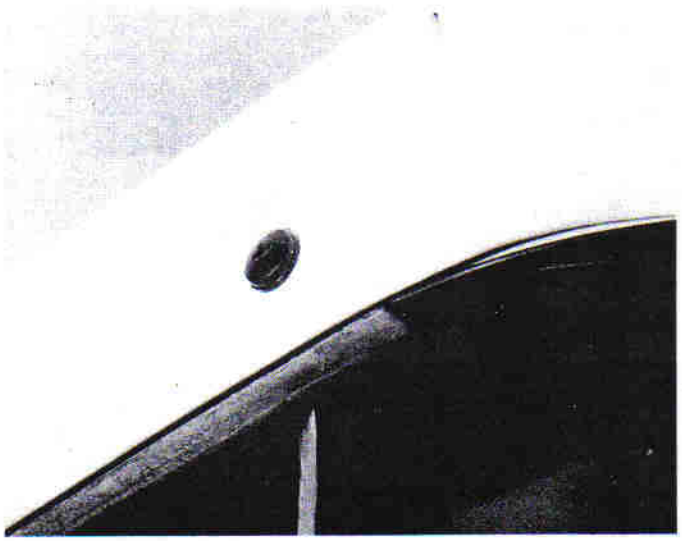
1 Remove the interior trim panel from the door as described in Section 11.

Fixed type

2 Fully lower the front window.
3 Remove the screws securing the front lower window guide channel to the door and remove the channel.
4 Remove the screws from the upper part of the window channel (photo), pull back as much as is necessary of the weather stripping and remove the channel.
5 The front quarterlight can now be manipulated from the door.
6 Refitting is a reversal of removal.

Opening type

7 Release the catch and open the window.
8 Remove the pinch-bolt from the lower swivel mounting bracket.
9 The quarterlight can now be manipulated from the door.
10 Refitting is a reversal of removal.



14.4 Upper window channel securing screw

15 Door windows – removal and refitting

1 Remove the interior trim panel from the door as described in Section 11.

Door with quarterlight

2 Remove the screws from the regulator assembly (photo).
3 If fitted, pull back the internal moistureproof sheet (photo).
4 Remove the screws and withdraw the front guide channel.
5 Support the window with a length of wood, then remove the remaining screws securing the regulator assembly to the door and release the nylon bush.
6 Remove the bolts from the window lift channel (photo).
7 Withdraw the regulator assembly from the door.
8 Remove the length of wood and manipulate the window out of the lower aperture in the door.
9 Refitting is a reversal of removal.

Door without quarterlight

10 The procedure is similar to that described previously, but where the window cannot be removed through the lower aperture because of the speaker mounting brackets, it must be removed upwards through the window aperture in the door.
11 In order to do this the weather stripping and rubber channelling in the window aperture of the door must be removed.
12 Refitting is a reversal of removal.

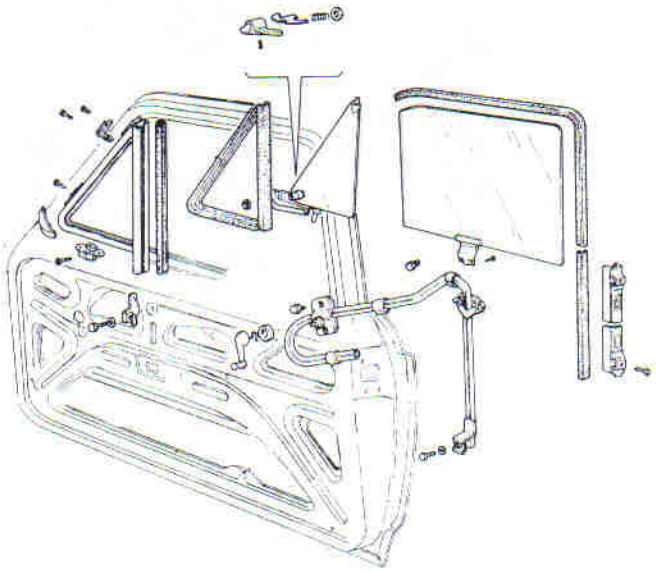


Fig. 11.3 Typical front door window assemblies (Secs 14 and 15)

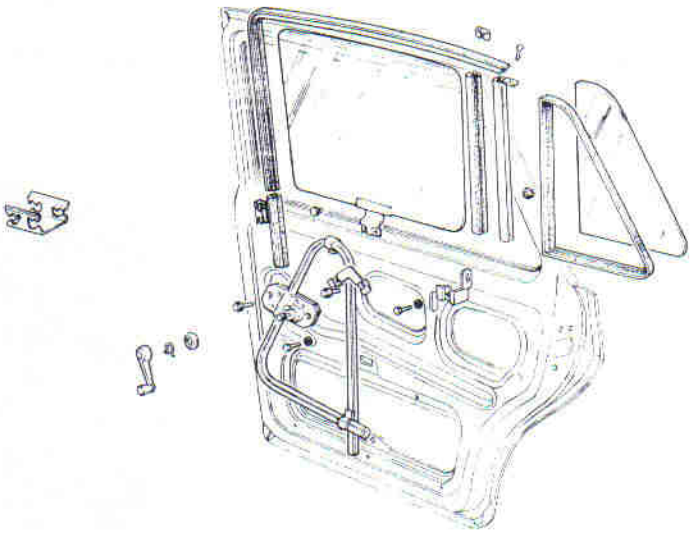
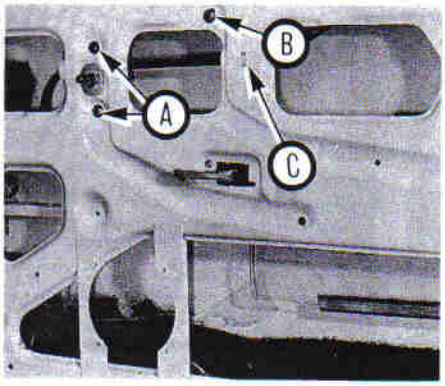


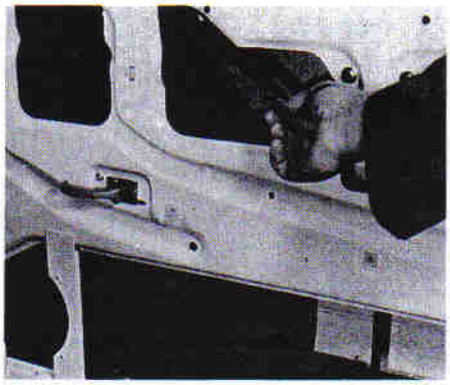
Fig. 11.4 Typical rear door window assemblies (Secs 14 and 15)

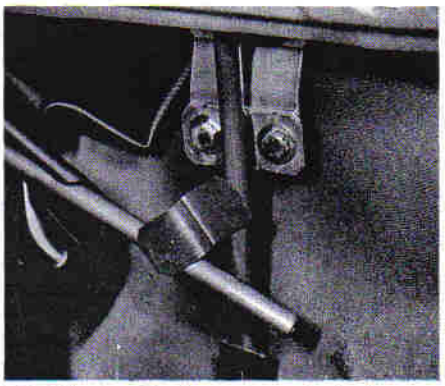
16 Windscreen glass – removal and refitting

1 The removal and refitting of the windscreen glass, although fairly straightforward, carries a high risk of breakage and it is better to have the work carried out by specialist windscreen fitters. For those who wish to do the job themselves proceed as follows.
2 Remove the interior rear view mirror, the tax disc and the wiper blades and arms.
3 If the glass is intact, go inside the car and pull the lip of the weatherseal downwards off the body metal all along the top edge.
4 Push the glass outwards while an assistant stands outside ready to catch it.
5 Clean the body flange and fit the weatherstrip to the glass.
6 Insert a length of strong cord in the body flange groove of the weatherseal so that the ends of the cord cross over at the centre of the bottom run and hang out a few inches.
7 Brush soapy water onto the edge of the body flange and then offer



15.2 Regulator assembly screws (A), guide channel screw (B) and nylon bush (C)


15.3 Pull back the moistureproof sheet


15.6 Window lift channel securing bolts

the glass to the body so that the bottom edge of the rubber seal engages over the metal flange.
8 With an assistant pressing on the outside of the glass, go inside and pull the cords evenly. This will draw the lip of the weatherseal over the body flange and seat the glass.
9 Tap the glass with the palm of the hand to settle it.
10 If the weatherseal is in good condition, then it should prove waterproof, but if there is any doubt, apply sealant with a gun between the rubber and the glass and the rubber and the body flange.
11 Refit the mirror, tax disc and wiper.

17 Tailgate glass – removal and refitting

The operations are very similar to those described for the windscreen, but disconnect the leads from the heater element terminals, and remove the wiper arm where fitted.

18 Fixed rear window glass – removal and refitting

The procedure is similar to that described for the windscreen, but disconnect the leads from the heater element terminals.

19 Hinged rear window – removal and refitting

1 Open the window and have someone support it.
2 Using circlip pliers, undo the lockring and release the catch from the window (photo).
3 Pull the window downwards and rearwards to release it from the lugs in the bodywork (photo). Do not pull the window out too far from its normal range of movement, or the lugs will be damaged.
4 To remove the lugs from the window undo the large screw (photo).
5 To remove the catch from the bodywork, undo the three screws (photo).
6 Renew the catch if any part is defective.
7 Refitting is a reversal of removal.

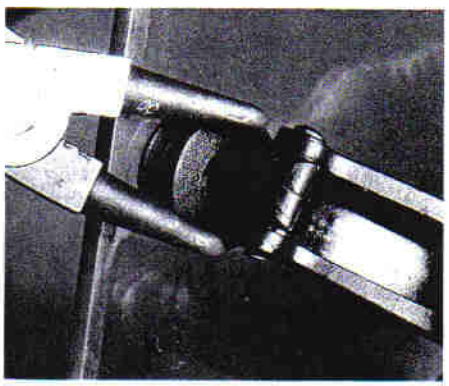
20 Tailgate – removal and refitting

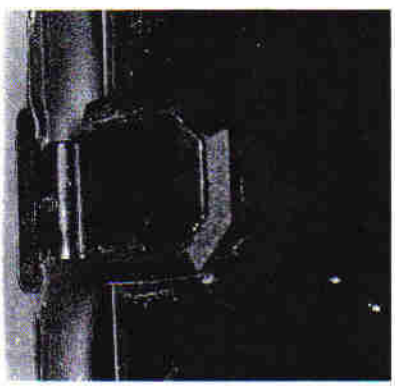
45/55/65 models

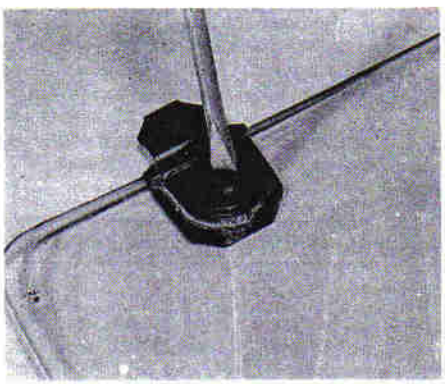
1 Open the tailgate and prop it in the open position using suitable lengths of wood.
2 Disconnect the wiring looms to the rear wiper, rear screen heater and numberplate lights.
3 The cables must now be pulled out of the tailgate and it is necessary to disconnect the cable ends from the multi-plug connector to do this.
4 Prise out the spring clip from the ball end on the gas strut and pull the joint from the ball stud (photos).
5 If the struts need renewal, the other end is secured to the bodywork by a screw.
6 Remove the tailgate hinge bolts and lift off the tailgate (photo).
7 Refitting is a reversal of removal, adjusting the lock and striker as described in Section 21.

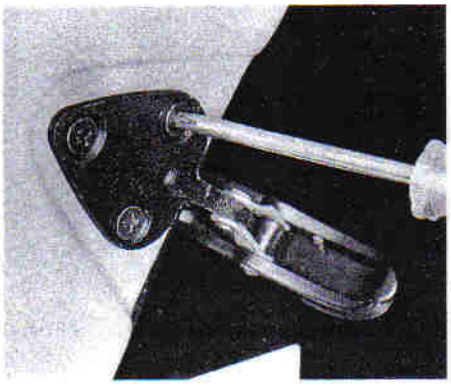
3/4/5 series models

8 Follow the same procedure as for 45/55/65 models, but there is only the screen heater cable to disconnect.
9 The hinge bolts are readily accessible (photo).
10 Refitting is a reversal of removal, adjusting the lock and striker as described in Section 21.

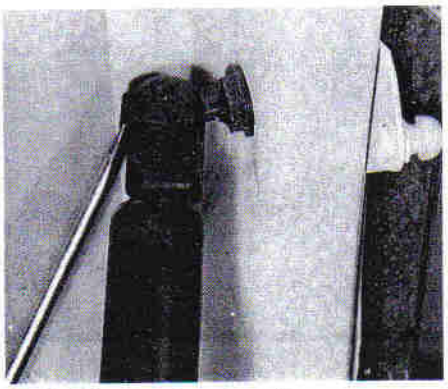

19.2 Using circlip pliers to undo the lockring


19.3 Releasing a lug from the bodywork

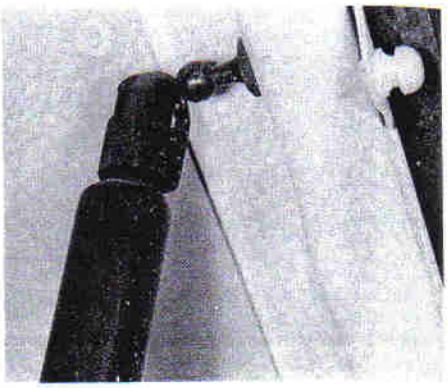

19.4 Removing a lug from a window



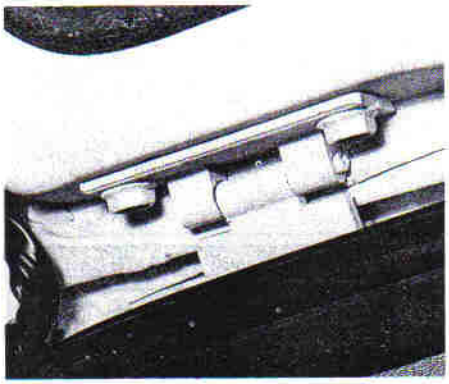
19.5 Removing the screws from the catch



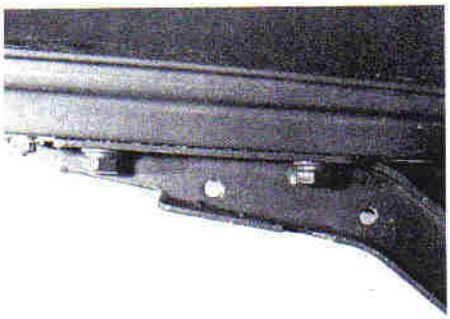
20.4A Prise out the spring clip ...



20.4B ... and pull the joint from the ball stud



20.6 Tailgate hinge bolts (45/55/65 models)



20.9 Tailgate hinge bolts on a 3/5 series model

21 Tailgate lock assembly – removal and refitting

45/55/65 models

1 Open the tailgate and remove the plastic trim panel from around the lock by undoing the two screws (photo).
2 Remove the bolts securing the lock to the tailgate and withdraw the lock assembly (photo).
3 If the lock is defective, renew the complete assembly.
4 The striker plate is bolted to the rear panel (photo).
5 Refitting is a reversal of removal, adjusting the lock and striker plate in the elongated holes so that the tailgate shuts without having to slam it, but is held firmly closed.

3/5 series models

6 Remove the plastic trim panel by undoing the screws (photo).
7 Remove the nuts securing the lock assembly to the tailgate and withdraw the lock from the tailgate (photo).
8 If the lock is defective, renew the complete assembly.
9 The striker plate is bolted to the rear panel.
10 Refitting is a reversal of removal, adjusting the lock and striker plate in the elongated holes so that the tailgate closes without having to slam it, but is held firmly closed.

22 Door-mounted rear view mirrors – removal and refitting

Fixed type

1 Early type fixed mirrors are secured to the door directly by two self-tapping screws, which when unscrewed allow the mirror to be removed.
2 On later types, remove the grub screw from the front edge of the mirror baseplate and lift off the mirror (photos).
3 The baseplate is secured to the door by two self-tapping screws.
4 If the mirror glass is broken, renew the complete mirror assembly.
5 The swivel action of the mirror can be adjusted by tightening the bolt in the mirror base (photo).
6 Refitting is a reversal of removal.

Internally adjustable types

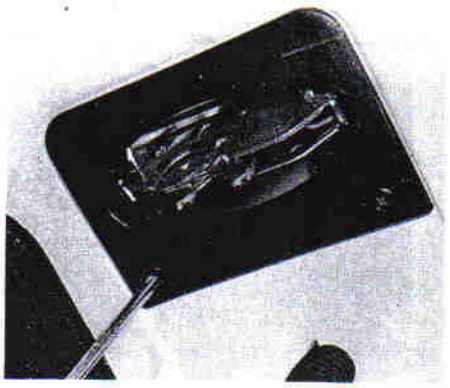
7 Different types of internally adjustable mirror may be encountered, the following being a general guide.
8 Pull the rubber outer cover off the lever (photo). On some types a plastic lever is fitted which is secured to the metal shaft by a grub screw.
9 Unscrew the lockring and remove it along with the washer (photos).
10 Withdraw the mirror from the door (photo).
11 To renew the mirror glass, remove the three screws from the base of the boss (photo).
12 Tap out the securing pin and pull off the boss (photos).
13 Remove the two screws in the base of the mirror and withdraw the mirror glass and control mechanism through the outer cover via the mirror glass aperture (photos).
14 Refitting is a reversal of removal.

23 Interior rear view mirror – removal and refitting

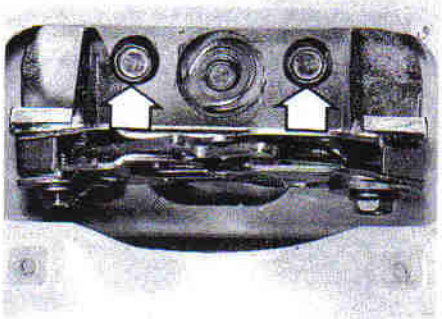
1 Remove the screws securing the mirror base to the roof and withdraw the mirror.
2 Refitting is a reversal of removal.

24 Sun visors – removal and refitting

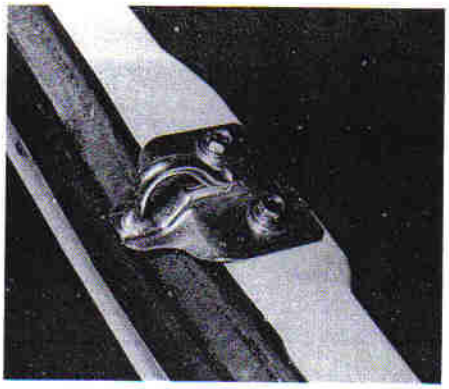
1 Remove the screws securing the visor to the roof and withdraw the visor.
2 Refitting is a reversal of removal.



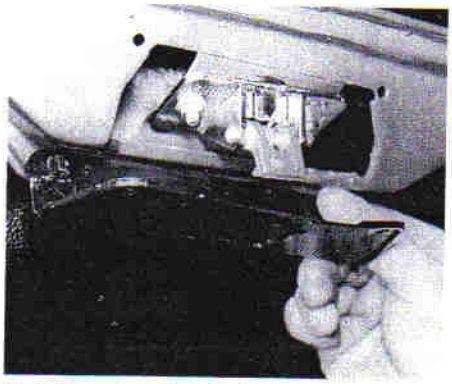
21.1 Removing a screw from the plastic trim panel



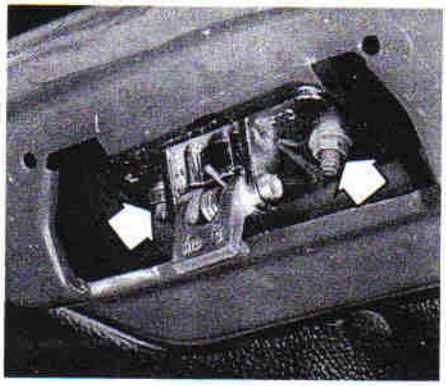
21.2 Tailgate lock securing bolts (arrowed) on a 45/55/65 model



21.4 Tailgate lock striker plate on a 45/55/65 model



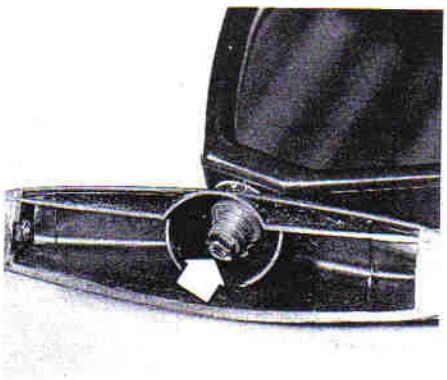
21.5 Removing the plastic trim panel on a 3/4/5 series model



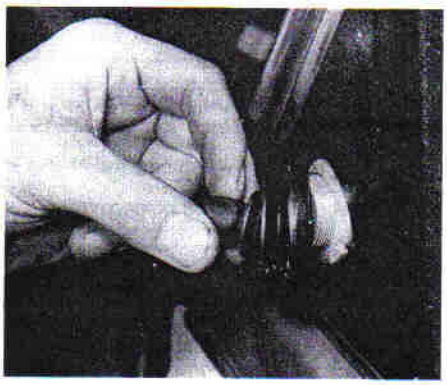
21.6 Tailgate lock securing nuts (arrowed) on a 3/4/5 series model

22.2A Remove the grub screw ...

22.2B ... and lift off the mirror

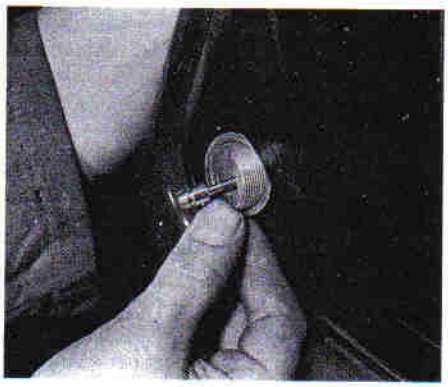


22.5 Adjusting bolt (arrowed) in base of mirror

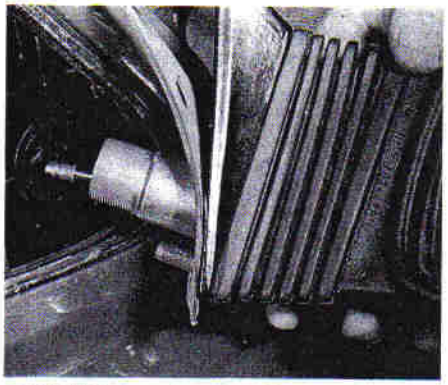


22.8 Pulling back the rubber cover

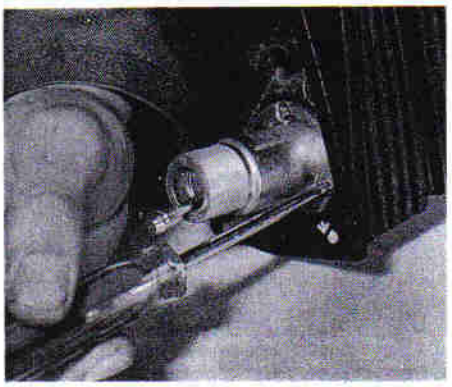
22.9A Unscrew the lockring ...



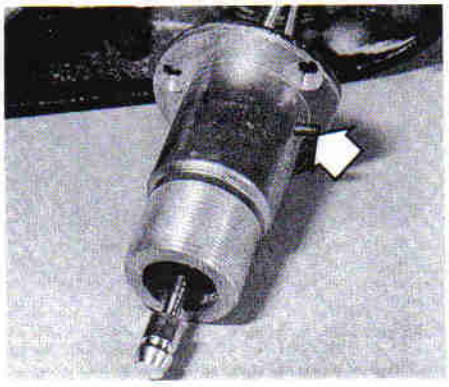
22.9B ... and remove the washer



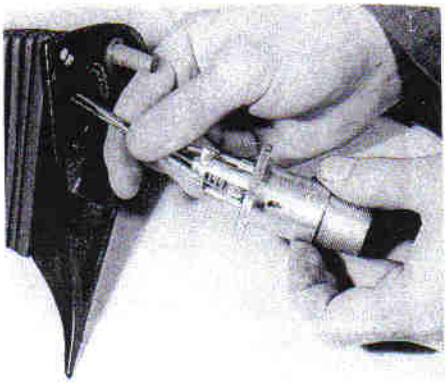
22.10 Withdraw the mirror from the door



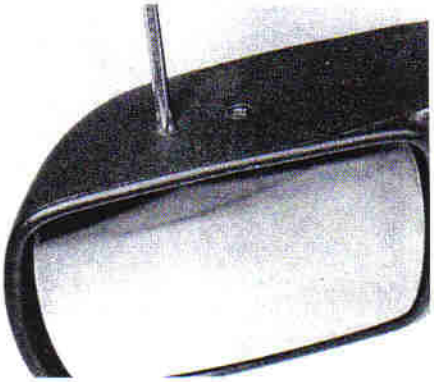
22.11 Removing the screws from the base of the boss



22.12A Securing pin partly withdrawn (arrowed)

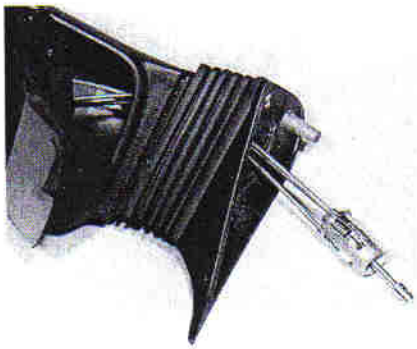


22.12B Pulling off the boss



22.13A Remove the screws in the base of the mirror ...

22.13B ... and withdraw the mirror glass ...



22.13C ... and control assembly

25 Interior grab handles – removal and refitting

1 Remove the screws securing the handle to the roof and withdraw the handle.
2 Refitting is a reversal of removal.

26 Centre console – removal and refitting

1 Where fitted, reach behind the console and disconnect the radio, digital clock and cigar lighter (refer to Chapter 12).
2 Remove the securing screws at each side of the console and withdraw it from the facia (photo).
3 Refit in reverse order.

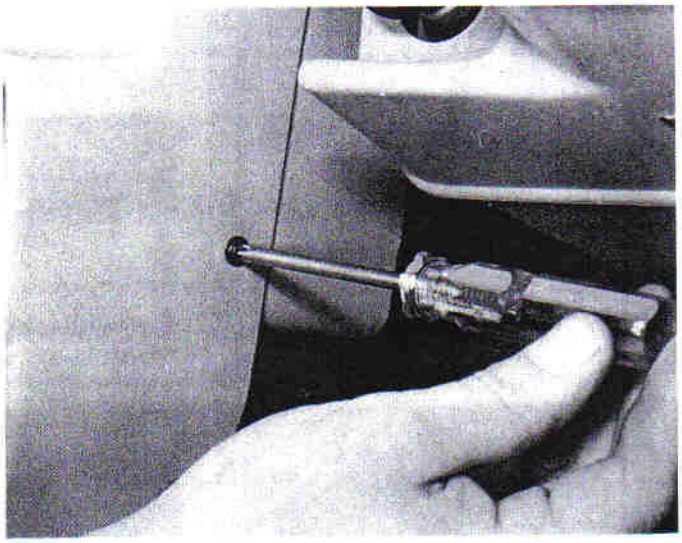
27 Floor-mounted console – removal and refitting

45/55/65 models

1 Remove the centre console as described in Section 26.
2 Undo the screws securing the console to the floor pan (photo).
3 Remove the screw from the console front edge previously hidden by the centre console.
4 Withdraw the console over the gear lever.
5 Refit in reverse order.

3/4/5 series models

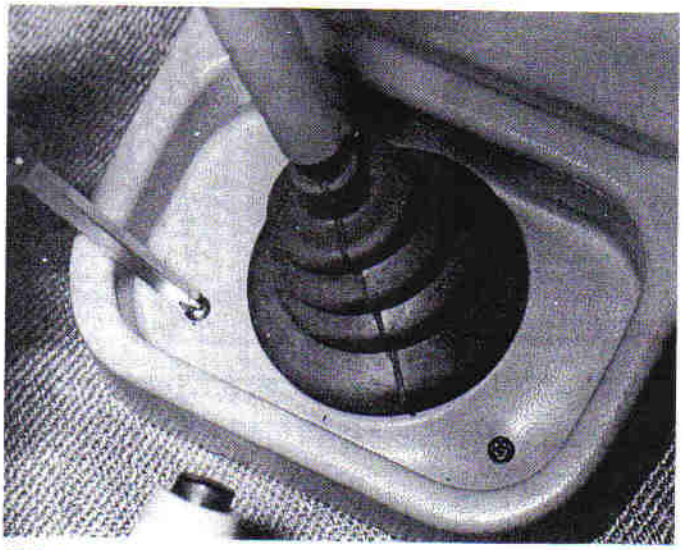
6 On early models the console is of different design, but its removal is similar to that described for 45/55/65 models, although the screws will be in different positions.
7 The gear lever gaiter may also need releasing from the gear lever.
8 On later models, the console is identical to the 45/55/65 models.
9 Refitting is a reversal of removal.



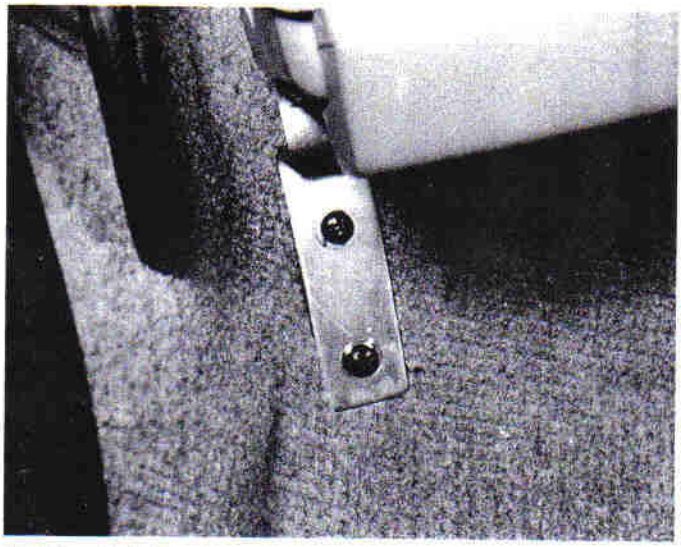
26.2 Removing a securing screw from the centre console

28 Front parcel shelf (45/55/65 models) – removal and refitting

1 Remove the two screws from the bracket at the outboard edge of the parcel shelf (photo).
2 Remove the inboard screw securing the shelf to the centre console.
3 Loosen the bolt on the rear bracket, free the shelf and withdraw it.
4 Refit in reverse order.



27.2 Removing a screw from the floor console



28.1 Parcel shelf outboard bracket

29 Glove box (3/4/5 series models) – removal and refitting

1 Remove the screws securing the top edge of the unit to the facia panel (photo).
2 Release the tongue from the bracket at the rear edge of the unit and withdraw the glove box.
3 Refit in reverse order.

30 Facia panel – removal and refitting

45/55/65 models

1 Remove the instrument panel as described in Chapter 12.
2 Remove the facia switches as described in Chapter 12.
3 Remove the centre console as described in Section 26.
4 Refer to Chapter 9 and remove the steering wheel, steering column switch gear and column shroud panels.
5 Remove the screws and withdraw the stowage box at the right-hand side of the facia (photo).
6 Remove the securing screws from the lower underside edge of the facia (photo).
7 Open the bonnet and remove the three nuts from the studs securing the facia to the scuttle. Access to these nuts is difficult as they are under the scuttle.
8 Gently prise and tap the facia panel upwards and outwards until it is free and withdraw it from the vehicle.
9 Refitting is a reversal of removal.

3/4/5 series models

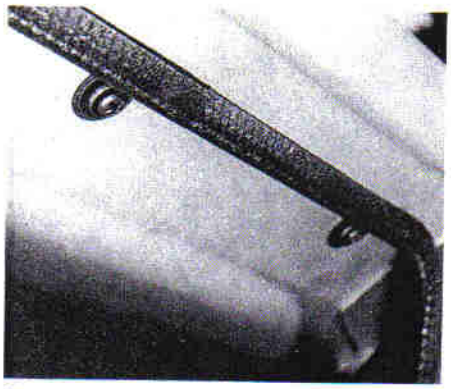
10 The procedure is basically as described for 45/55/65 models with the following differences.
11 On some models it is necessary to remove the screws from the heater control panel to release it from the facia.
12 Disconnect the cigar lighter (see Chapter 12).
13 Disconnect the choke cable (see Chapter 3).
14 Disconnect any warning lights in the facia (see Chapter 12).
15 Refitting is a reversal of removal.

31 Facia air vents – removal and refitting

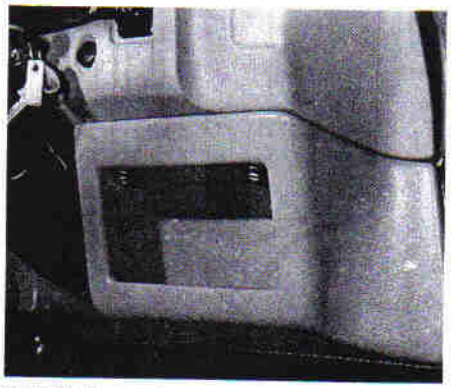
1 The facia air vents on all models are removed by prising them from their housings in the facia (photo).
2 Push them back in firmly to refit.

32 Front seats – removal and refitting

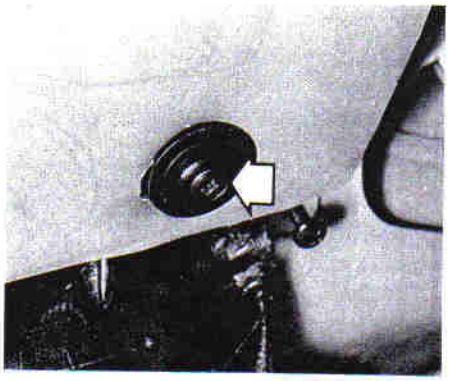
1 Slide the seats fully forward on their runners.
2 Remove the rear bolts securing the runners to the floor pan (photo).
3 On later models the bolts are of recessed Allen type and an Allen key will be required to remove them (photo).
4 Slide the seats fully rearward and repeat the operation on the front bolts (photos).



29.1 Glove box securing screws on a 3/4/5 series model



30.5 Right-hand stowage box securing screws on a 45/55/65 model



30.6 Lower underside facia securing screw (arrowed) on a 45/55/65 model

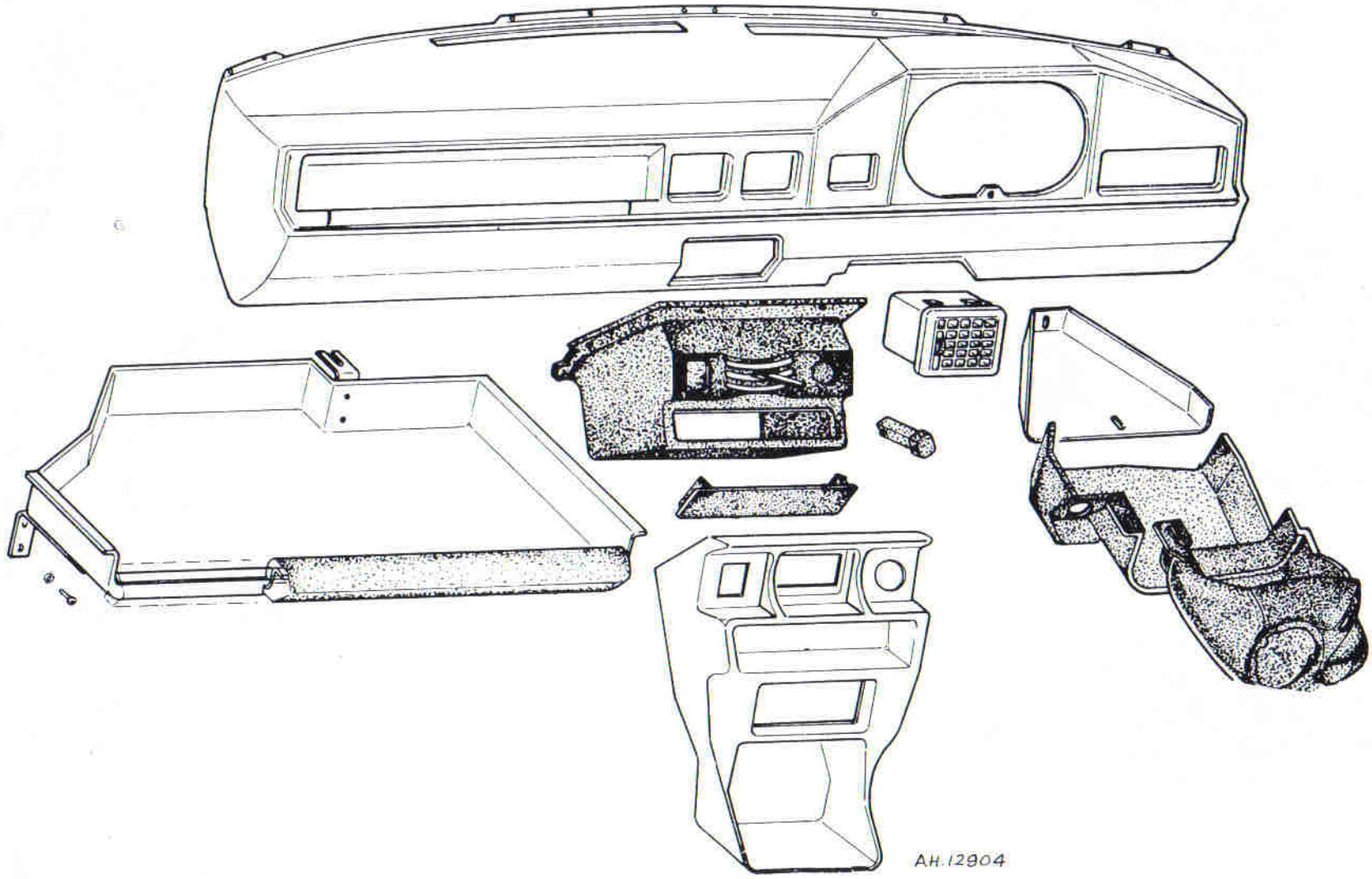


Fig. 11.5 Exploded view of facia panel of 45/55/65 models (Sec 30)

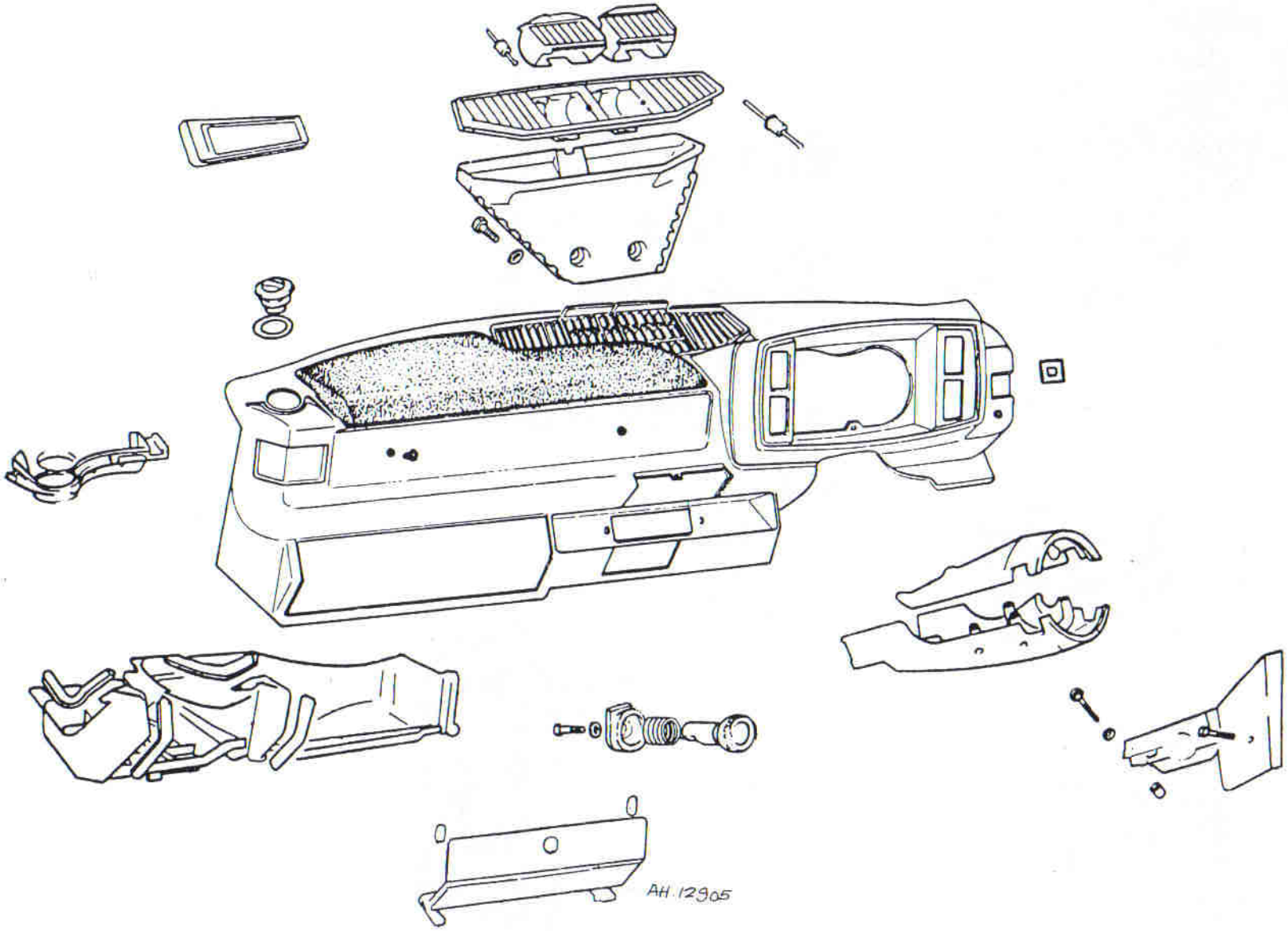
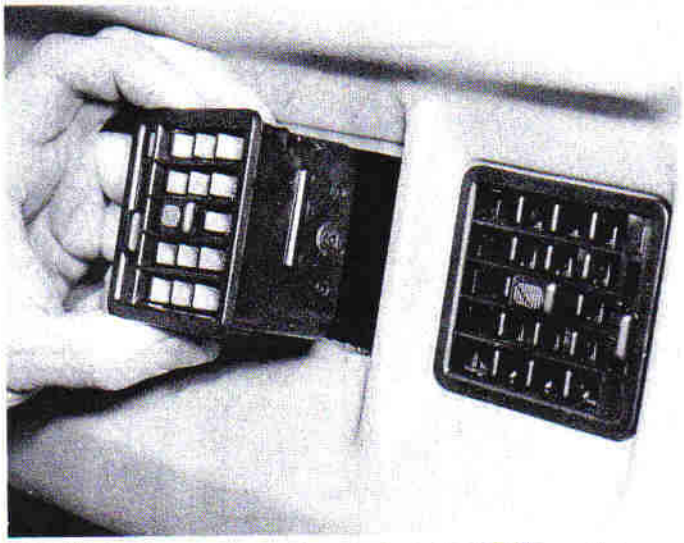
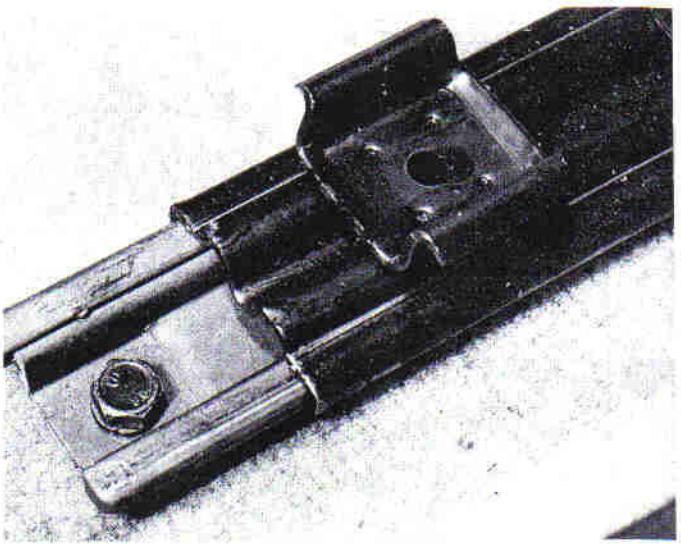


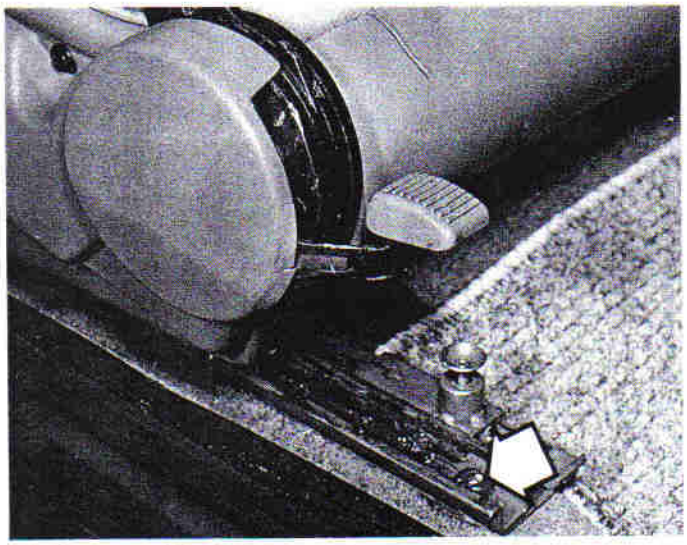
Fig. 11.6 Exploded view of facia panel of 3/4/5 series models (Sec 30)



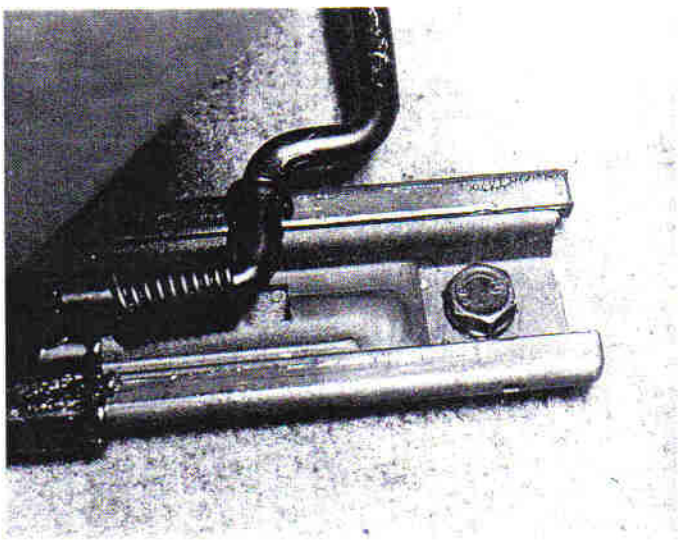
31.1 Withdrawing an air vent from the facia (45/55/65 models)



32 2 Seat runner rear securing bolt



32.3 Later type Allen bolt (arrowed)



32.4 Seat runner front bolt

5 Lift out the seats and runners.
6 The seats are either bolted to the runners, or secured to the runners by pins depending on model and can be removed for cleaning, overhaul and regreasing.
7 Repair of the various seat operating mechanisms and upholstery is best left to a dealer.
8 When refitting note that the seat stop fits under the nearside front seat-to-runner bolt, and that if there are thick and thin washers under the seat securing bolts, the thick ones go to the rear.

33 Rear seats – removal and refitting

45/55/65 models

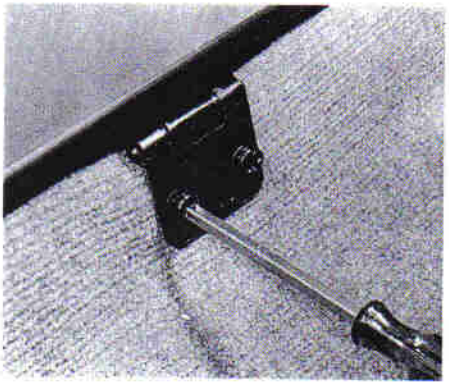
1 The rear seat is removed as one assembly (squab and backrest).
2 Remove the screws securing the seat squab hinge brackets to the floor pan in the passenger footwell (photo).
3 Remove the rear parcel shelf.
4 Prise out the plugs securing the carpet to the backrest and pull the carpet down.
5 Remove the bolt from the seat stay bracket on the backrest, then pull the stay from the bracket on the floor (photos).
6 Release the seat back catches and tilt the backrest forward.
7 Feed the rear seat belts (if fitted) through the seat between the backrest and squab and remove the complete seat assembly from the vehicle.
8 The hinges are screwed to the backrest and squab (photos).
9 To gain access to the seat catch mechanism, remove the plastic panel which is secured by screws (photo).
10 Remove the bolts and withdraw the catch (photo).
11 If the catch is defective, renew the complete mechanism.
12 Refitting is a reversal of removal.

3/4/5 series models

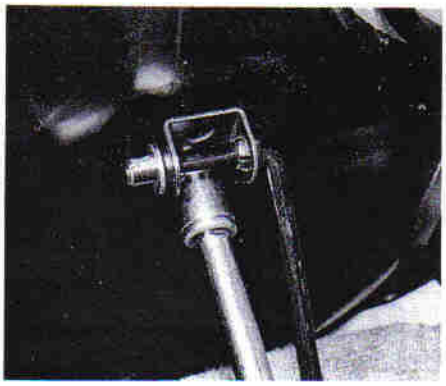
13 The basic procedure is similar to that for 45/55/65 models, but may vary between models, especially where the saloon version is involved.
14 The squab and back rest are removed separately.
15 Tilt the seat squab forwards and remove the screws from the hinges.
16 Lift out the squab.
17 Release the seat back catch and tilt the backrest forward.
18 Remove the screws securing the hinges and lift out the backrest.
19 Refit in reverse order.

Remote control cable – renewal

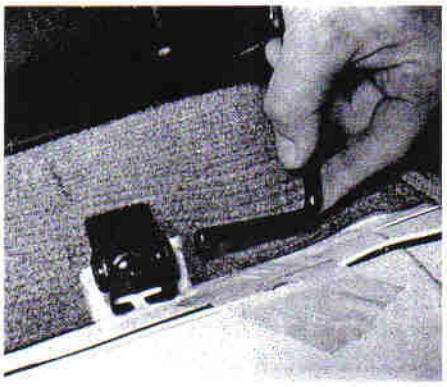
20 Release the catch end of the cable, removing the catch securing bolts if necessary.
21 Release the other end of the cable from the lever.
22 Fit the new cable in reverse order.



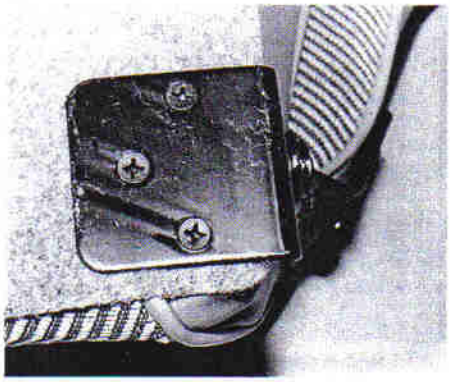
33.2 Removing a screw from the seat squab hinge bracket (45/55/65 models)



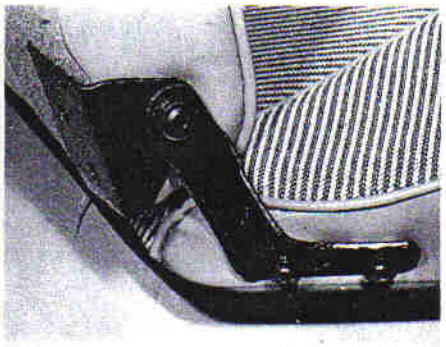
33.5A Removing the bolt from the seat stay bracket ...



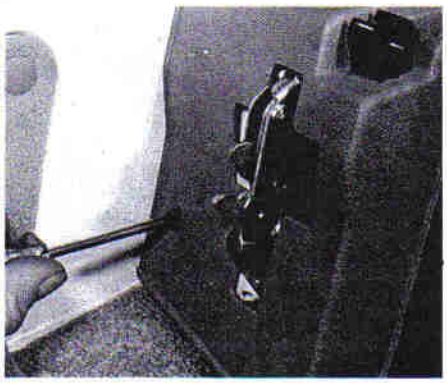
33.5B ... and releasing the stay



33.8A Hinge securing screws on the back rest ...



33.8B and seat squab



33.9 Undoing a screw on the seat catch cover panel

34 Seat belts – removal and refitting

Note: *Although this section covers all models, it is intended as a general guide. The fitted positions of the belt components may not be exactly as shown in the photographs on all models.*

Front centre stalks

1 Remove the plastic cap from the securing bolt head (photo).
2 Remove the bolt and withdraw the stalks.
3 If any of the wire strands are frayed the complete stalk(s) must be renewed.
4 Refitting is a reversal of removal.

Front belt lower anchorage

5 Remove the bolt from the front end of the anchor bar and detach the rear end from its locating hole (photos).
6 Refitting is a reversal of removal.

Front belt upper anchorage

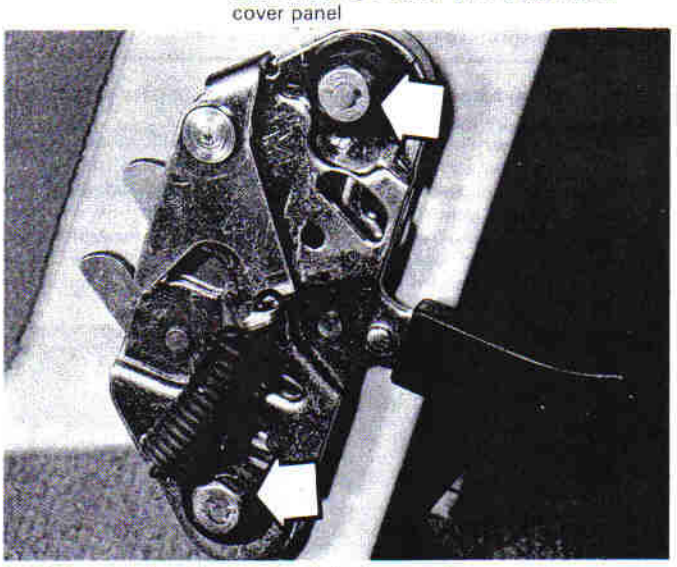
7 Prise off the plastic cover and remove the anchor bolt.
8 Refitting is a reversal of removal.

Front inertia reel units

9 To gain access to the inertia reel unit the interior side panel must be removed which on some models will involve removal of the rear seats.
10 Remove the anchor bolt from the inertia reel and withdraw the unit (photo).
11 Refitting is a reversal of removal.

Rear lap straps

12 Better access is obtained if the seats are either removed or tilted out of the way.
13 Prise off the caps from the bolt heads and undo the bolts to withdraw the straps.
14 The outer strap is bolted to the side of the footwell.
15 Refitting is a reversal of removal.



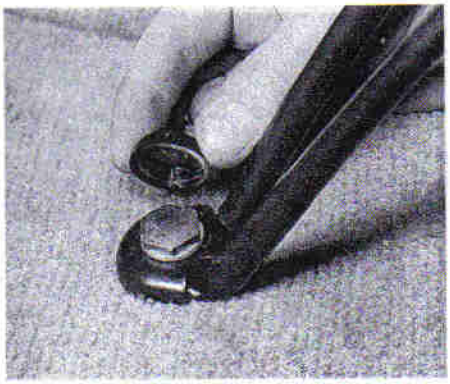
33.10 Seat back catch securing bolts (arrowed)

Rear upper anchorage

16 Prise out the cap from the anchorage cover (photo).
17 Remove the nut and withdraw the belt (photo).
18 Refitting is a reversal of removal.

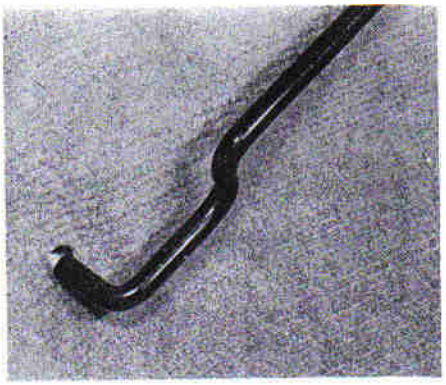
Front and rear belts – inspection

19 Inspect the belts for fraying, cuts and splits and for contamination by oil or grease which rots nylon. The belts must be renewed if any of these conditions exist.
20 Belts can be washed in a mild detergent solution and dried thoroughly before refitting.
21 Seat belts which have been subjected to severe impact usage must also be renewed.

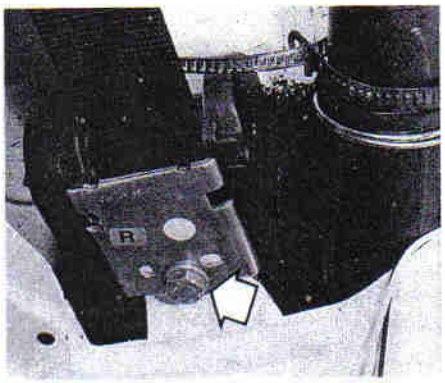


34.1A Removing plastic cap from bolt head

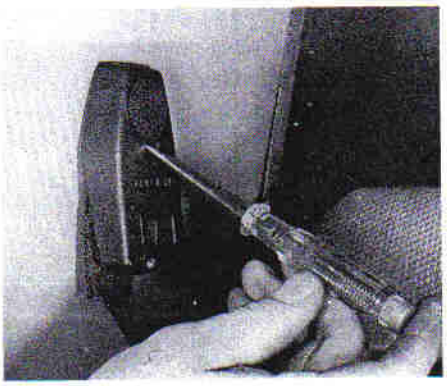
34.5A Remove the bolt from the front end



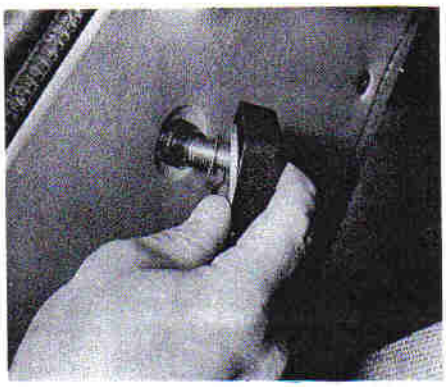
34.5B ... and detach the rear end of the anchor bar



34.7 Front inertia reel anchor bolt (arrowed)



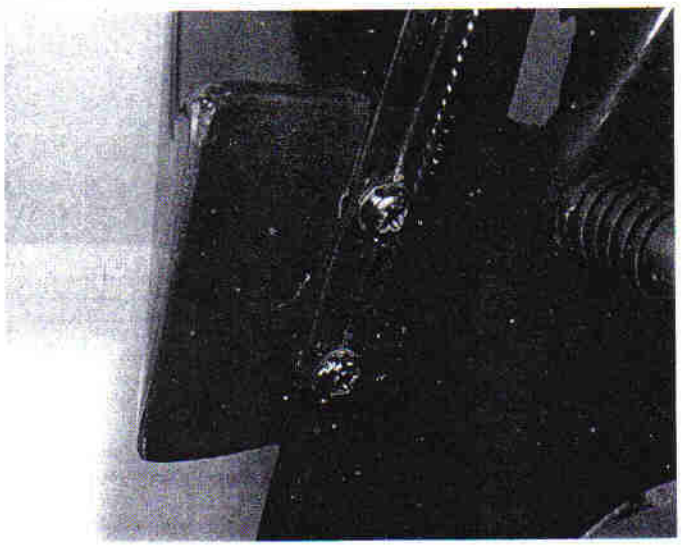
34.16 Prise out the cap



34.17 Withdraw the belt

35 Rear spoilers – general

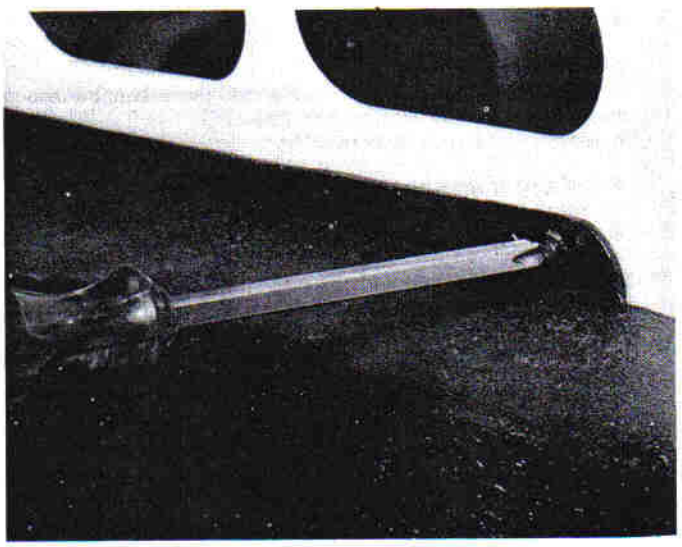
1 Both the tailgate and roof spoilers may be bonded to the bodywork or attached by double-sided sticky tape.
2 Additionally, as is the case with the 65A GLX model, the tailgate spoiler may be attached by two screws at either end (photo).
3 Removal of the spoilers is eased if the bonded areas are first warmed using gentle heat from a heat gun or hair drier.
4 When refitting, follow the manufacturer's instructions regarding bonding agents and ensure components are correctly positioned before finally pressing into place.



35.2 Tailgate spoiler securing screws (65A GLX model)

36 Front and rear air dams and side skirts – general

1 These components are attached to the bodywork or bumpers using self-tapping screws, rivets and/or bonding agent or double-sided tape (photo).
2 To remove the side skirts drill out the rivets, then refer to Section 35 for hints on removal of bonded components.
3 On some models the air dams are fixed using self-tapping screws. Where this is the case, undo the screws and remove the air dam.
4 On models where the air dams are integral with the bumpers, refer to Section 37.



36.1 Removing an air dam securing screw (45A model shown)

37 Bumpers – removal and refitting

1 On all models first refer to Chapter 12 and remove any side, fog, reversing or driving lights fitted in the bumper.
2 Where fitted, remove the wheel arch panels.

45/55/65 models – front

3 Remove the nuts from the side fixings securing the wrap-around sections to the front wings.
4 Where it is fitted independently, remove the self-tapping screws from the front air dam and remove it.
5 On some models the air dam is integral with the bumper. Note that on some models the air dam is riveted to the front wheel arches and to the front valance by metal straps. Where this is the case, drill out the rivets (photos).
6 Remove the bolts securing the bumper support brackets to the main chassis members and withdraw the bumper (photo).
7 The air dam and bumper are secured to the bumper brackets by studs and nuts (photo).
8 Refitting is a reversal of removal.

45/55/65 models – rear

9 The procedure is basically as described for the front bumpers.
10 Access to the bumper support bracket bolts can be gained after pulling back the carpet in the boot space, which will reveal two rubber plugs.
11 Prise out the plugs and remove the bolts (photo).
12 Refitting is a reversal of removal.

3/4/5 series models – front

13 Follow the procedure as for 45/55/65 models, but remove the bumper from the bumper support brackets by undoing the nuts at the rear of the bumper, and not by removing the brackets with the bumper (photo).
14 Refitting is a reversal of removal.

3/4/5 series models – rear

15 Follow the procedure described for the front bumper 45/55/65 models regarding the rear air dam.
16 Undo the two nuts from the side fixings securing the wrap-around sections to the rear wings (photo).
17 Remove the bumper bracket-to-chassis member nuts and withdraw the bumper (photo).
18 On some models the over-riders are secured by screws.

38 Engine splash panels – removal and refitting

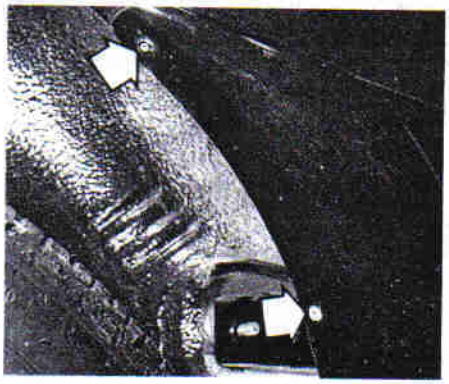
1 The engine splash panels are secured by bolts in various positions, and can be difficult to remove (photo).
2 The removal of the front wheels eases access (photo).
3 One panel is bolted to the heater support frame (photo) and on some models to the exhaust manifold hot air collector shroud.
4 Before removing the panels take careful note of their fitted positions.
5 Refitting is a reversal of removal.

39 Wheel arch panels – removal and refitting

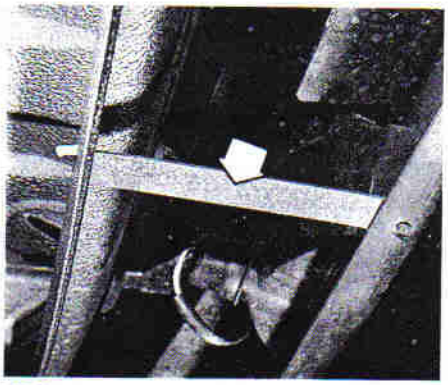
1 Remove the wheels as required to ease access.
2 Unscrew the panel securing plugs (photo).
3 Lift out the panel (photo).
4 Refit in reverse, pushing the securing plugs home with a thumb.

40 Sunroof – general

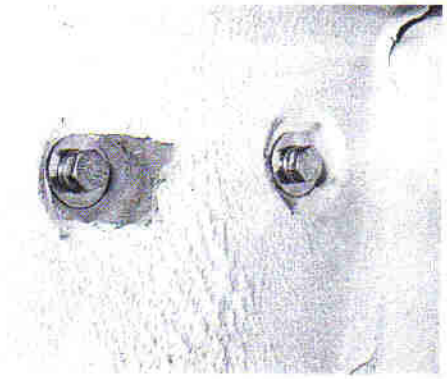
1 The sunroof fitted as an optional extra is a standard glass roof light.
2 If problems of leakage or breakage occur, refer to a Yugo dealer or local windscreen specialist.



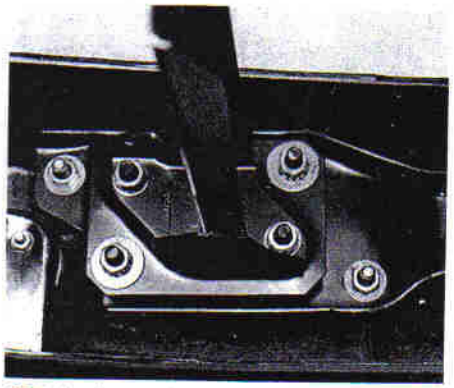
37.5A Rivets securing the front air dam to the wheel arch on a 65A GLX model



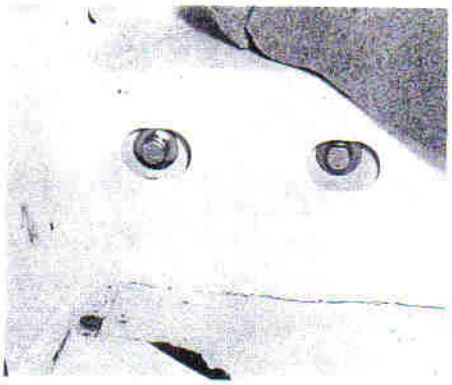
37.5B Metal strap (arrowed) riveted to the front valance and air dam on a 65A GLX model



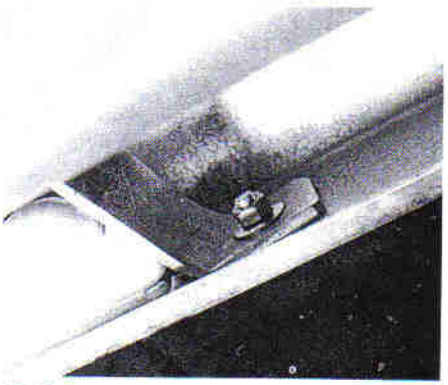
37.6 Bolts securing bumper to main chassis member (45/55/65 models)



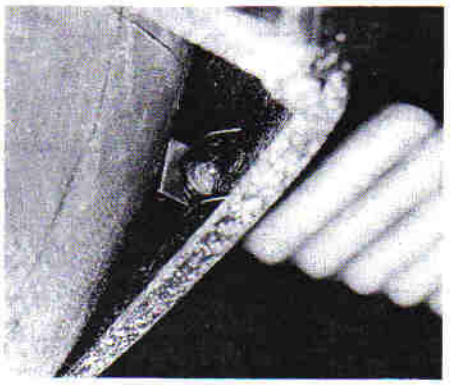
37.7 Air dam and bumper-to-bracket nuts (45/55/65 models)



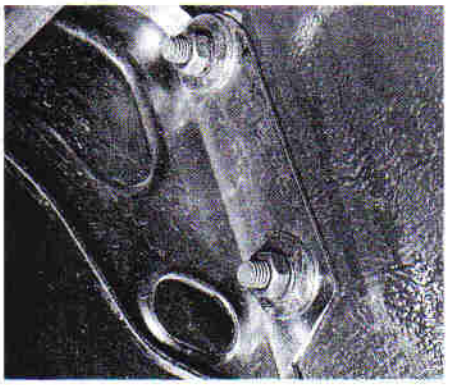
37.11 Bumper support bracket bolts (45/55/65 models)



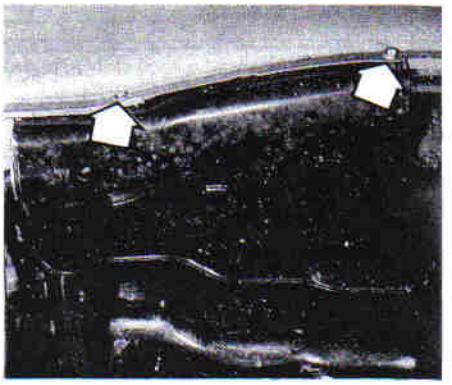
37.13 Bumper-to-support bracket bolts (3/4/5 series models)



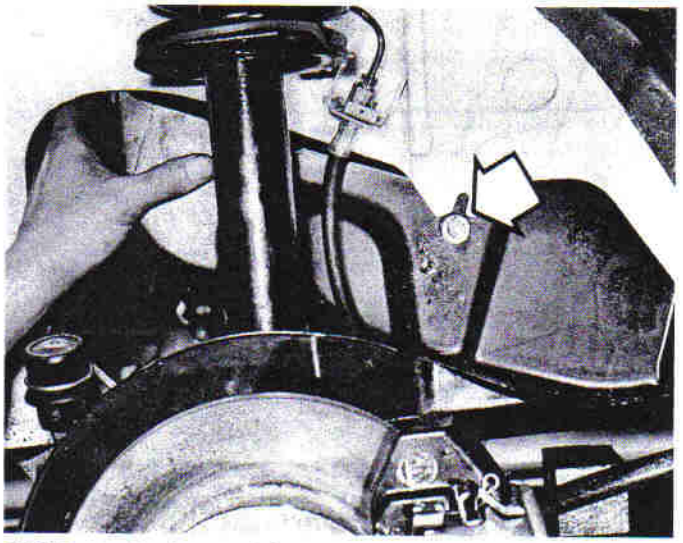
37.16 Side fixing nuts on wrap around section of rear bumper (3/4/5 series models)



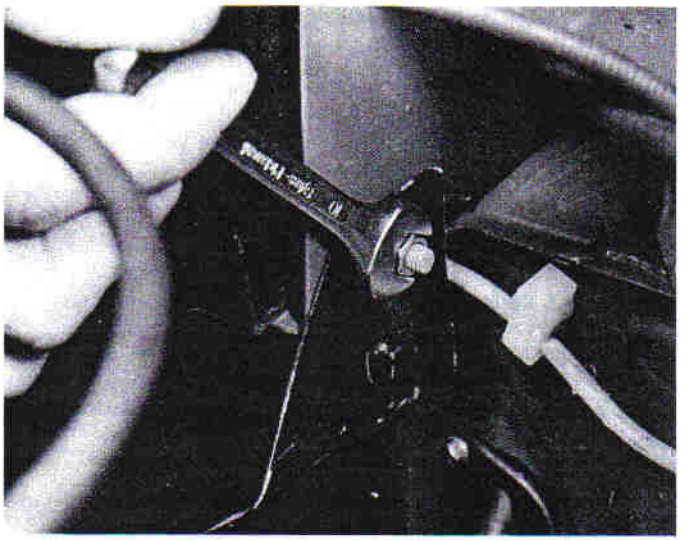
37.17 Bumper bracket-to-chassis member nuts (3/4/5 series models)



38.1 Engine splash panel securing bolts (arrowed)

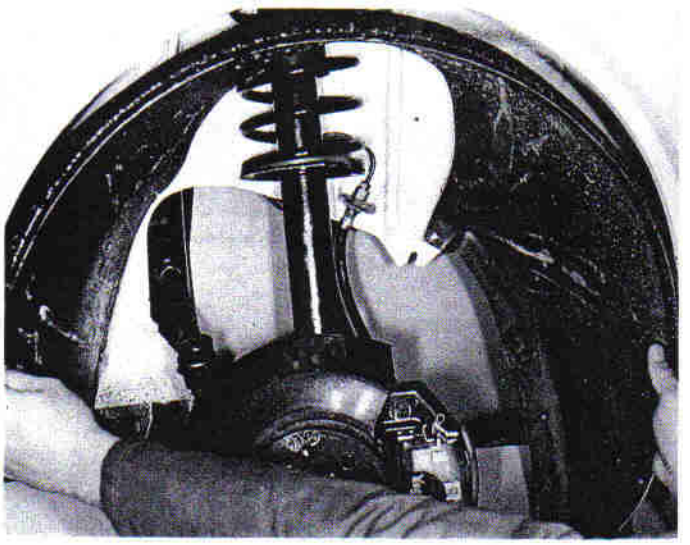


38.2 Front wheel removed for access to another securing nut (arrowed)



38.3 Panel secured to heater support frame

39.2 Unscrewing a wheel arch panel securing plug



39.3 Removing a wheel arch panel

Chapter 12 Electrical system

Contents

Specifications

General

System type	12 volt, negative earth, alternator and voltage regulator, pre-engaged starter

Battery

Nominal rating	12 volt; 34, 45, 55 or 65 Ah

Alternator

Type and output:	
Up to 1987	Iskra AAG 14 volt 33 amp
1987 on	Iskra AAG 14 volt 45 amp Iskra AAK 1172 14 volt 55 amp Iskra AAK 1173 14 volt 65 amp*
Drivebelt deflection	10 to 15 mm (0.4 to 0.6 in)

* *Fitted to Yugo 65A equipped with automatic choke*

Voltage regulator

Type:	
Up to 1987	AEC 0101 14 volt
1987 on	AER 1505 14 volt AER 1518 14 volt* AER 1525 14 volt

* *Fitted to Yugo 65A equipped with automatic choke*

Starter motor

Type	Iskra or Cajevac
Rating	12 volt
Output	0.8 kW

Fuses – 3/4/5 series models

Fuse number	Protected circuit	Fuse rating
1	Indicator and repeater lights, brake lights, water temperature and fuel gauges, low fuel warning light, heater fan motor, low oil pressure light and windscreen wiper motor	8 amp
2	Horn, cooling fan motor and switch, courtesy light, hazard warning lights and rear window heater	16 amp
3	Headlight main beam (left-hand) and main beam indicator	8 amp
4	Headlight main beam (right-hand)	8 amp
5	Headlight dipped beam (left-hand)	8 amp
6	Headlight dipped beam (right-hand)	8 amp
7	Front sidelight (left-hand), sidelight indicator, rear sidelight (right-hand), number plate light (left-hand) instrument panel lights and reversing light	8 amp
8	Front sidelight (right-hand), rear sidelight (left-hand), number plate light (right-hand)	8 amp
Line fuse:	Heated rear window and cigar lighter	16 amp

Fuses – 45/55/65 models

Fuse number	Protected circuit	Fuse rating
A	Indicator lights, windscreen wipers and washer system	8 amp
B	Fuel gauge and warning lights, water temperature gauge, oil pressure warning light, brake failure warning light, heater fan motor, brake and reversing lights	8 amp
C	Headlight main beam (left-hand) and main beam warning light	8 amp
D	Headlight main beam (right-hand)	8 amp
E	Headlight dipped beam (left-hand)	8 amp
F	Headlight dipped beam (right-hand)	8 amp
G	Front sidelight (left-hand), rear sidelight (right-hand), number plate light (left-hand), instrument lights	8 amp
H	Front sidelight (right-hand) rear sidelight (left-hand) number plate light (right-hand), cigar lighter	8 amp
I	Horn, radiator fan and courtesy light	16 amp
J	Heated rear window and cigar lighter	10 amp

Bulbs

	Wattage
Headlights	40/45 or Halogen 60/55
Sidelights	5
Front indicator light	21
Rear indicator light	21
Side repeater light	4
Brake/tail light	21/5
Reversing light	21
Number plate light	5
Courtesy light	5
Instrument and warning lights	3
Rear foglight	21

Windscreen wipers

Wiper blades:	
45, 55 and 65 models:	
Front	Champion X-4103
Rear	Champion X-3303
All other models (front and rear)	Champion X-3803
Wiper arms:	
45, 55 and 65 models:	
Front	Champion CCA2
Rear	Champion type not available
All other models	Champion CCA2

Torque wrench setting

	Nm	lbf ft
Alternator mounting bolts	49	36

1 General description

The major components of the 12 volt negative earth system consist of a 12 volt battery, an alternator (driven from the crankshaft pulley), and a starter motor.

The battery supplies a steady amount of current for the ignition, lighting and other electrical circuits and provides a reserve of power when the current consumed by the electrical equipment exceeds that being produced by the alternator.

The alternator has its own regulator which ensures a high output if the battery is in a low state of charge and the demand from the electrical equipment is high, and a low output if the battery is full charged and there is little demand from the electrical equipment.

When fitting electrical accessories to cars with a negative earth system it is important, if they contain silicon diodes or transistors, that they are connected correctly, otherwise serious damage may result to the components concerned. Items such as radios, tape players, electronic ignition systems, electronic tachometer, automatic dipping etc, should all be checked for correct polarity.

Many of the electrical components used are common to all models and where Section headings do not specify otherwise, it can be assumed that the procedure covers both 45/55/65 and 3/4/5 series models.

2 Routine maintenance

At the intervals given in the 'Routine maintenance' Section at the beginning of this manual, carry out the following:

Check and if necessary top up the battery electrolyte level (Section 3)
Check the condition and tension of the alternator drivebelt (Section 7)
Check the headlight beam alignment (Section 13)
Check that all lights are working and that other electrical services, eg windscreen washers, wipers, rear screen heater etc function correctly

3 Battery – inspection and topping-up

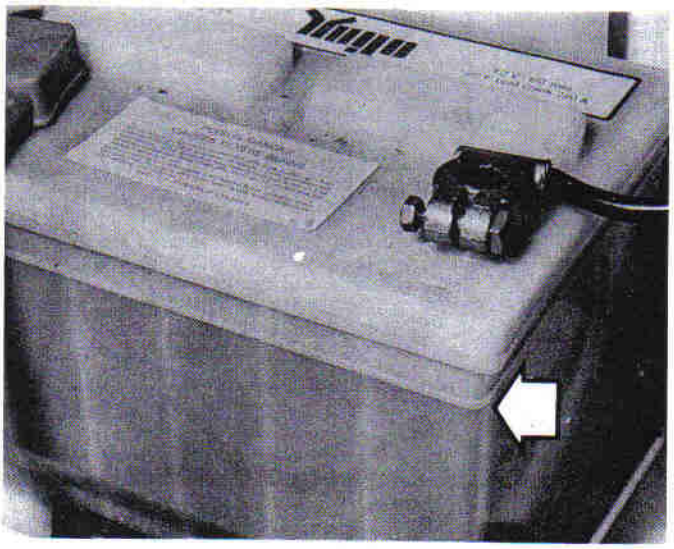
1 Periodically inspect the battery for loose or corroded terminals, cracking of the case and signs of leakage. Check the tightness of the filler plugs and battery clamp bolt.
2 The level of the electrolyte in the battery cells must be maintained at the 'fill line' mark on the side of the battery (photo).
3 The battery case is translucent and the electrolyte level in each cell can clearly be seen through it. If any one cell is low, replenish it with distilled water as follows.
4 Remove the filler plug from the cell. The plug will either be an individual plug screwed into the cell or a triple unit which is a push fit (photo).
5 Fill the cell with distilled water to the fill line, then refit the plug(s) and mop up any spillage immediately.
6 Do not allow the electrolyte level to drop below the level of the lead plates or the plates will become distorted, ruining the battery.
7 If one or more cells is frequently low on inspection, suspect a fault with the battery or the charging system. (In an old battery which is approaching the end of its life, the two outer cells often need frequent topping-up.)
8 Keep the terminal posts clean and free from the corrosive deposit which builds up on them. A smear of petroleum jelly on the posts and terminals is beneficial in this respect.
9 Ensure the routing of the battery cables is maintained as designed and that any support clips are kept in position to minimise chafing which could lead to short circuits.

4 Battery – disconnecting, removal and refitting

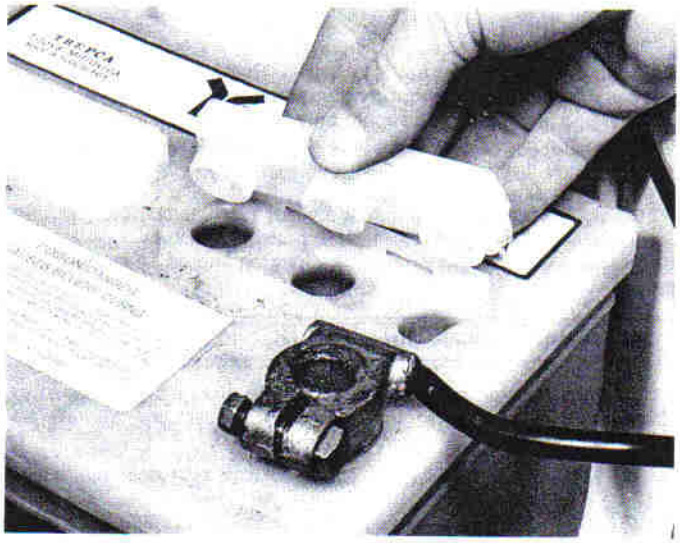
1 To disconnect the battery for servicing requirements, loosen the nut on the negative terminal clamp bolt and lift off the terminal, laying it safely to one side.
2 To remove the battery, disconnect both terminals, negative first, undo the bolt from the clamp plate on the battery tray and lift out the battery (photos).
3 Keep the battery level at all times to avoid spillage and be extremely careful not to drop it.
4 Refitting the battery and reconnection are a reverse of removal.

5 Battery – charging

1 In normal use the battery should not require charging from an external source, unless the vehicle is laid up for long periods, when it should be recharged every six weeks or so. If vehicle use consists entirely of short runs in darkness it is also possible for the battery to become discharged. Otherwise, a regular need for recharging points to a fault in the battery or elsewhere in the charging system.
2 *There is no need to disconnect the battery from the vehicle wiring* when using a battery charger, but switch off the ignition and if possible leave the bonnet open.
3 Domestic battery chargers (up to about 6 amps output) may safely be used overnight without special precautions. Make sure that the charger is set to deliver 12 volts before connecting it. Connect the leads *(red or positive to positive terminal, black or negative to the* negative terminal) **before** switching the charger on at the mains.
4 When charging is complete, switch off at the mains **before**



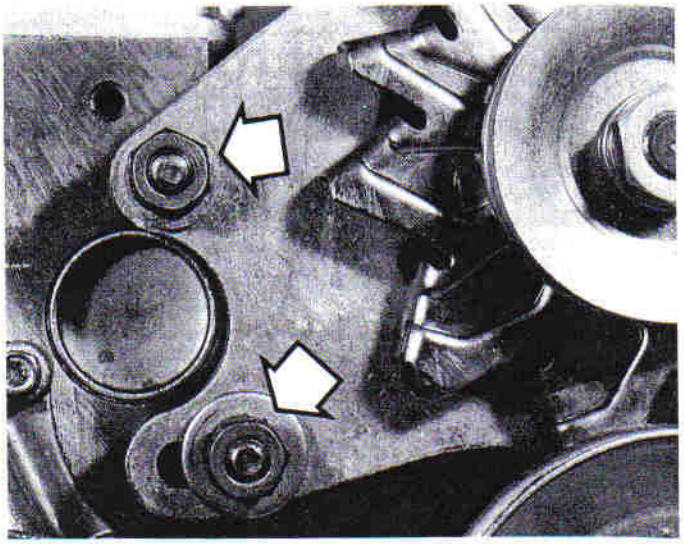
3.2 'Fill line' mark (arrowed) on side of battery



3.4 Triple unit plug being removed from battery

4.2A Battery terminal post and clamp bolt

4.2B Removing the battery clamp plate bolt



7.4 Alternator mounting nuts (arrowed) on OHV engine

disconnecting the charger from the battery. Remember that the battery will be giving off hydrogen gas, which is potentially explosive.

5 Charging at a higher rate should only be carried out under carefully controlled conditions. Very rapid or 'boost' charging should be avoided if possible, as it is liable to cause permanent damage to the battery through overheating.

6 During any sort of charging, battery electrolyte temperature should never exceed 38°C (100°F). If the battery becomes hot, or the electrolyte is effervescing vigorously, charging should be stopped.

6 Alternator – precautions

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 the correct battery polarity

7 Alternator drivebelt – inspection, renewal and tensioning

1 The alternator drivebelt is driven from the crankshaft pulley and also drives the water pump.

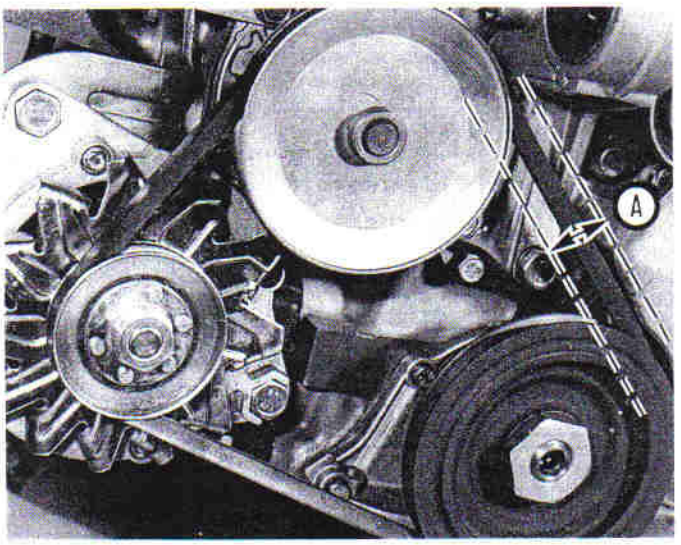
2 Inspect the drivebelt at the intervals given in the *'Routine maintenance'* Section for fraying, cuts, cracking and hardening, and correct tension.

3 A belt which shows signs of deterioration should be renewed at the earliest opportunity, and it is sound practice to carry a spare in the vehicle at all times.

4 To renew a belt, loosen the alternator mounting nuts/bolts to relieve the tension, then slip the belt off the pulleys (photo).

5 Fit a new belt over the pulleys, then apply the correct tension to the belt by pulling the alternator upwards on OHV engines and downwards on OHC engines until the belt deflection under moderate thumb pressure (10.0 kg 22.0 lb) is as specified (photo).

6 Keep the belt tensioned while the mounting nuts/bolts are tightened and check the tension on completion.



7.5 Alternator drive deflection (A)

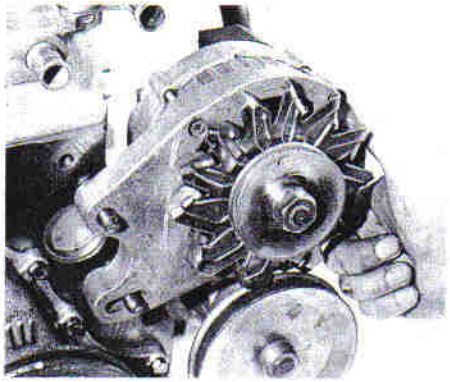
8 Alternator – removal and refitting

OHV engines

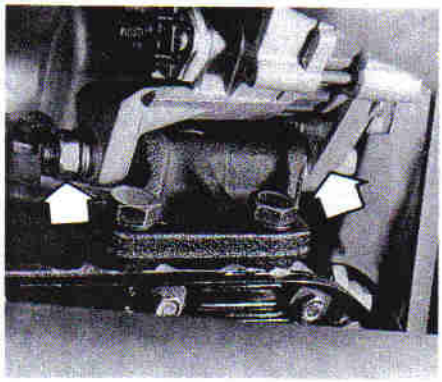
1 Disconnect the battery.
2 Disconnect the terminals at the rear of the alternator.
3 Loosen the alternator mounting nuts and remove the drivebelt.
4 Remove the nuts and lift the alternator off the studs (photo).
5 Refitting is a reversal of removal, but tension the drivebelt as described in Section 7.

OHC engines

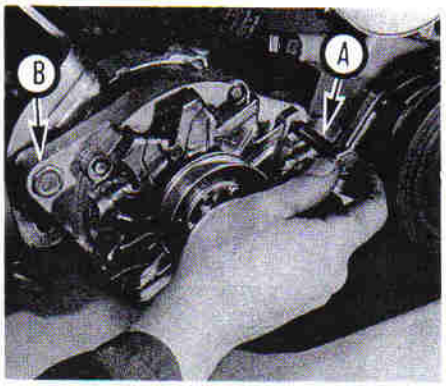
6 Carry out paragraphs 1 to 3 above (photo).
7 Remove the mounting bolt and tensioner strap bolt and lift off the alternator (photo).
8 Refit in reverse order and tension the drivebelt as described in Section 7.



8.4 Lifting the alternator from the studs (OHV engine)



8.6 Alternator mounting bracket and bolt on OHC engine



8.7 Alternator mounting bolt (A) and tensioner strap bolt (B) on OHC engine

9 Alternator – overhaul

1 Overhaul of the alternator should be limited to renewal of the brushes. If the unit has covered a high mileage, it will be found more economical to exchange it for a new or factory-reconditioned one, rather than renew worn components on the original unit.

Brush renewal

2 The procedure for both Iskra and Bosch alternators is similar.
3 Remove the alternator as described in Section 8.
4 Remove the screws from the brush holder, lift it from the alternator and disconnect the terminals (photos).
5 Fit a new brush holder, which comes complete with brushes, in reverse order.

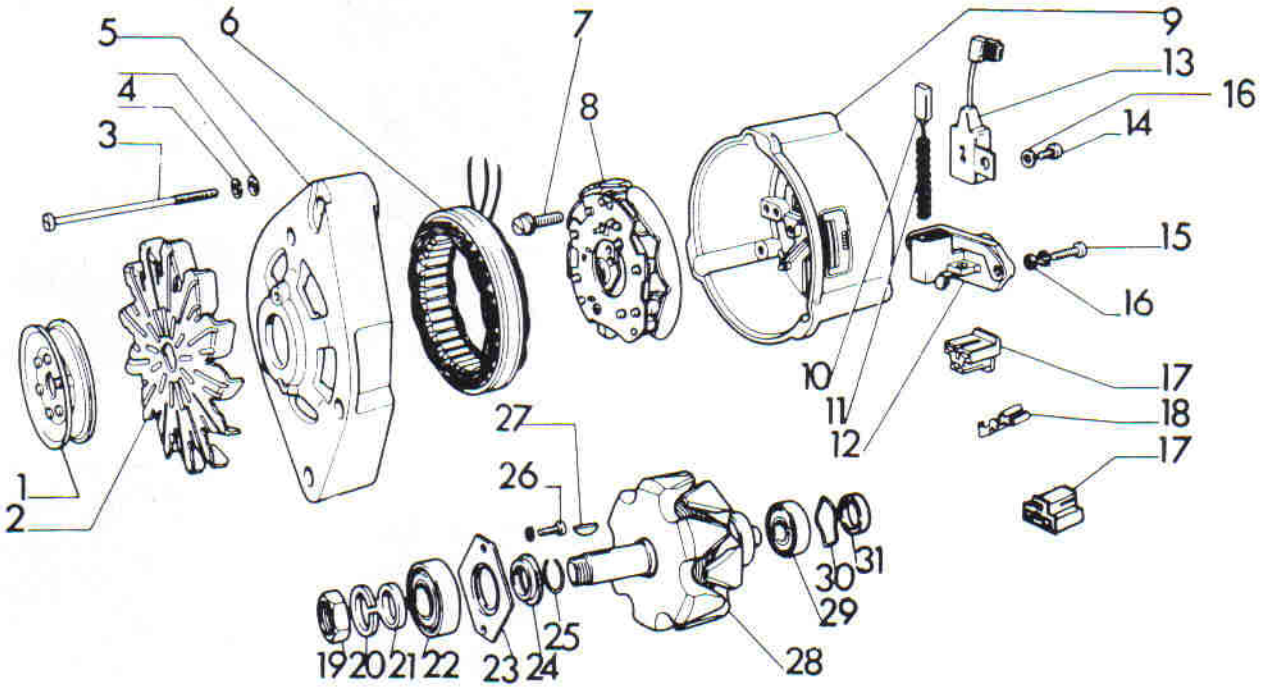
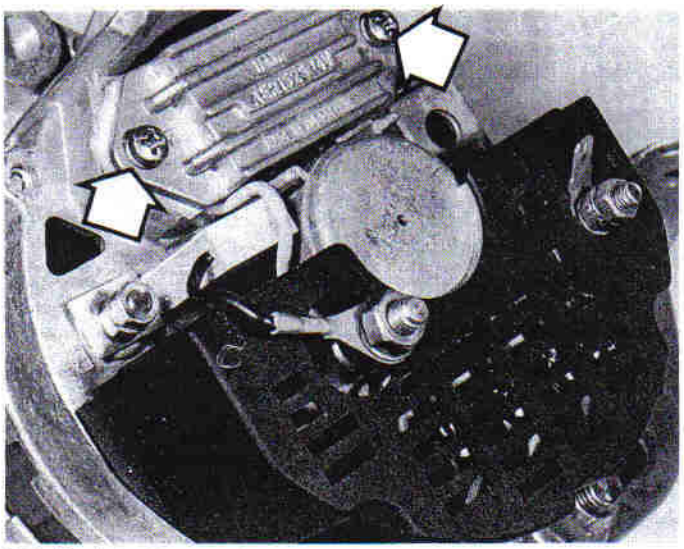
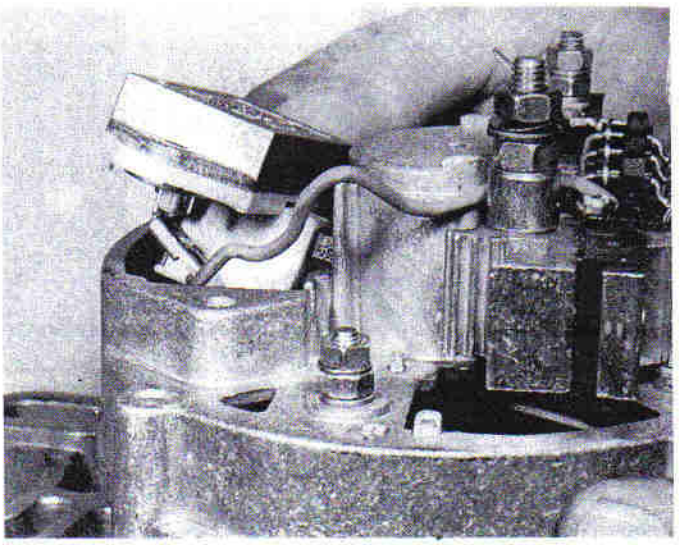


Fig. 12.1 Exploded view of a typical alternator (Sec 9)

1 *Pulley*
2 *Fan*
3 *Bolts*
4 *Washers*
5 *Drive-end bracket*
6 *Stator windings*
7 *Plate screw*
8 *Diode plate (rectifier pack)*
9 *Body*
10 *Brush*
11 *Spring*
12 *Brush holder/ voltage regulator*
13 *Condenser*
14 *Screw*
15 *Screw*
16 *Washers*
17 *Plug sockets*
18 *Suppressor*
19 *Shaft nut*
20 *Spring washer*
21 *Thrust ring*
22 *Bearing*
23 *Retainer plate*
24 *Thrust ring*
25 *Spring washer*
26 *Washer*
27 *Key*
28 *Rotor*
29 *Bearing*
30 *Backing washer*
31 *Shield (where applicable)*



9.4A Brush holder securing screws (arrowed)



9.4B Lift out the brush holder

10 Voltage regulator – description and renewal

1 The voltage regulator is integral with the alternator.

2 The regulator controls the output of the alternator, allowing a high charge rate during periods of high current consumption (eg in winter, when wipers, rear screen heater and lights are in frequent use) and a low rate when current demand is not so high.

3 A faulty voltage regulator is indicated by an under or over-charged battery, but before renewing the regulator have the charging system checked by a Yugo dealer or auto-electrician.

4 The regulator and brush assembly are integral. To renew the voltage regulator, proceed as described in Section 9 for brush renewal.

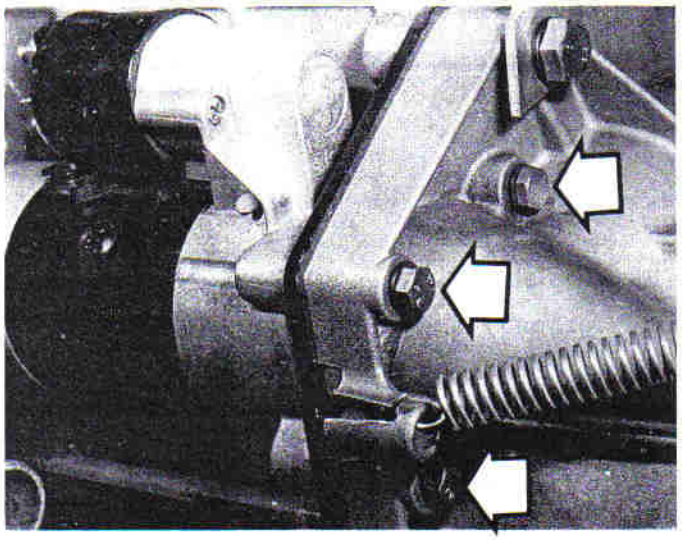
11 Starter motor – removal and refitting

1 Disconnect the battery negative terminal.

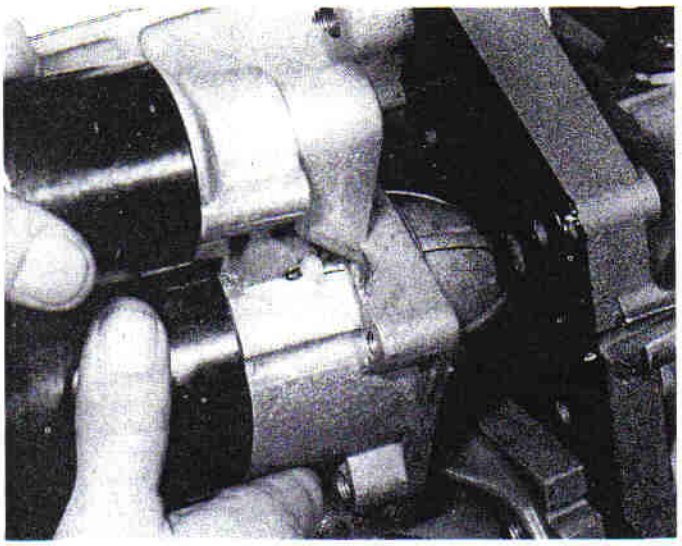
2 Disconnect the leads from the starter motor.

3 Unscrew the bolts securing the starter motor to the clutch bellhousing, noting their different lengths, and withdraw the starter motor (photos).

4 Refit in reverse order.



11.3A Starter motor mounting bolts (arrowed)



11.3B Withdrawing the starter motor

12 Starter motor – overhaul

1 As with the alternator, overhaul of the starter motor should be restricted to renewal of the brushes.

2 If further overhaul work is necessary it is better to purchase and fit an exchange unit.

3 Several variations in starter motor may be encountered and two typical examples of brush renewal are given in the following paragraphs.

Brush renewal – Iskra type 1

4 Remove the starter motor as described in Section 11.

5 Remove the nuts and lift off the endplate (photos).

6 Remove the four carbon segments from the rotor (photo).

7 Remove the circlip from the end of the shaft and lift off the rotor (photos).

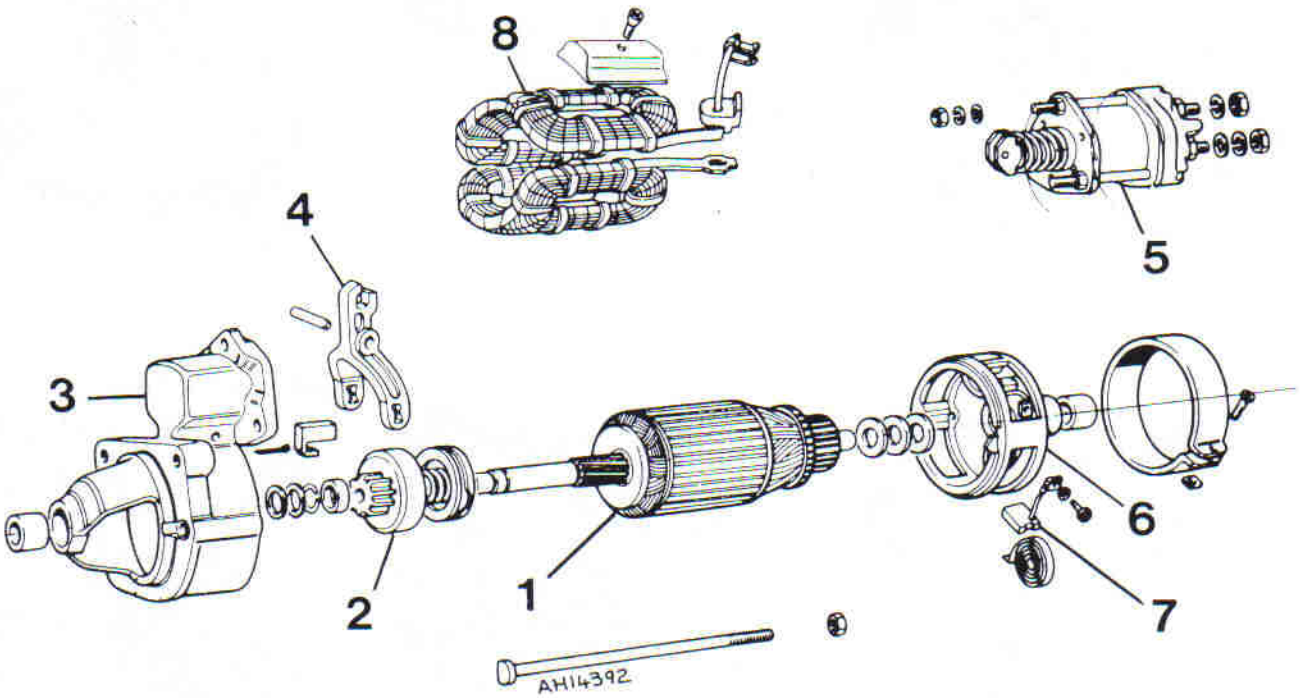


Fig. 12.2 Exploded view of a typical starter motor (Sec 12)

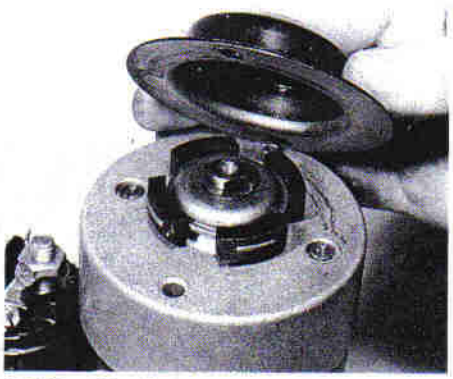
1 Armature	*4 Shift lever*	*7 Brush*
2 Drive pinion/clutch	*5 Solenoid*	*8 Field windings*
3 Drive end bracket	*6 Brush endplate*	

8 Take careful note of the number of washers under the circlip and ensure that they are all refitted on reassembly (photo).
9 Lift off the end cover (photo).
10 Remove the fibre washer from the shaft to ensure it is not lost (photo).
11 Prise up the brush spring and withdraw the carbon brush (photo).
12 The brush wire is soldered to the brush housing and careful use of a soldering iron is required to release the wire and solder back the new one (photo).
13 Reassembly is a reversal of removal. Refit the starter motor as described in Section 11.

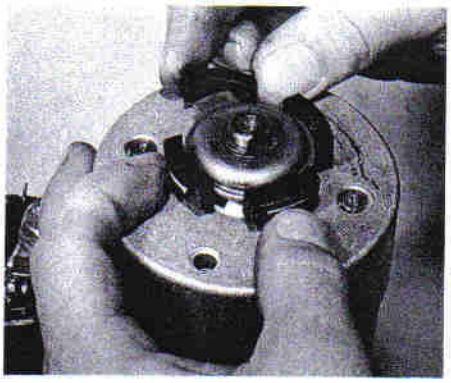
Brush renewal – Iskra type 2

14 Remove the nuts and lift off the end cap (photo).
15 Remove the circlip from the end of the shaft (photo).
16 Take careful note of the number of washers under the circlip and ensure that the same number are refitted on reassembly (photo).
17 Lift off the end cover (photo).
18 Prise back the brush spring and withdraw the brush (photos).
19 Careful use of a soldering iron will be required to release the brush wire and solder back the new one.
20 Reassemble in reverse order and refit the starter motor as described in Section 11.

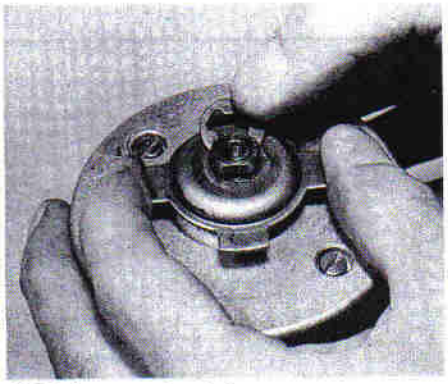
12.5A Remove the nuts ...



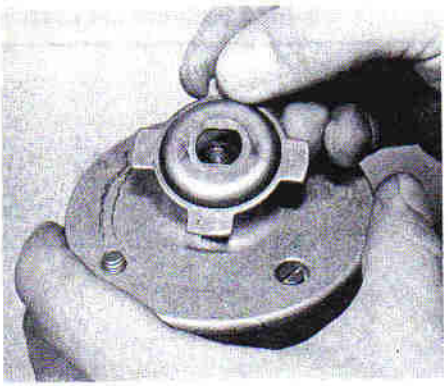
12.5B ... lift off the end plate



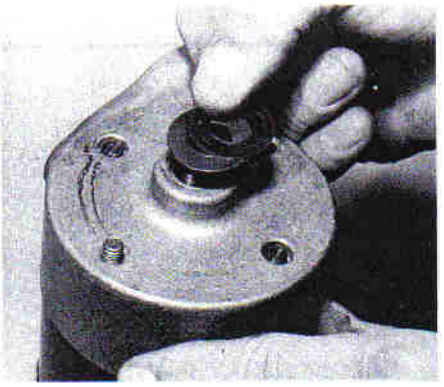
12.6 Remove the four carbon segments



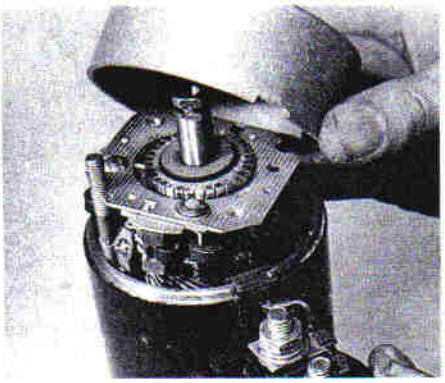
12.7A Remove the circlip ...



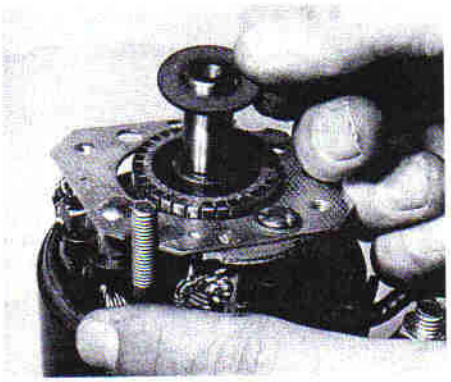
12.7B ... and rotor



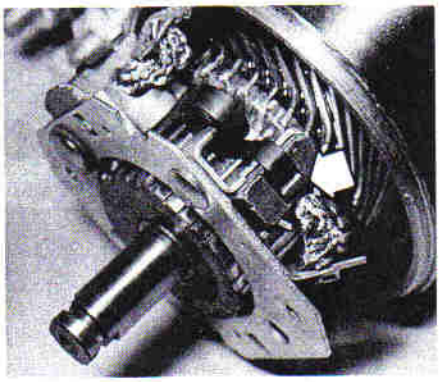
12.8 Note the washers for reassembly



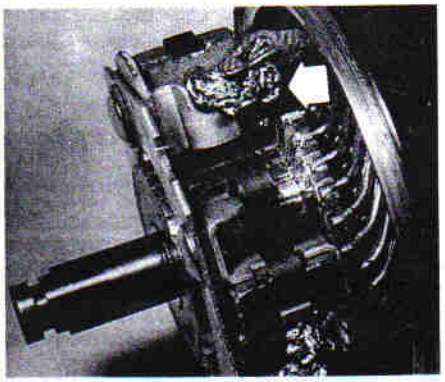
12.9 Lift off the end cover



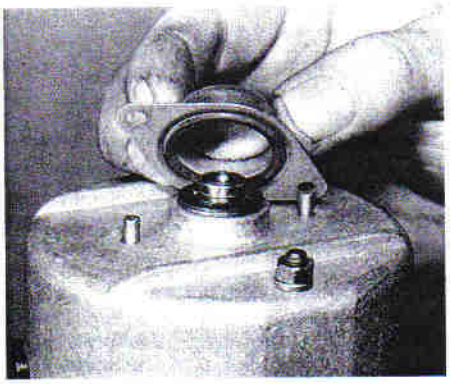
12.10 Remove the fibre washer



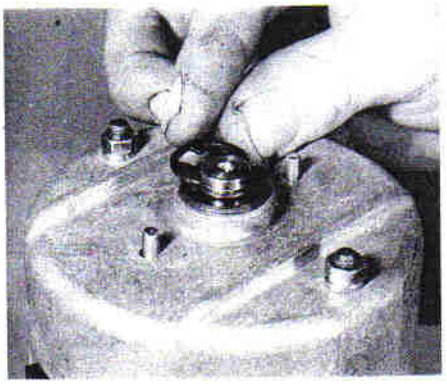
12.11 Brush and springs (arrowed)



12.12 Brush wire (arrowed) is soldered to housing



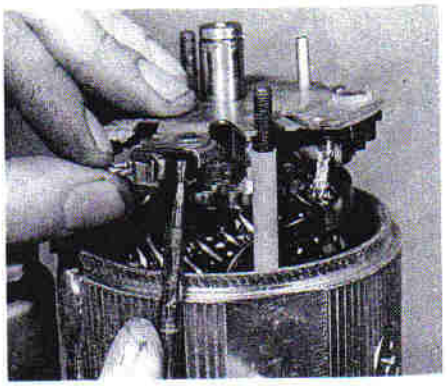
12.14 Lift off the end cap



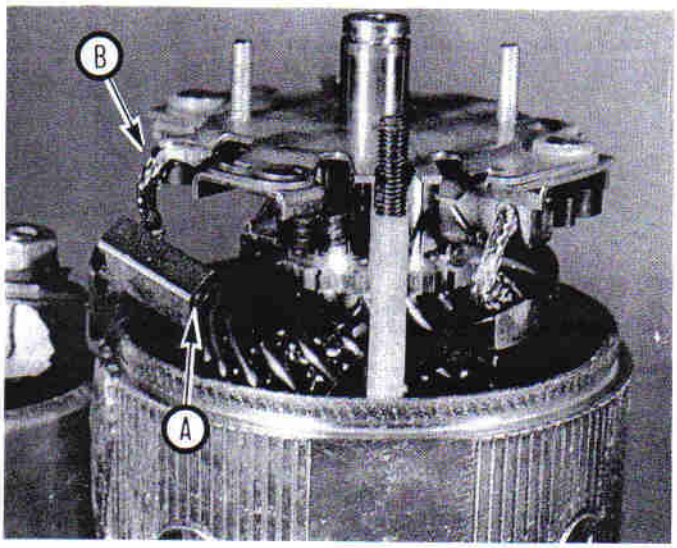
12.15 Remove the circlip ...

12.16 ... and count the washers

12.17 Lift off the end cover



12.18A Prising back the brush spring



12.18B Brush (A) and solder point (B)

13 Headlight beam – adjustment

Note: *Holts Amber Lamp is useful for temporarily changing the headlight colour to conform with the normal usage on Continental Europe*

Load adjusters

1 Under normal driving conditions the mechanical adjuster should be in the 'UP' position (photo).
2 When carrying heavy loads, moving the adjuster handle downwards will cause the headlight beam to be aimed somewhat lower than normal to prevent dazzle to other road users.

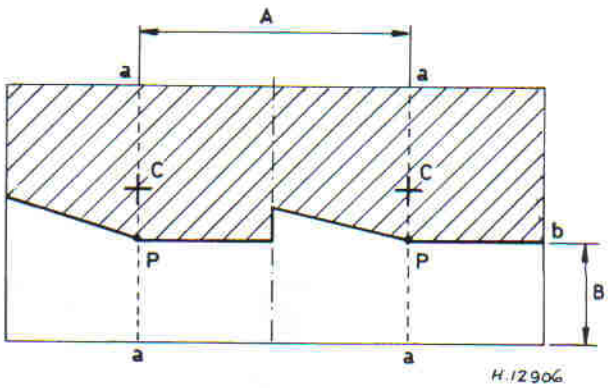


Fig. 12.3 Headlight beam adjustment diagram (Sec 13)

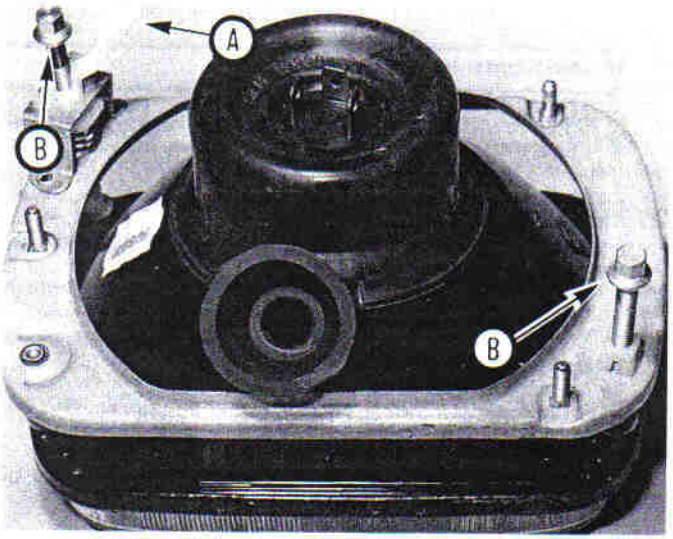
A = 1030 mm (40.5 in)
B = C minus 90 mm (3.5 in)
C = Height above ground of headlight centres
P = 90 mm (3.5 in) below C

Beam adjustment

3 Whenever the headlight units are removed and refitted, the beams should be checked and if necessary adjusted.
4 The most accurate and preferred method is to take the vehicle to a Yugo dealer who has the necessary beam alignment equipment.
5 If this is not possible a reasonably accurate alignment can be obtained as follows.
6 Park the vehicle on level, firm ground 5 metres (16.0 feet) from a wall. The vehicle centreline should be at right-angles to the wall, and the tyres should be inflated to the correct pressure, with the vehicle unladen.
7 Put the load adjuster in the 'UP' (normal) position.
8 Draw lines on the wall, the intersections of which should correspond to the headlight centres (see Fig. 12.3).
9 Switch the headlights on to dipped beam.
10 Adjust the beams using the vertical and horizontal beam adjuster bolts on the rear of the headlight units so that the centre of the projected beams is the specified distance below the headlight centre reference marks.

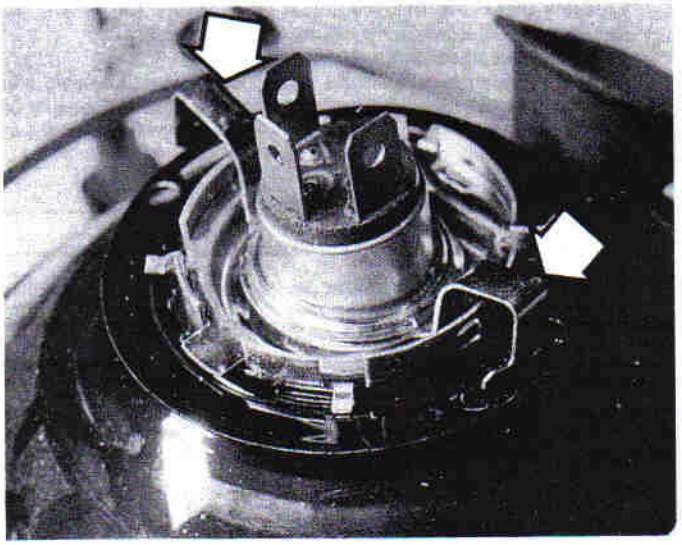
14 Headlights – bulb renewal

1 Open the bonnet and disconnect the battery negative terminal.
2 Pull the connector from the rear of the light unit.
3 Peel back the rubber cover and remove it (photo).
4 Depress the arms of the lock-ring and turn it anti-clockwise to remove it (photo).
5 Lift out the bulb (photo).
6 When handling halogen bulbs do not touch the bulb glass with the fingers as it is detrimental to the bulb. If the glass is accidentally touched, clean it with methylated spirit.
7 Fit a new bulb in reverse order.

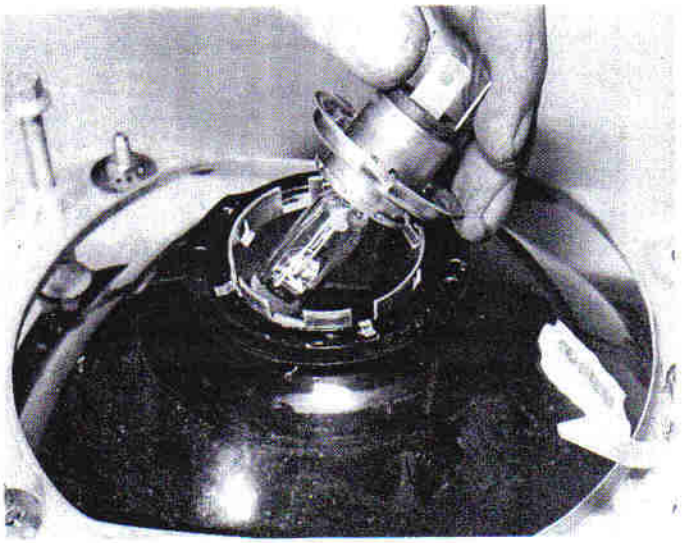


13.1 Load adjuster (A) and headlight beam adjusting bolts (B)

14.3 Peel back the rubber cover



14.4 Depress the arms of the lock-ring (arrowed)



14.5 Lift out the bulb

15 Headlights – removal and refitting

1 On 45/55/65 models take out the screws from the headlight surround and remove the surround. The two inboard screws also secure the radiator grille (photos).
2 On 3/4/5 series models remove the radiator grille as described in Chapter 11.
3 Where fitted, disconnect the connector and pull out the sidelight (see Section 16).
4 Remove the nuts securing the headlight to the front panel, noting the earth leads under the nuts (photo).
5 On 3/4/5 series models, one of these nuts is reached through the recess behind the radiator grille (photo).
6 Lift out the headlight unit (photo).
7 If the headlight glass is cracked or broken the complete unit will have to be renewed.
8 Refitting is a reversal of removal.
9 Check and if necessary adjust the headlamp beam as described in Section 13.

16 Front sidelights – bulb renewal

1 The sidelights on all models after 1983 are contained within the headlight shells.
2 Prior to 1983 the sidelights were mounted in the bumper with the front indicator lights and bulb renewal is covered in Section 17.
3 Open the bonnet.
4 Pull the sidelight bulb holder from the headlight unit (photo).
5 The bulb is a bayonet fit in the holder.
6 To renew the holder, simply disconnect the leads and fit a new holder to them.
7 Refit in reverse, ensuring the holder is pushed fully into the rubber housing in the headlight.

17 Front indicator lights – removal, refitting and bulb renewal

45/55/65 models – bulb renewal

1 Remove the screws from the lens and lift off (photo).
2 The bulb is a bayonet fit in the holder (photo).
3 Refit the new bulb in reverse order.

45/55/65 models – removal and refitting

4 Pull the connector from the rear of the unit.
5 Undo the nuts securing the unit to the bumper and remove the unit (photo).

Note: There is not much room between the bumper and front valance for access and if desired it may be easier to remove the bumper mounting bolts and draw the bumper forward to give more room.
6 Refitting is a reversal of removal.

3/4/5 series models – bulb renewal

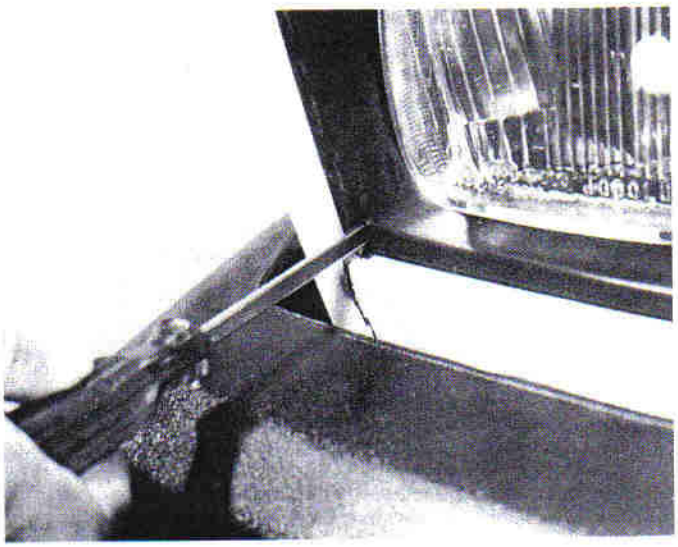
7 Remove the screws from the lens and lift off (photo).
8 The bulb is a bayonet fit in the holder (photo).
9 Refit the new bulb in reverse order.
10 On early models the sidelight is incorporated in the same unit as the indicator light. Bulb renewal is as described for the indicator light.

3/4/5 series models – removal and refitting

11 The procedure is as described for 45/55/65 models (photo).

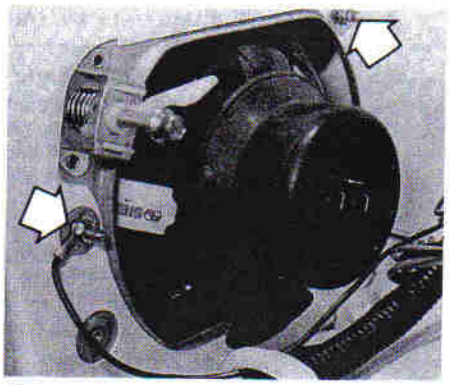
18 Side repeater lights – removal, refitting and bulb renewal

1 If the bulb in the side repeater light fails the complete unit must be renewed.
2 Prise the unit from its location in the front wing and disconnect the leads (photos).
3 Fit the new unit in reverse order, ensuring the rubber cover is pulled back over the terminals before pushing the unit back into place.



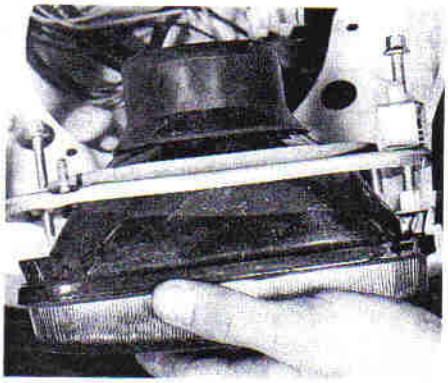
15.1A Removing a headlamp surround securing screw on a 45/55/65 model

15.1B Removing the headlight surround



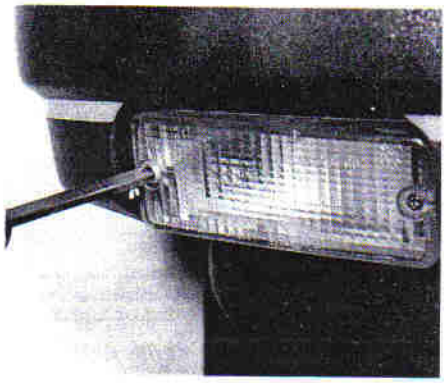
15.4 Headlight securing screws

15.5 Headlight securing nut on 3/4/5 series model is reached through recess

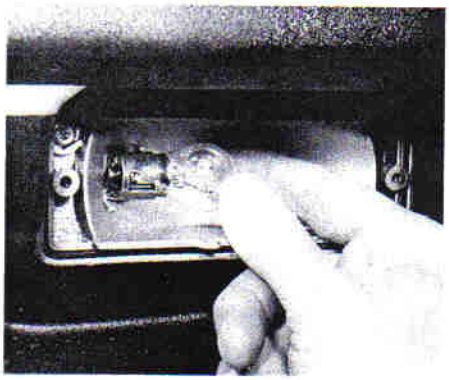


15.6 Lifting out a headlight unit

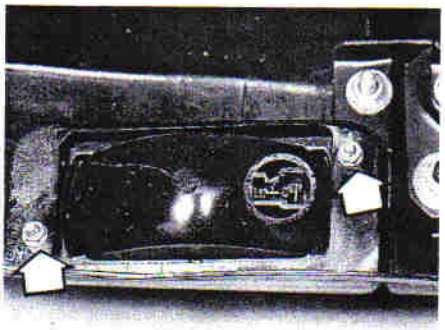
16.4 Pull the sidelight bulb holder from the headlight unit



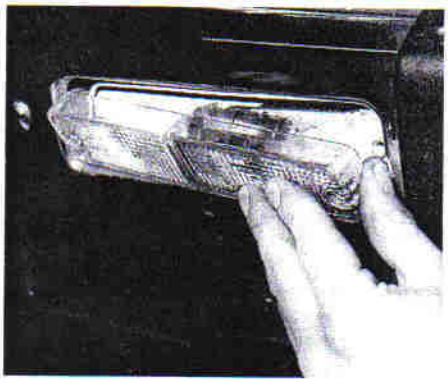
17.1 Remove the screws from the lens ...



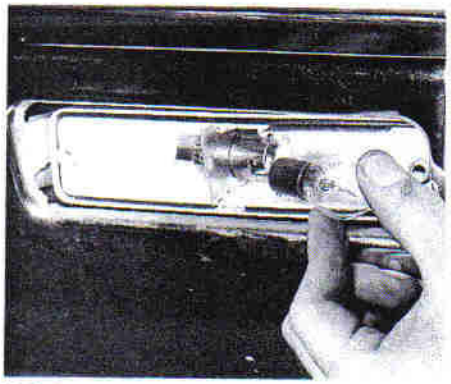
17.2 ... bulb is a bayonet fix



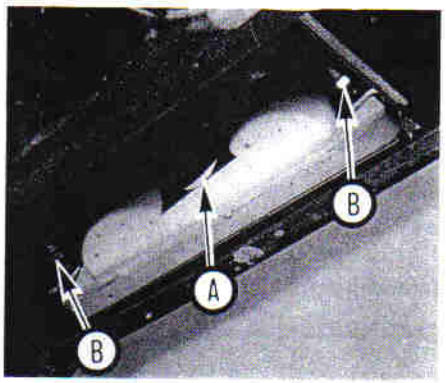
17.5 Front indicator light securing nuts (arrowed) on 45/55/65 model



17.7 Lift off the lens

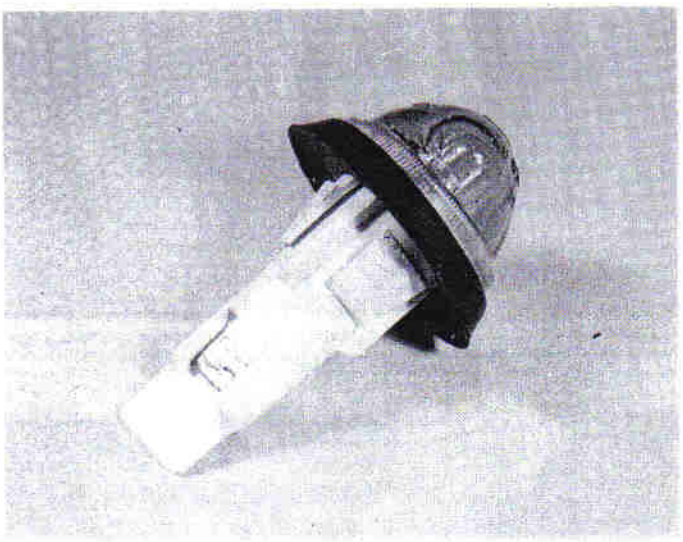


17.8 Bulb is a bayonet fix



17.11 Lead cover (A) and securing nuts (B) on 3/4/5 series model front indicator light

18.2A Removing the side repeater light on a 3/4/5 series model



18.2B Side repeater light on a 45/55/65 model

19 Rear light cluster – removal, refitting and bulb renewal

45/55/65 models – bulb renewal

Note: On early models the fog and reversing lights were mounted independently on the rear bumper as for 3/4/5 series models. From 1988 the rear light cluster incorporates the fog and reversing lights and is covered in the procedure given here.

1 Remove the screws from the lens cover and take off the lens (photo).
2 The bulbs are a bayonet fit in the holder (photo).
3 Refit a new bulb in reverse order.

45/55/65 models – removal and refitting

4 Remove the carpet in the luggage area.
5 Disconnect the wiring multi-plug (photo).
6 Remove the lens.
7 Undo and remove the nuts securing the unit to the rear panel (photo).
8 Withdraw the unit outwards (photo).
9 Further dismantling can be effected by removing the plastic cover on the rear of the unit (photos).
10 Refitting is a reversal of removal.

3/4/5 series models – bulb renewal

11 Each lens is secured individually to the baseplate. Remove the screws and take off whichever lens is applicable (photo).
12 The bulbs are all a bayonet fit in their holders (photo).
13 Refit the new bulb in reverse order.

3/4/5 series models – removal and refitting

14 Remove the lenses.
15 Remove the self-tapping screw from the outboard edge of the unit.
16 Pull back the carpet in the luggage area and remove the nuts securing the unit to the rear panel (photos).
17 Withdraw the unit and disconnect the leads from the back (photo).
18 Refitting is a reversal of removal.

20 Rear foglight (3/4/5 series models) – removal, refitting and bulb renewal

Bulb renewal

1 Remove the screws from the lens and lift off (photo).
2 The bulb is a bayonet fit in the holder (photo).
3 Refit the new bulb in reverse order.

Removal and refitting

4 Pull the connector block from the rear of the light unit (photo).
5 Undo the nuts and bolts securing the unit to the rear bumper and withdraw the unit (photos).
6 Refitting is a reversal of removal.

21 Rear foglights (45/55/65 models) – removal, refitting and bulb renewal

1 Remove the screws securing the lens to the base and remove the lens (photo).
2 The bulb is a bayonet fit in the holder.
3 The screws which secure the lens also hold the light unit in the rear air dam, so to remove the unit simply remove the lens and disconnect the lead.
4 Refitting is a reversal of removal.

22 Number plate light

3/4/5 series models – bulb renewal

1 Prise the number plate light unit from the plastic location plugs in the rear bumper (photo).
2 Release the lens which is clipped to the base unit.
3 There are two bulbs, both of which are a bayonet fit in the holders.
4 Refit in reverse order.

3/4/5 series models – removal and refitting

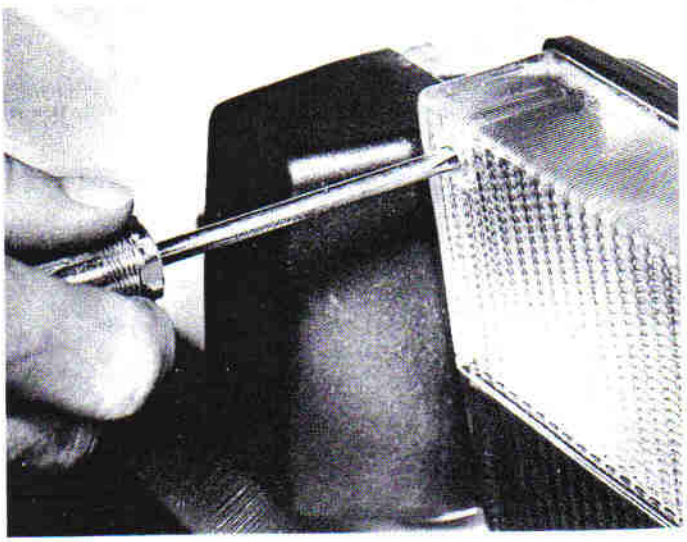
5 Removal is basically covered under bulb renewal, but disconnect the lead to remove the unit (photo).

45/55/65 models – bulb renewal

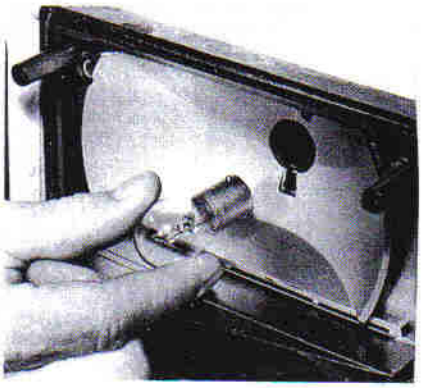
6 Remove the two screws from the lens unit and withdraw the lens from the base (photo).
7 The bulb is a bayonet fit in the holder (photo).
8 Refit the new bulb in reverse order.

45/55/65 models – removal and refitting

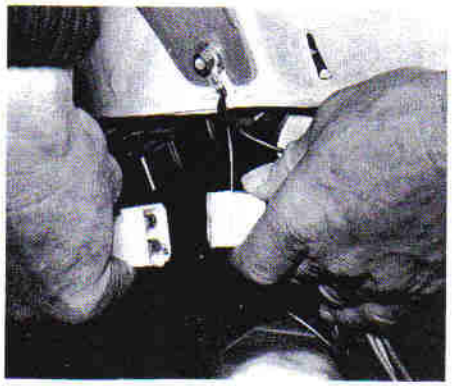
9 Pull back the carpet from the rear panel in the luggage area.
10 Pull the connector from the back of the light unit (photo).
11 Remove the plastic cap from the nut and unscrew the nut (photo).
12 Withdraw the unit from outside the vehicle.
13 Refit in reverse order.



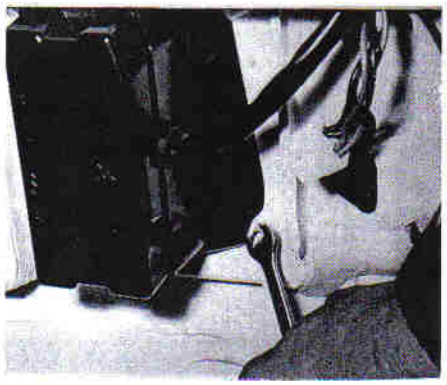
19.1 Removing a screw from rear light unit on a 45/55/65 model



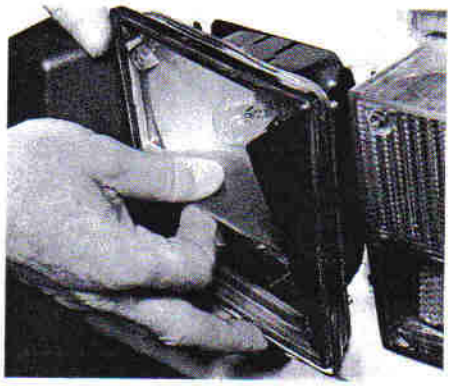
19.2 Bulb is a bayonet fit



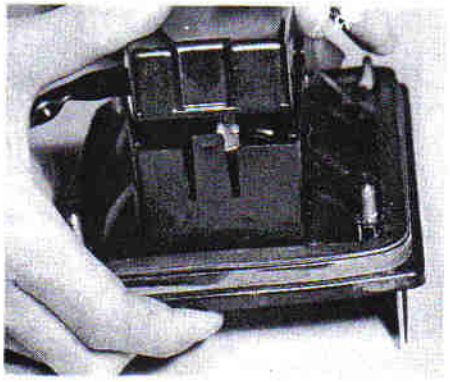
19.5 Disconnect the wiring multi-plug



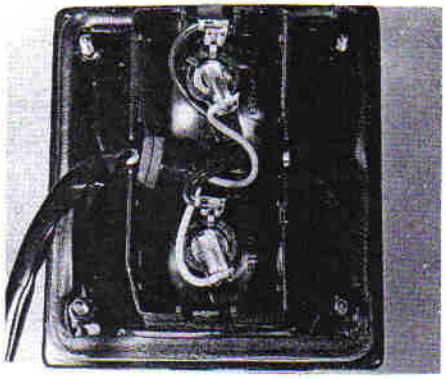
19.7 Undoing a rear light unit securing nut (45/55/65 model)



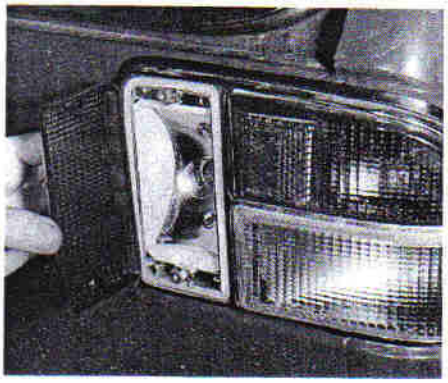
19.8 Withdrawing the unit



19.9A Removing the plastic cover ...

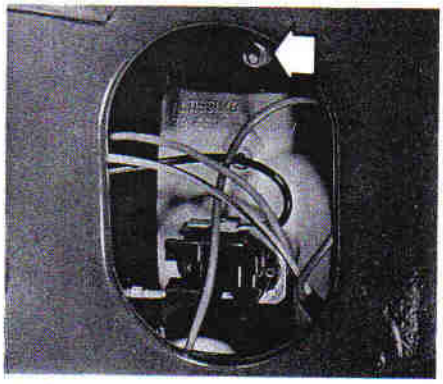


19.9B ... for further dismantling

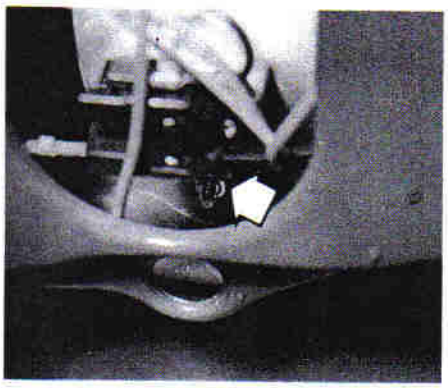


19.11 Removing the brake light lens

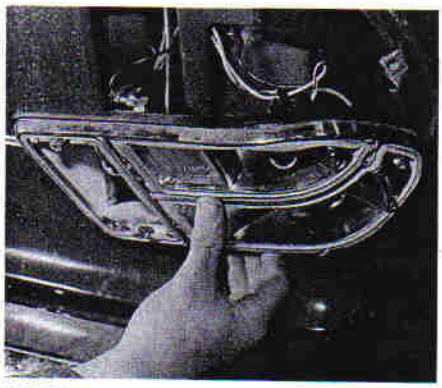
19.12 Bulbs are all a bayonet fit



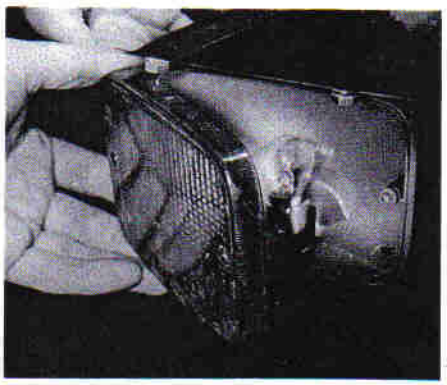
19.16A Upper rear light cluster securing nut (arrowed)



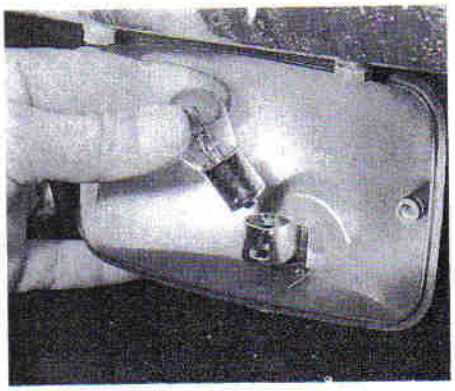
19.16B ... and the lower securing nut (arrowed)



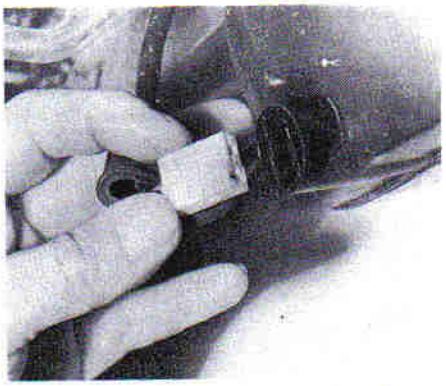
19.17 Withdraw the unit and disconnect the leads



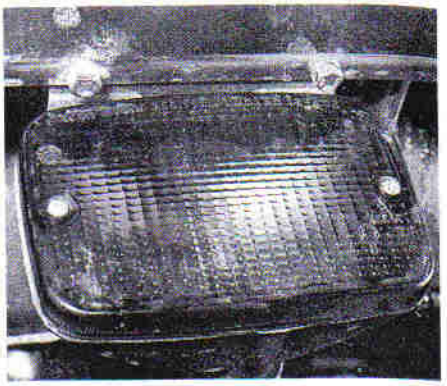
20.1 Remove the screws and lift off the lens



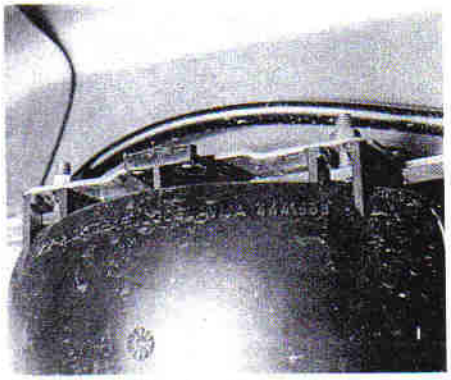
20.2 Bulb is a bayonet fit



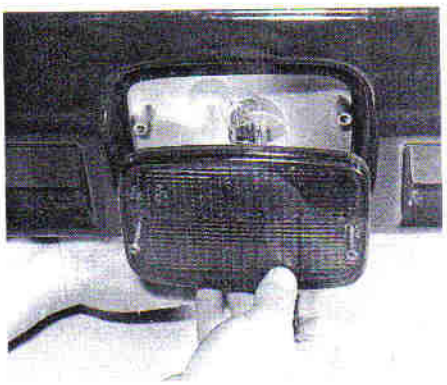
20.4 Pulling the connector block from the rear of the light unit



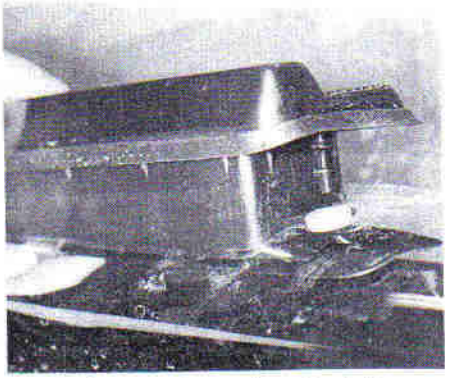
20.5A Rear foglight securing bolts (3/4/5 series models) viewed from outside the bumper ...



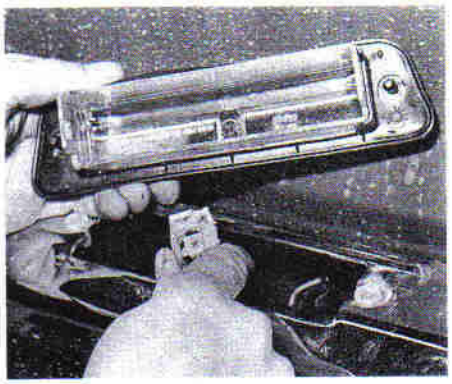
20.5B ... and from inside



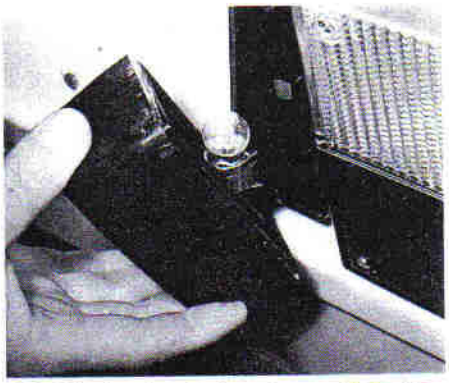
21.1 Removing the lens from a rear foglight on a 45/55/65 model



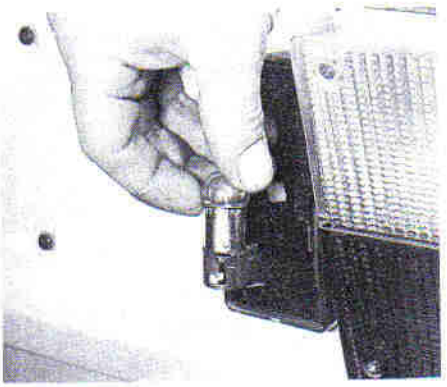
22.1 Prising out the number plate light on a 3/4/5 series model



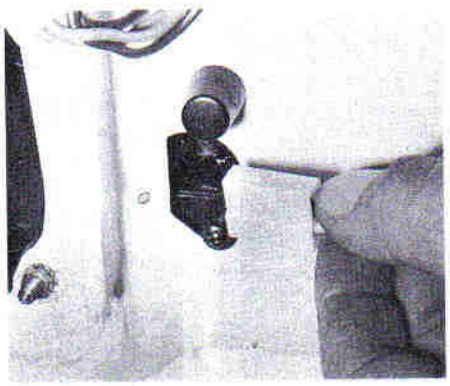
22.5 Disconnect the lead



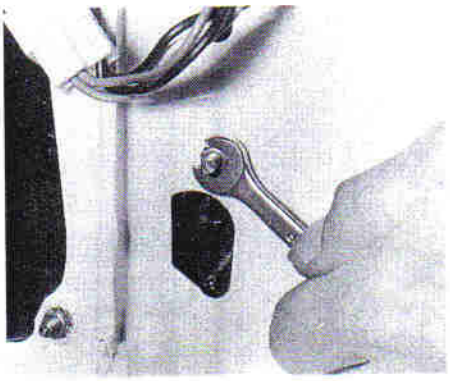
22.6 Withdrawing the lens from a 45/55/65 model number plate light



22.7 Bulb is a bayonet fit



22.10 Pull the connector from the back of the light unit



22.11 Undoing the securing nut

23 Dim-dip system – general

1 All models produced from 1987 are fitted with a dim-dip system.
2 The system allows the headlights to be operated on reduced dipped beam intensity when the ignition is switched on, making it impossible to drive the car with only sidelights illuminated.
3 The control unit is mounted on the inner wing, by the coil on 45/55/65 models and by the heater on 3/4/5 series models (photos).
4 If the system fails to operate correctly, check the fuses in the fuse box (refer to Fig. 12.5) before renewing the control unit.
5 To remove the control unit, remove the screws securing it to the bodywork, disconnect the wiring loom at the connector and remove the unit.
6 Refit in reverse order ensuring that the control unit inner face makes good contact with the surface of the bodywork.

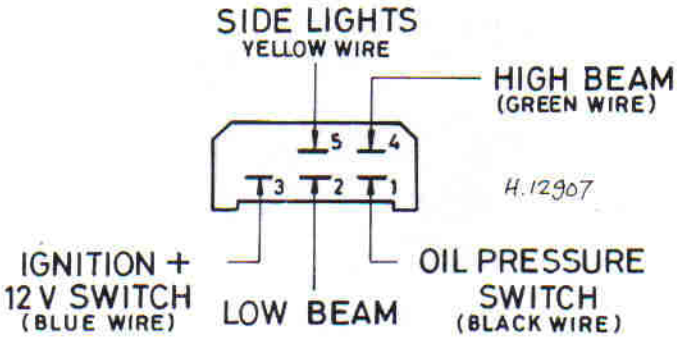


Fig. 12.4 Dim-dip wiring connections at fuse box (Sec 23)

Yellow wire – fuse 7 or 8
Green wire – fuse 4
Grey wire – fuse 5
Blue wire – fuse 1

24 Courtesy light – removal, refitting and bulb renewal

45/55/65 models – bulb renewal

1 Pull the lens from the base unit (photo).
2 The bulb is of the festoon type, secured between two spring contacts.
3 Refit the new bulb in reverse order.

45/55/65 models – removal and refitting

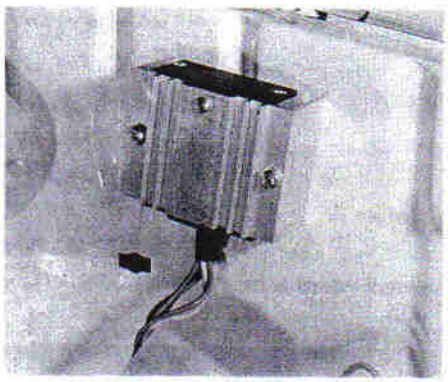
4 To remove the complete unit prise out the base (photo).
5 Pull off the leads and remove the unit (photo).
6 Refit in reverse order.

3/4/5 series models – removal, refitting and bulb renewal

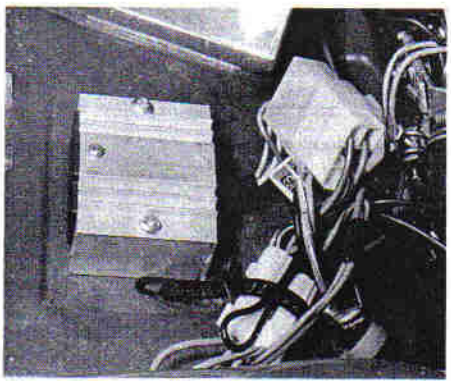
7 Prise the unit from the door pillar (photo).
8 The bulb is of the festoon type held between two spring contacts.
9 To remove the unit disconnect the leads.
10 Refitting is a reversal of removal.

25 Courtesy light microswitches – removal and refitting

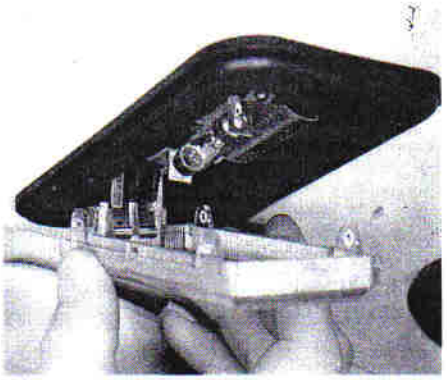
1 Remove the screw securing the switch to the door pillar (photo).
2 Pull the switch from the door pillar and disconnect the wire (photo).
3 Refit in reverse order.



23.3A Dim-dip control unit on 45/55/65 models ...

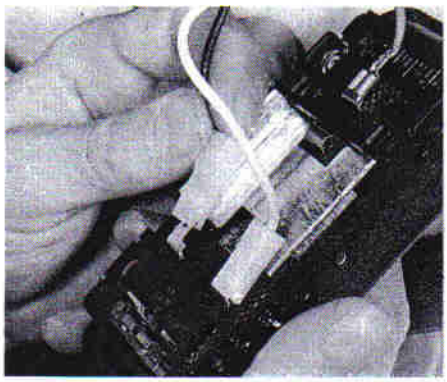


23.3B ... and on 3/4/5 series models

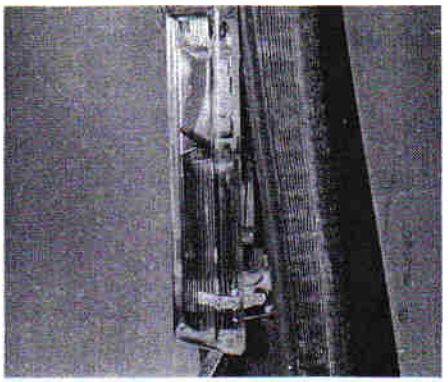


24.1 Removing the courtesy lamp lens on 45/55/65 models

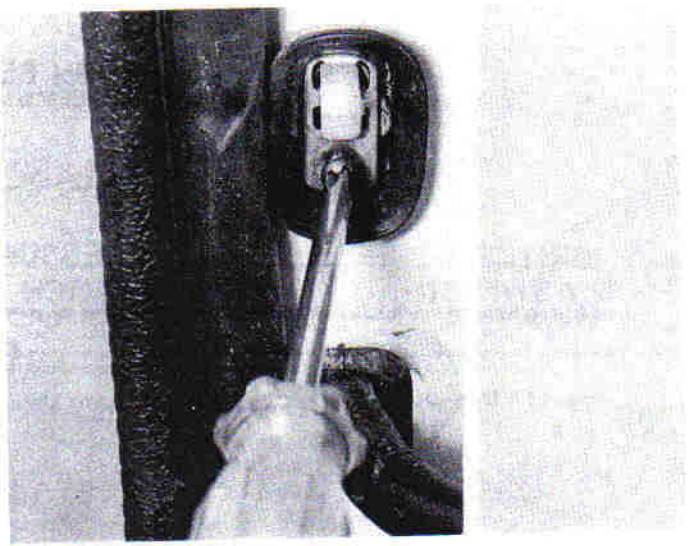
24.4 Prising out the base ...



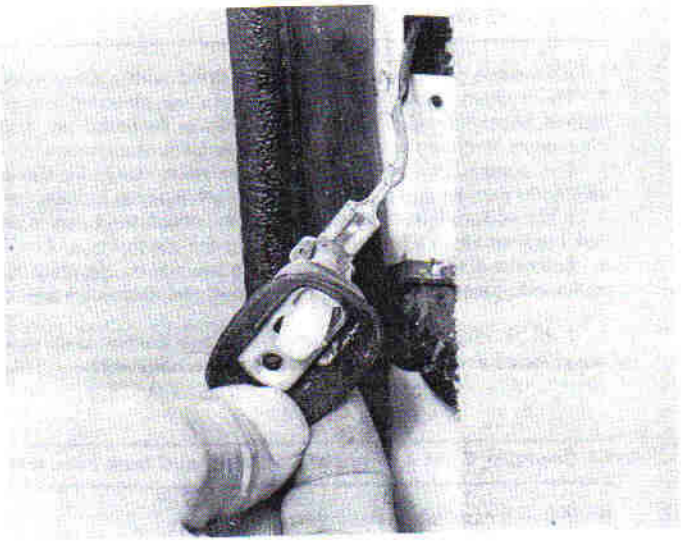
24.5 ... and pulling off the leads



24.7 Prising out the courtesy light on a 3/4/5 series model



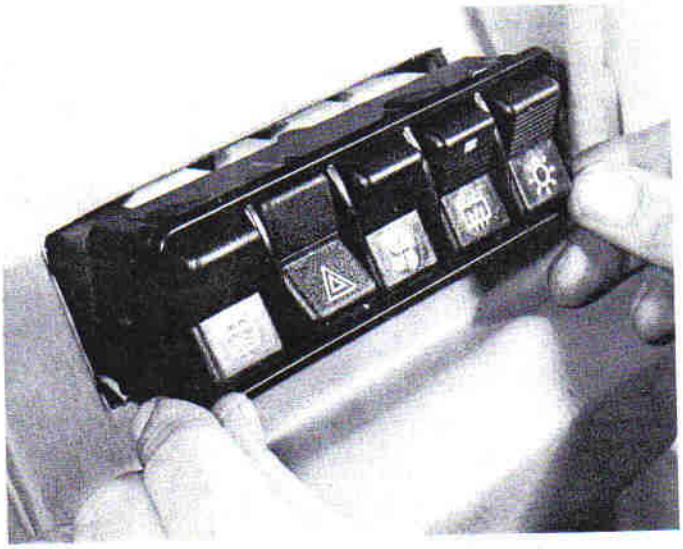
25.1 Remove the screw ...



25.2 ... and pull out the switch

26 Facia panel switches – removal and refitting

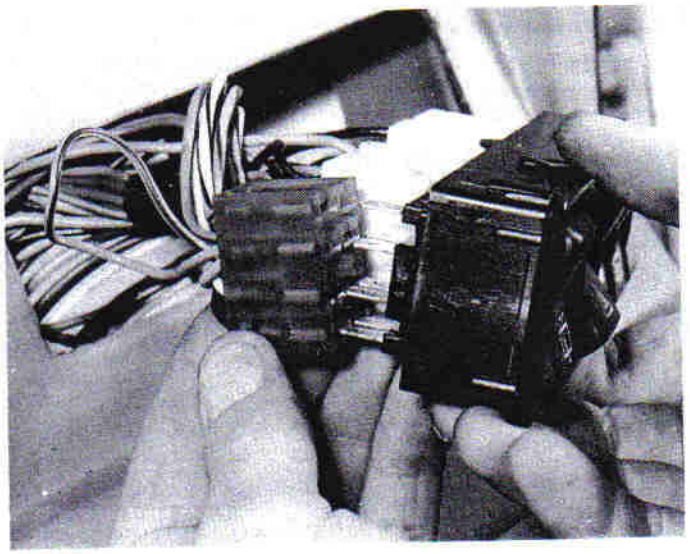
1 The procedure given here and the photographic sequences apply to a 45/55/65 model. Although the switches on 3/4/5 series models are positioned differently, the procedure for removing them is the same.
2 Prise the switch assembly from the facia (photo).
3 Pull the multi-connector or individual leads from the rear of the switch (photos).
4 Each switch is clipped into the holder and can be removed independently (photo).
5 Refit in reverse order.



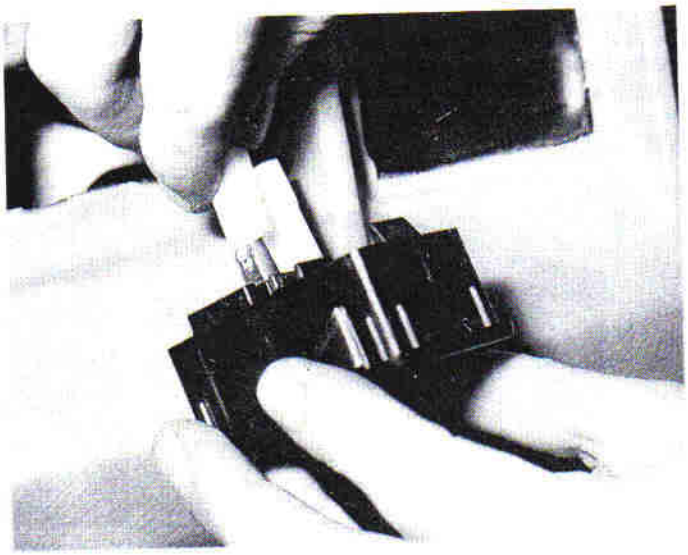
26.2 Removing a control switch assembly from the facia

27 Instrument panel – removal and refitting

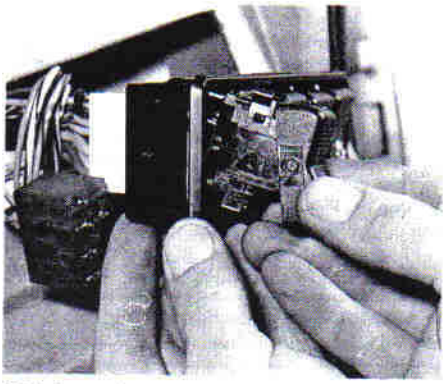
1 Although the instrument panels are of different shape depending on model, the procedure for removing them is the same, and all models are covered here.
2 Remove the lower screw from the centre of the instrument panel.
3 Prise out the lower edge of the panel which allows the clips at the top to be disengaged and the panel brought forward a little.
4 Reach behind the panel and undo the knurled nut securing the speedometer cable to the speedometer (photo).



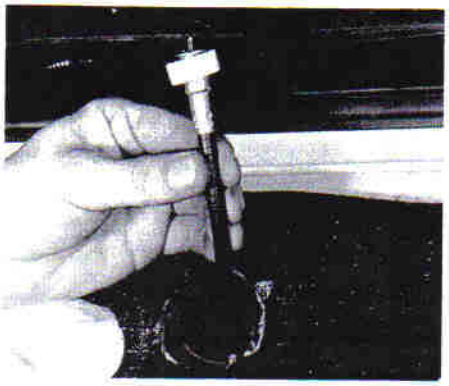
26.3A Pull off the multi-connector ...



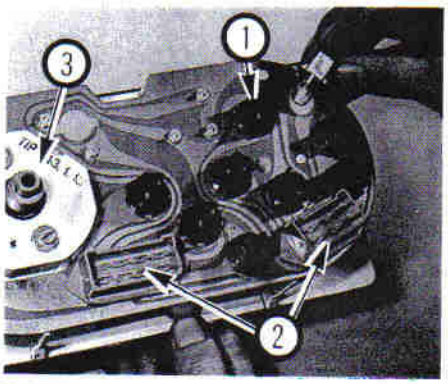
26.3B ... or individual leads



26.4 Removing an individual switch



27.4 Speedometer cable knurled nut (facia and instrument panel removed)



27.6 Pulling out a warning light bulb holder (1) and showing the multi-block connections (2) and speedometer (3)

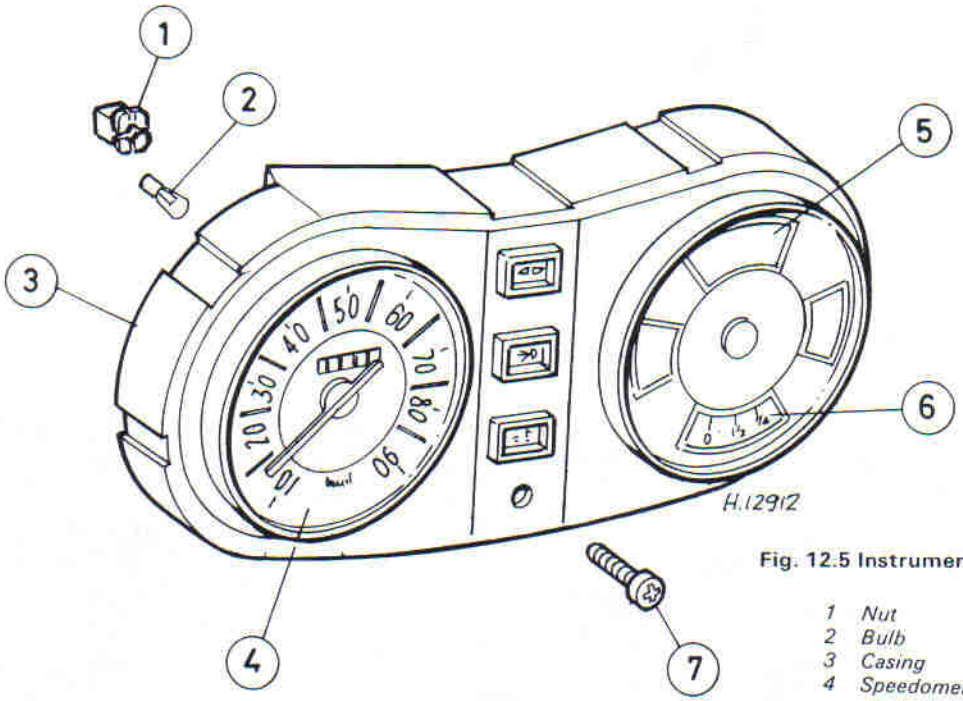


Fig. 12.5 Instrument panel on a 3/4/5 series model (Sec 27)

1 Nut
2 Bulb
3 Casing
4 Speedometer
5 Temperature gauge
6 Fuel gauge
7 Screw

5 The panel will now come further forward to allow the multi-block connectors to be pulled off and the panel withdrawn.
6 To change a warning light bulb twist out the holder. The bulbs are a push fit (photo).
7 Refit in reverse order.

28 Windscreen wiper blades – renewal

1 Windscreen wiper blades must be renewed when they no longer clear water from the screen efficiently.
2 Often the wipers do not work efficiently because the pressure exerted by the wiper arm is too great or too little because the arms have been bent at some stage of their life. Rectify the problem by fitting new wiper arms.
3 Similarly, if the blade does not touch the windscreen at the correct angle blade judder may result.
4 It is difficult to be precise about wiper blade-to-arm fixings as so many different types are now available. If difficulty is encountered, renew the complete arm and blade with replacements obtained from a Yugo dealer.
5 On later models, the standard fixing is a push fit, where the blade pivot is clipped into the arm connection (photo).
6 Earlier models may have a hook type connection where the blade pivot is clipped into the hooked end of the wiper arm.

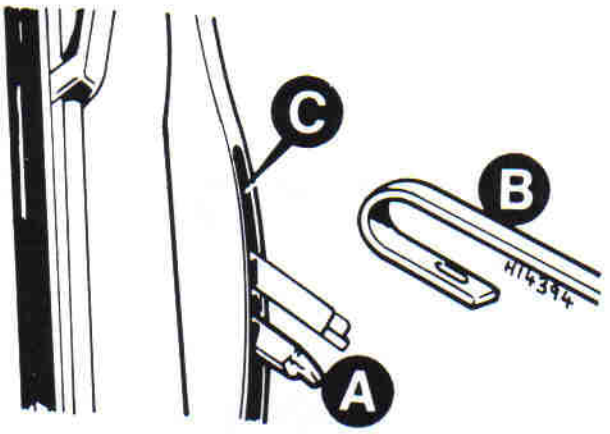
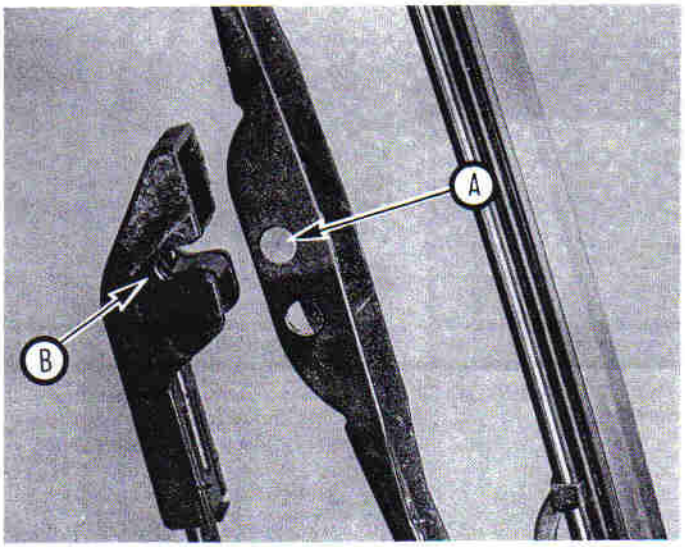


Fig. 12.6 Hook type windscreen wiper blade fixing (Sec 28)

A Tab
B Wiper arm
C Blade slot



28.5 Later type windscreen wiper blade fixture
A Blade pivot *B Arm connection*

29 Windscreen wiper arms – removal and refitting

1 There are two methods of securing the wiper arms to the spindles.

Type 'A' – removal

2 To remove the arm the small spring under the arm must be depressed to release the arm and pull it off (photos).
3 Refit the arm by simply pushing it back on to the spindle.

Type 'B' – removal

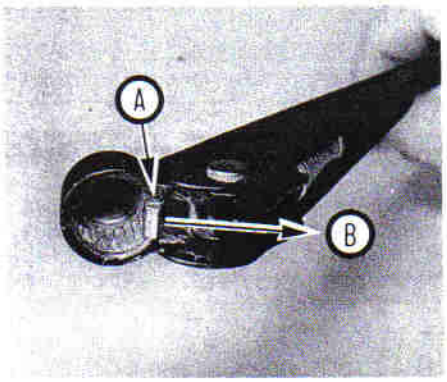
4 Prise out the rubber cap from the spindle cover (photo).
5 Remove the nut and washer and pull off the arm (photos).

Both types – refitting

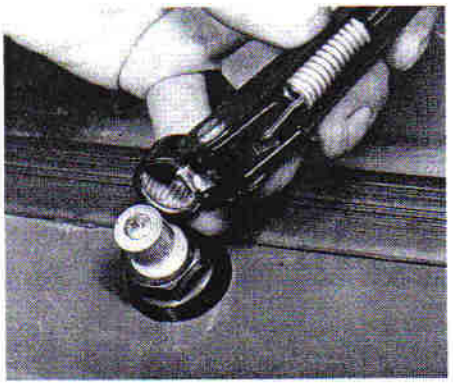
6 Refit in reverse order, but line up the wiper arms/blades, which should be horizontal to the lower edge of the windscreen, before pushing the arm onto the splines of the spindle.
7 If the blades hit the edges of the windscreen in operation remove them and turn them one spline in the required direction.

30 Windscreen wiper motor and linkage – removal and refitting

1 The wiper motor on all models is located under the scuttle.
2 It may be found than on pre-1983 models the motor is on the right-hand side, but on later models it is on the left-hand side. The procedure for removing both is similar, the later type being described here.
3 Remove the wiper arms as described in Section 29.
4 Undo the spindle securing nut on both spindles and remove the base seals (photo).
5 Open the bonnet and remove the spare wheel.
6 Disconnect the electrical plug to the motor.
7 Undo the motor securing bolts (photo).
8 Release the spindle shafts by pushing them down out of the scuttle, and withdraw the motor and linkage assembly from under the scuttle (photo).
9 To remove the motor from the linkage and bracket, undo the motor driveshaft nut and the three bolts securing the motor to the bracket (photo).
10 If the linkage is worn or distorted, or the motor faulty, renew as necessary.



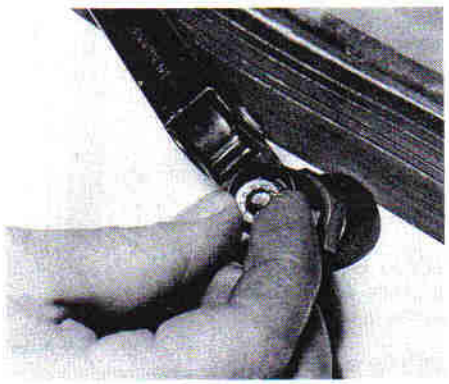
29.2A Spring A must be depressed towards B to remove the arm



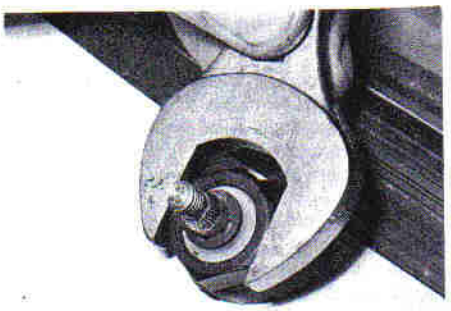
29.2B Lifting the arm from the spindle

29.4 Prise out the rubber cap ...

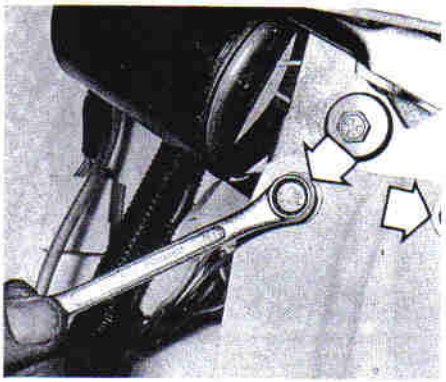
29.5A ... remove the nut ...



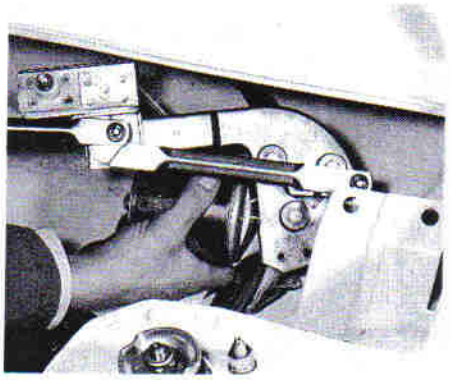
29.5B ... and washer



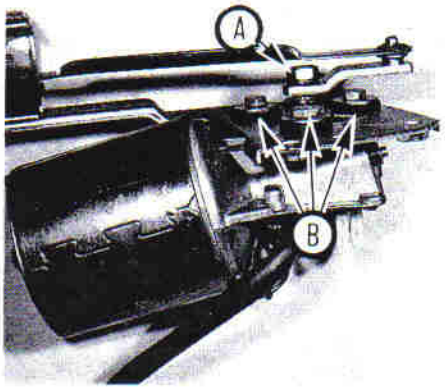
30.4 Undoing the spindle securing nut



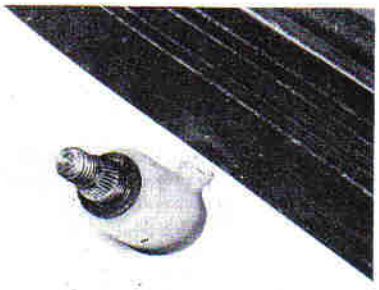
30.7 Undoing the motor securing bolts (arrowed)



30.8 Withdrawing the motor and linkage



30.9 Motor driveshaft nut (A) and motor securing bolts (B)



30.12 Ensure the lugs in the nylon base blocks enters the cut-outs in the scuttle

31.1 Removing a tailgate wiper arm on a 45/55/65 model

11 Refitting is a reversal of removal applying a little grease to all pivot points.
12 Ensure the lugs on the nylon base blocks enter the cut-outs in the shuttle (photo).

31 Tailgate wiper arms (45/55/65 models) – removal and refitting

The procedure is as described in Section 29 (photo).

32 Tailgate wiper motor (45/55/65 models) – removal and refitting

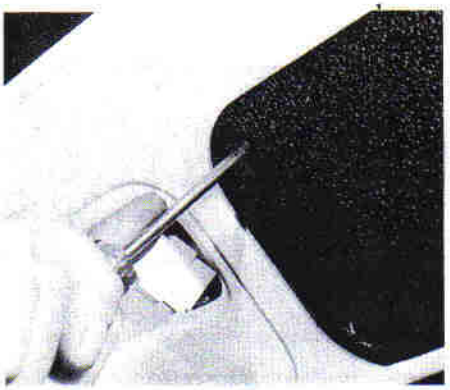
1 Remove the wiper arm as described in Section 29.
2 Undo the large nut securing the wiper shaft and plastic seating to the tailgate.
3 Open the tailgate and remove the plastic panel covering the wiper motor (photo).
4 Separate the electrical connector (photo).
5 Remove the wiper motor securing bolt and withdraw the unit from the tailgate.
6 If the wiper motor is defective, renew the complete unit.
7 Refitting is a reversal of removal.

33 Heated rear window – general

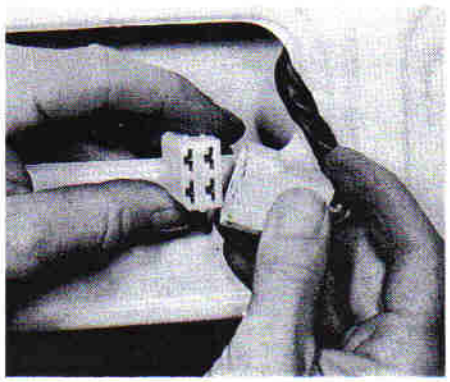
1 The heated rear window element is bonded to the inside of the rear window.
2 Care should be taken when cleaning the inside of the window not to damage the element.
3 If the element does become damaged a commercial electro-conductive paint is available from accessory shops, and the gap in the element can be bridged with the paint thus restoring continuity.
4 Do not leave the heater on any longer than is necessary to clear the window, as it draws a heavy current.
5 The connectors are at each side of the window (photo).

34 Windscreen and tailgate wash system – general

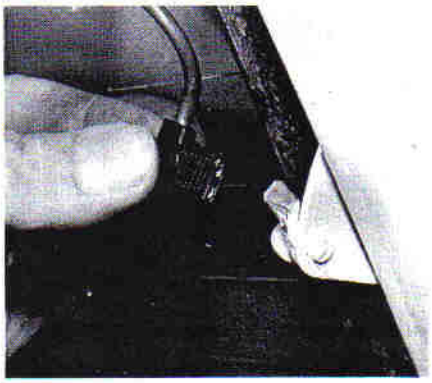
1 The windscreen wash bottle is located on the inner wing by the battery on 3/4/5 series models and by the suspension strut tower on 45/55/65 models.
2 The tailgate wash bottle on 45/55/65 models is mounted in a bracket on the left-hand side of the luggage area.
3 The pump can be removed from all bottles by disconnecting the electrical leads and pulling off the washer tube (photos). Place a finger over the washer tube connection to prevent fluid spillage while the bottle is removed from the bracket (45/55/65 models) or unhooked (3/4/5 series models).
4 Once the bottle is removed, tip out any remaining fluid and pull the pump from the rubber grommet in the bottle.
5 If the motor is defective, renew the motor/pump assembly.
6 Refit in reverse order.
7 The washer jets are a push fit in plastic plugs in the bodywork.
8 Adjust the jet direction by twisting the jet in the plug, and the jet height by moving the nozzle with a screwdriver.
9 The jet should strike the screen at the top centre of the swept area.



32.3 Removing a screw from the plastic trim panel in the tailgate



32.4 Separating the electrical connector



33.5 Typical heated rear window connection

10 Periodically flush the system through with fresh clean water, if the jets are blocked clear them with a pin.
11 Keep the bottle filled with water to which a commercial windscreen wash can be added if desired. Do not use household cleaners as they can cause windscreen smear and dazzle.

35 Cigar lighter – removal and refitting

1 Refer to Chapter 2, and release the heater control console.
2 Disconnect the leads from the back of the cigar lighter (photo).
3 Push the unit from the control panel.
4 Refit in reverse order.

36 Horn – removal and refitting

1 For details of the horn push button refer to Chapter 9.
2 The horn is bolted to the front crossmember and is accessible from under the engine bay.
3 Disconnect the leads to the horn and either remove the nut securing the horn to the bracket, or the nuts securing the bracket to the crossmember (photo).
4 Refit in reverse order.

37 Fuses and relays – general

Fuses

1 On 45/55/65 models the fuse box is located in the engine bay by the side of the heater air inlet duct (photo).
2 On 3/4/5 series models it is situated under the right-hand facia panel.
3 In addition to the fuses in the fuse box, certain circuits may b protected by a line fuse. For instance, on some models the heated rea window and cigar lighter are protected by 16 amp line fuses.
4 To gain access to both types of fuse box, prise off the plastic cove (photos).
5 The fuse numbers and ratings are marked on the cover.
6 If a fuse blows frequently or immediately on renewal, investigat the cause, which is generally defective wiring. Never bridge the fus terminals with silver paper or suchlike which can cause overheating o the protected circuit and subsequent fire.

Relays

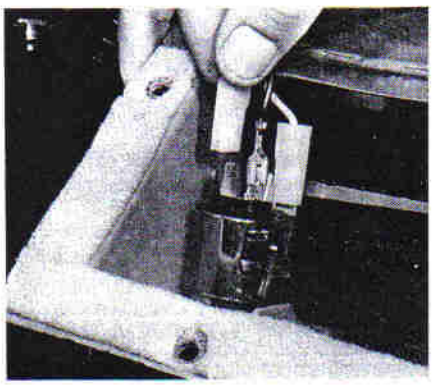
7 Relays are designed to use a small current from a switch to direc larger current to a consumer. Thus lighter wiring can be used for switch gear.
8 On 45/55/65 models most of the relays are mounted by the fus box.
9 On 3/4/5 series models, the relays may be found in various place around the engine bay, by the fuse box, or in other locations.
10 Circuits using relays include:

Direction indicators
Hazard warning
Heated rear screen
Headlamps

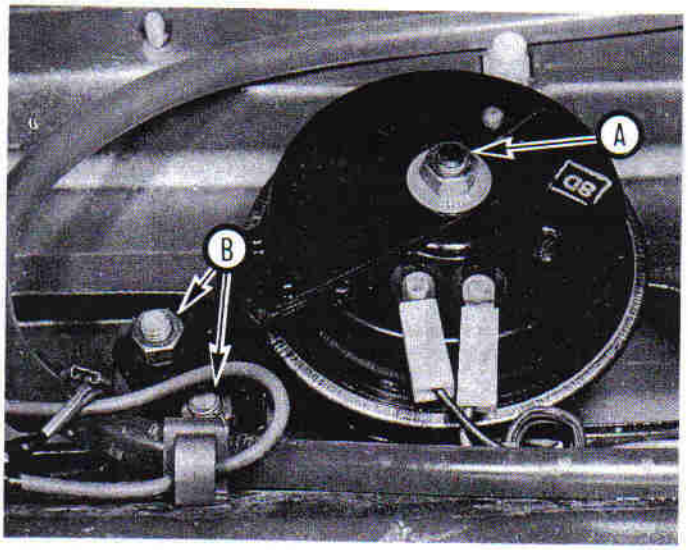
11 On all models the direction indicator flasher unit is mounted on the brake pedal support bracket. On later models the flasher uni incorporates the hazard warning flasher function.
12 On early models a separate relay was used for hazard warning. This is located under the bonnet adjacent to the heater box.
13 One method of identifying a particular relay is to have an assistan listen at the relay while various systems are operated. The relay will be heard to 'click' when it is in use.

34.3A Disconnect the electrical lead ...

34.3B ... and pull off the washer tube

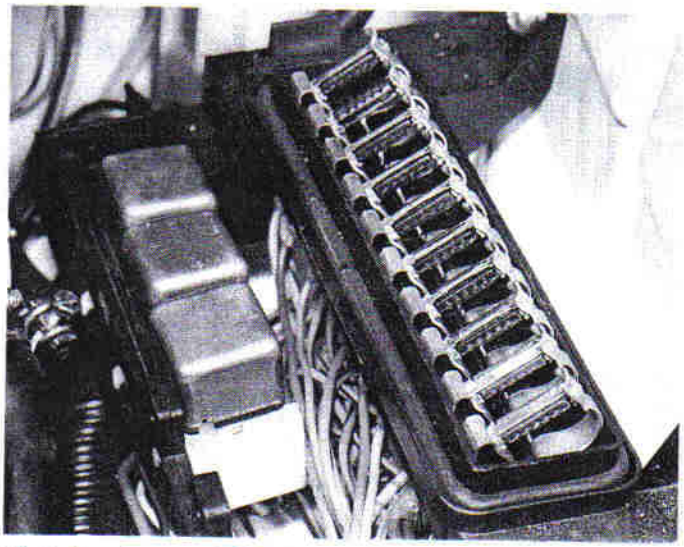


35.2 Disconnecting a cigar lighter

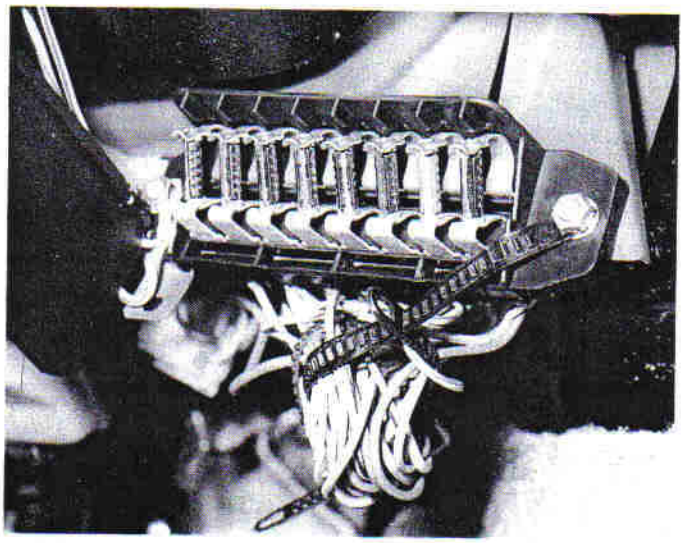


36.3 Horn securing nut (A) and bracket securing nuts (B)

37.1 Fuse box and relays on a 45/55/65 model



37.4A Fuse box on a 45/55/65 model with cover removed ...



37.4B ... and on a 3/4/5 series model

38 Radio – removal and refitting

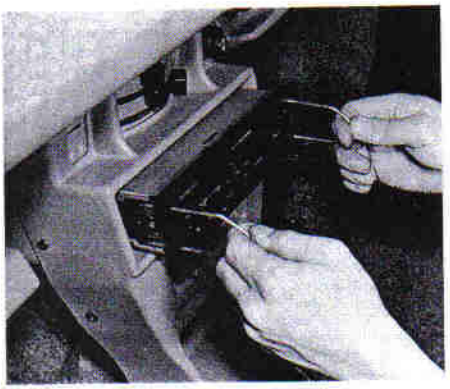
1 Many different types of radio fitment may be encountered depending upon the age of the vehicle.
2 The following procedure is for a 'DIN' standard fit which will be found on many later models. For other types, refer to Section 42.
3 With the radio fitting kit will come two fitting tools. If these are not available they can be obtained from accessory shops.
4 Insert the tools into the holes at either side of the radio to release the internal spring clips securing the radio to the console (photo).
5 Withdraw the radio from the console.
6 Disconnect the multi-plug and aerial (photos).
7 The radio is secured in the console by a metal frame which can be removed from the console by depressing the spring clips at each side (photo).
8 Refitting is a reversal of removal there being no need to use the tools, simply push the radio back into the frame in the console.

39 Radio aerial – removal and refitting

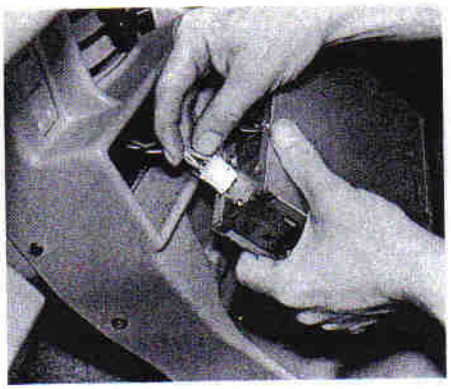
1 The aerial fitted to later 45/55/65 models is contained within the 'A' pillar.
2 For other types of aerial refer to Section 42.
3 To remove the aerial, undo the screws securing the baseplate to the roof panel.
4 Disconnect the aerial lead from the back of the radio and feed it through the underside of the facia so that it lies free in the passenger footwell.
5 Tie a length of stout cord to the free end of the aerial lead.
6 Withdraw the aerial, pulling the lead and cord up through the 'A' pillar (photo).
7 Once the end of the aerial lead appears out of the pillar, untie the cord and leave it in the pillar so that the end of the lead can be pulled back into the vehicle on refitting.
8 Fit the baseplate and tighten the retaining screws.

40 Door-mounted speakers – removal and refitting

1 Undo the screws securing the speaker to the door.
2 Lift off the speaker grille and withdraw the speaker (photo).
3 Disconnect the leads from the back of the speaker before removing it.
4 If the door is being removed, feed the speaker cables through the rubber grommet in the door frame after the trim panel has been removed.



38.4 Withdrawing the radio using the special tools

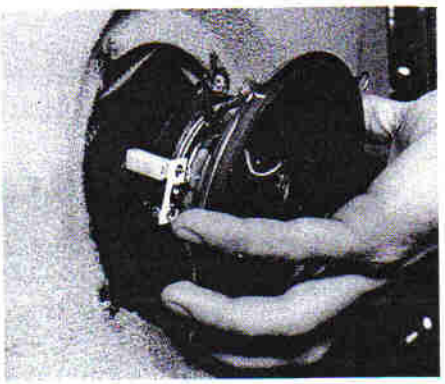


38.6A Disconnect the multi-plug ...

38.6B ... and aerial

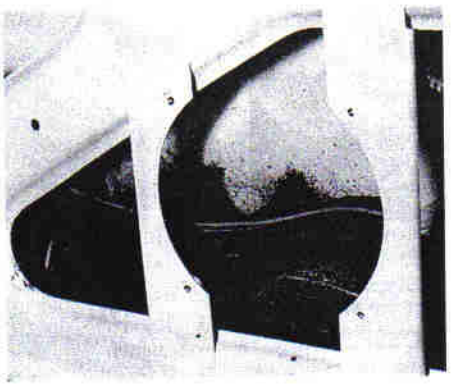
38.7 Removing the metal frame from the console

39.6 Withdrawing the aerial from the 'A' pillar

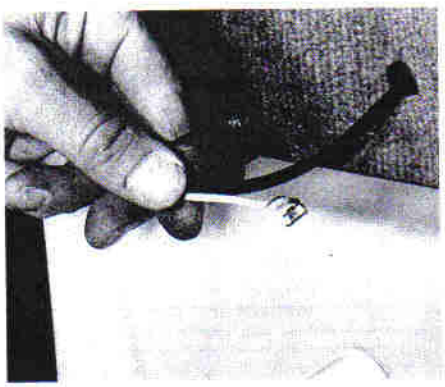


40.2 Withdrawing the speaker

40.3 Speaker leads



40.6 Pre-drilled brackets fitted to the doors of later models



41.2 Rear speaker leads are already installed on later models

5 Refit in reverse order.
6 On later models the doors are fitted with pre-drilled brackets which will accept the Yugo original equipment speakers (photo).

41 Rear shelf-mounted speakers – removal and refitting

1 On later models the rear trim panels at either side of the luggage area are designed to accept additional speakers.
2 The wiring for these speakers is already installed in the vehicle and the ends are taped to the luggage area sides (photo).
3 The speaker can be mounted in the trim panels using self-tapping screws.

42 Mobile radio equipment – interference-free installation

Aerials – selection and fitting

The choice of aerials is now very wide. It should be realised that the quality has a profound effect on radio performance, and a poor, inefficient aerial can make suppression difficult.

A wing-mounted aerial is regarded as probably the most efficient for signal collection, but a roof aerial is usually better for suppression purposes because it is away from most interference fields. Stick-on wire aerials are available for attachment to the inside of the windscreen, but are not always free from the interference field of the engine and some accessories.

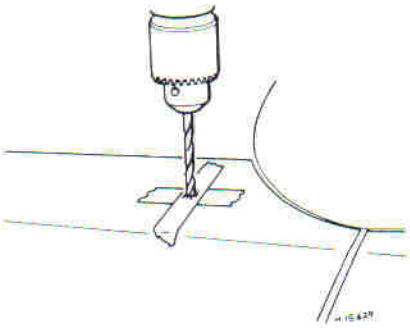


Fig. 12.7 Drilling the bodywork for aerial mounting (Sec 42)

Motorised automatic aerials rise when the equipment is switched on and retract at switch-off. They require more fitting space and supply leads, and can be a source of trouble.

There is no merit in choosing a very long aerial as, for example, the type about three metres in length which hooks or clips on to the rear of the car, since part of this aerial will inevitably be located in an interference field. For VHF/FM radios the best length of aerial is about one metre. Active aerials have a transistor amplifier mounted at the base and this serves to boost the received signal. The aerial rod is sometimes rather shorter than normal passive types.

A large loss of signal can occur in the aerial feeder cable, especially over the Very High Frequency (VHF) bands. The design of feeder cable is invariably in the co-axial form, ie a centre conductor surrounded by a flexible copper braid forming the outer (earth) conductor. Between the inner and outer conductors is an insulator material which can be in solid or stranded form. Apart from insulation, its purpose is to maintain the correct spacing and concentricity. Loss of signal occurs in this insulator, the loss usually being greater in a poor quality cable. The quality of cable used is reflected in the price of the aerial with the attached feeder cable.

The capacitance of the feeder should be within the range 65 to 75 picofarads (pF) approximately (95 to 100 pF for Japanese and American equipment), otherwise the adjustment of the car radio aerial trimmer may not be possible. An extension cable is necessary for a long run between aerial and receiver. If this adds capacitance in excess of the above limits, a connector containing a series capacitor will be required, or an extension which is labelled as 'capacity-compensated'.

Fitting the aerial will normally involve making a 7/8 in (22 mm) diameter hole in the bodywork, but read the instructions that come with the aerial kit. Once the hole position has been selected, use a centre punch to guide the drill. Use sticky masking tape around the area for this helps with marking out and drill location, and gives protection to the paintwork should the drill slip. Three methods of making the hole are in use:

(a) Use a hole saw in the electric drill. This is, in effect, a circular hacksaw blade wrapped round a former with a centre pilot drill.
(b) Use a tank cutter which also has cutting teeth, but is made to shear the metal by tightening with an Allen key.
(c) The hard way of drilling out the circle is using a small drill, say 1/8 in (3 mm), so that the holes overlap. The centre metal drops out and the hole is finished with round and half-round files.

Whichever method is used, the burr is removed from the body metal and paint removed from the underside. The aerial is fitted tightly ensuring that the earth fixing, usually a serrated washer, ring or clamp, is making a solid connection. *This earth connection is important in reducing interference.* Cover any bare metal with primer paint and topcoat, and follow by underseal if desired.

Aerial feeder cable routing should avoid the engine compartment and areas where stress might occur, eg under the carpet where feet will be located. Roof aerials require that the headlining be pulled back and that a path is available down the door pillar. It is wise to check with the vehicle dealer whether roof aerial fitting is recommended.

Loudspeakers

Speakers should be matched to the output stage of the equipment, particularly as regards the recommended impedance. Power transistors used for driving speakers are sensitive to the loading placed on them.

Before choosing a mounting position for speakers, check whether the vehicle manufacturer has provided a location for them. Generally door-mounted speakers give good stereophonic reproduction, but not all doors are able to accept them. The next best position is the rear parcel shelf, and in this case speaker apertures can be cut into the shelf, or pod units may be mounted.

For door mounting, first remove the trim, which is often held on by 'poppers' or press studs, and then select a suitable gap in the inside door assembly. Check that the speaker would not obstruct glass or winder mechanism by winding the window up and down. A template is often provided for marking out the trim panel hole, and then the four fixing holes must be drilled through. Mark out with chalk and cut cleanly with a sharp knife or keyhole saw. Speaker leads are then threaded through the door and door pillar, if necessary drilling 10 mm diameter holes. Fit grommets in the holes and connect to the radio or tape unit correctly. Do not omit a waterproofing cover, usually supplied with door speakers. If the speaker has to be fixed into the metal of the door itself, use self-tapping screws, and if the fixing is to the door trim use self-tapping screws and flat spire nuts.

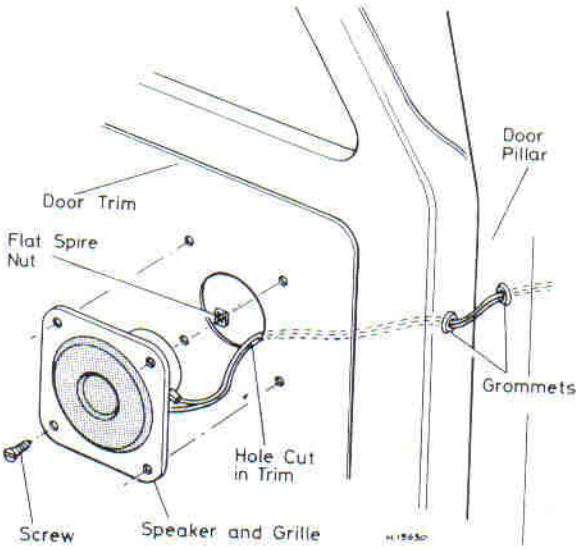


Fig. 12.8 Door-mounted speaker installation (Sec 42)

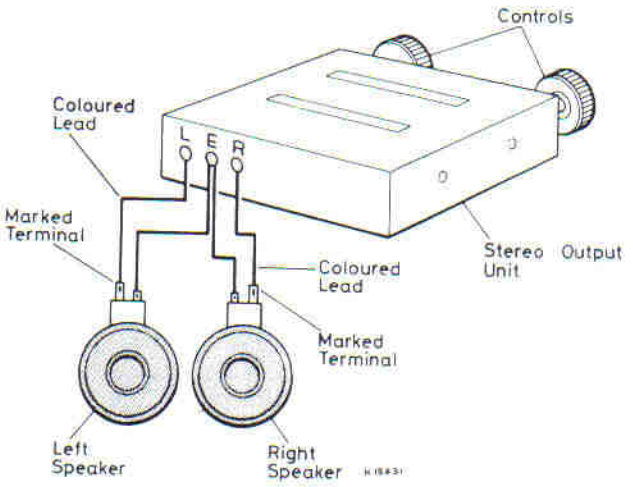


Fig. 12.9 Speaker connections must be correctly made as shown (Sec 42)

Rear shelf mounting is somewhat simpler but it is necessary to find gaps in the metalwork underneath the parcel shelf. However, remember that the speakers should be as far apart as possible to give a good stereo effect. Pod-mounted speakers can be screwed into position through the parcel shelf material, but it is worth testing for the best position. Sometimes good results are found by reflecting sound off the rear window.

Unit installation

Many vehicles have a dash panel aperture to take a radio/audio unit, a recognised international standard being 189.5 mm x 60 mm. Alternatively a console may be a feature of the car interior design and this, mounted below the dashboard, gives more room. If neither facility is available a unit may be mounted on the underside of the parcel shelf; these are frequently non-metallic and an earth wire from the case to a good earth point is necessary. A three-sided cover in the form of a cradle is obtainable from car radio dealers and this gives a professional appearance to the installation; in this case choose a position where the controls can be reached by a driver with his seat belt on.

Installation of the radio/audio unit is basically the same in all cases, and consists of offering it into the aperture after removal of the knobs (*not* push buttons) and the trim plate. In some cases a special mounting plate is required to which the unit is attached. It is worthwhile supporting the rear end in cases where sag or strain may occur, and it is usually possible to use a length of perforated metal strip attached between the unit and a good support point nearby. In general it is recommended that tape equipment should be installed at or nearly horizontal.

Connections to the aerial socket are simply by the standard plug terminating the aerial downlead or its extension cable. Speakers for a stereo system must be matched and correctly connected, as outlined previously.

Note: *While all work is carried out on the power side, it is wise to disconnect the battery earth lead.* Before connection is made to the vehicle electrical system, check that the polarity of the unit is correct. Most vehicles use a negative earth system, but radio/audio units often have a reversible plug to convert the set to either + or – earth. *Incorrect connection may cause serious damage.*

The power lead is often permanently connected inside the unit and terminates with one half of an in-line fuse carrier. The other half is fitted with a suitable fuse (3 or 5 amperes) and a wire which should go to a power point in the electrical system. This may be the accessory terminal on the ignition switch, giving the advantage of power feed with ignition or with the ignition key at the 'accessory' position. Power to the unit stops when the ignition key is removed. Alternatively, the lead may be taken to a live point at the fusebox with the consequence of having to remember to switch off at the unit before leaving the vehicle.

Before switching on for initial test, be sure that the speaker connections have been made, for running without load can damage the output transistors. Switch on next and tune through the bands to ensure that all sections are working, and check the tape unit if applicable. The aerial trimmer should be adjusted to give the strongest reception on a weak signal in the medium wave band, at say 200 metres.

Interference

In general, when electric current changes abruptly, unwanted electrical noise is produced. The motor vehicle is filled with electrical devices which change electric current rapidly, the most obvious being the contact breaker.

When the spark plugs operate, the sudden pulse of spark current causes the associated wiring to radiate. Since early radio transmitters used sparks as a basis of operation, it is not surprising that the car radio

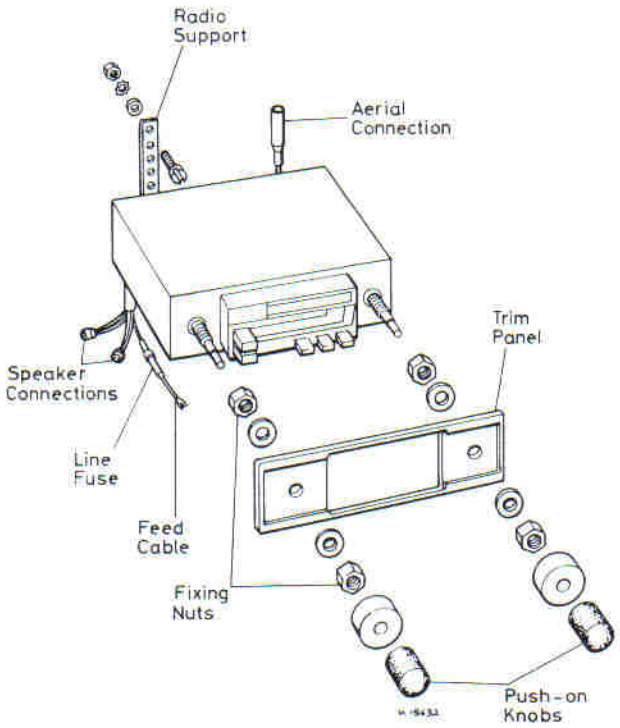


Fig. 12.10 Mounting component details for radio/cassette unit (Sec 42)

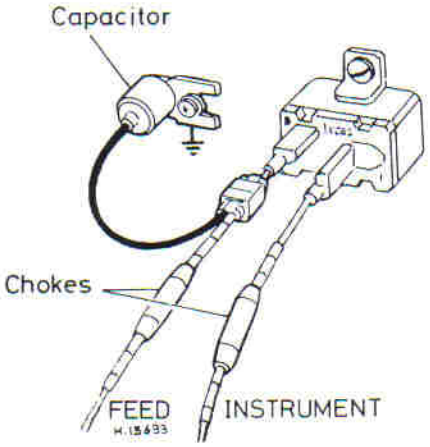


Fig. 12.11 Voltage regulator interference suppression (Sec 42)

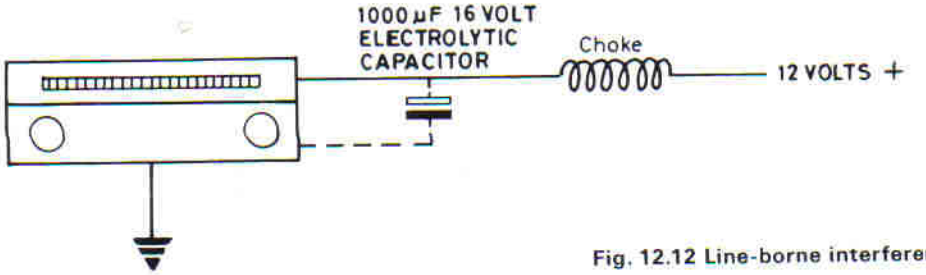


Fig. 12.12 Line-borne interference suppression (Sec 42)

will pick up ignition spark noise unless steps are taken to reduce it to acceptable levels.

Interference reaches the car radio in two ways:

(a) by conduction through the wiring.
(b) by radiation to the receiving aerial.

Initial checks presuppose that the bonnet is down and fastened, the radio unit has a good earth connection *(not* through the aerial downlead outer), no fluorescent tubes are working near the car, the aerial trimmer has been adjusted, and the vehicle is in a position to receive radio signals, ie not in a metal-clad building.

Switch on the radio and tune it to the middle of the medium wave (MW) band off-station with the volume (gain) control set fairly high. Switch on the ignition (but do not start the engine) and wait to see if irregular clicks or hash noise occurs. Tapping the facia panel may also produce the effects. If so, this will be due to the voltage stabiliser, which is an on-off thermal switch to control instrument voltage. It is located usually on the back of the instrument panel, often attached to the speedometer. Correction is by attachment of a capacitor and, if still troublesome, chokes in the supply wires.

Switch on the engine and listen for interference on the MW band. Depending on the type of interference, the indications are as follows.

A harsh crackle that drops out abruptly at low engine speed or when the headlights are switched on is probably due to a voltage regulator.

A whine varying with engine speed is due to the alternator. Try temporarily taking off the fan belt – if the noise goes this is confirmation.

Regular ticking or crackle that varies in rate with the engine speed is due to the ignition system. With this trouble in particular and others in general, check to see if the noise is entering the receiver from the wiring or by radiation. To do this, pull out the aerial plug, (preferably shorting out the input socket or connecting a 62 pF capacitor across it). If the noise disappears it is coming in through the aerial and is *radiation noise*. If the noise persists it is reaching the receiver through the wiring and is said to be *line-borne*.

Interference from wipers, washers, heater blowers, turn-indicators, stop lamps, etc is usually taken to the receiver by wiring, and simple treatment using capacitors and possibly chokes will solve the problem. Switch on each one in turn (wet the screen first for running wipers!) and listen for possible interference with the aerial plug in place and again when removed.

Electric petrol pumps are now finding application again and give rise to an irregular clicking, often giving a burst of clicks when the ignition is on but the engine has not yet been started. It is also possible to receive whining or crackling from the pump.

Note that if most of the vehicle accessories are found to be creating interference all together, the probability is that poor aerial earthing is to blame.

Suppression methods – ignition

Suppressed HT cables are supplied as original equipment by manufacturers and will meet regulations as far as interference to neighbouring equipment is concerned. It is illegal to remove such suppression unless an alternative is provided, and this may take the form of resistive spark plug caps in conjunction with plain copper HT cable. For VHF purposes, these and 'in-line' resistors may not be effective, and resistive HT cable is preferred. Check that suppressed cables are actually fitted by observing cable identity lettering, or measuring with an ohmmeter – the value of each plug lead should be 5000 to 10 000 ohms.

A 1 microfarad capacitor connected from the LT supply side of the ignition coil to a good nearby earth point will complete basic ignition interference treatment. *NEVER fit a capacitor to the coil terminal to the contact breaker – the result would be burnt out points in a short time.*

If ignition noise persists despite the treatment above, the following sequence should be followed:

(a) Check the earthing of the ignition coil; remove paint from fixing clamp.
(b) If this does not work, lift the bonnet. Should there be no change in interference level, this may indicate that the bonnet is not electrically connected to the car body. Use a proprietary braided strap across a bonnet hinge ensuring a first class electrical connection. If, however, lifting the bonnet increases the interference, then fit resistive HT cables of a higher ohms-per-metre value.

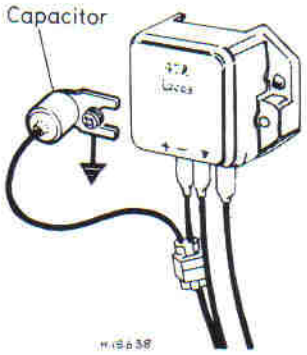


Fig. 12.13 Electronic voltage regulator suppression (Sec 42)

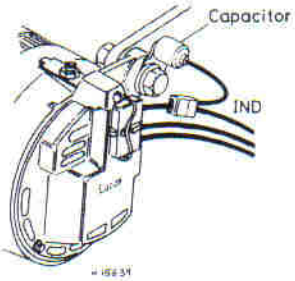


Fig. 12.14 Suppression of interference from electronic voltage regulator when integral with alternator (Sec 42)

(c) If all these measures fail, it is probable that re-radiation from metallic components is taking place. Using a braided strap between metallic points, go round the vehicle systematically – try the following: engine to body, exhaust system to body, front suspension to engine and to body, steering column to body (especially French and Italian cars), gear lever to engine and to body (again especially French and Italian cars), Bowden cable to body, metal parcel shelf to body. When an offending component is located it should be bonded with the strap permanently.
(d) As a next step, the fitting of distributor suppressors to each lead at the distributor end may help.
(e) Beyond this point is involved the possible screening of the distributor and fitting resistive spark plugs, but such advanced treatment is not usually required for vehicles with entertainment equipment.

Electronic ignition systems have built-in suppression components, but this does not relieve the need for using suppressed HT leads. In some cases it is permitted to connect a capacitor on the low tension supply side of the ignition coil, but not in every case. Makers' instructions should be followed carefully, otherwise damage to the ignition semiconductors may result.

Suppression methods – voltage regulators

Voltage regulators used with DC dynamos should be suppressed by connecting a 1 microfarad capacitor from the control box D terminal to earth.

Alternator regulators come in three types:

(a) Vibrating contact regulators separate from the alternator. Used extensively on continental vehicles.
(b) Electronic regulators separate from the alternator.
(c) Electronic regulators built-in to the alternator.

In case (a) interference may be generated on the AM and FM (VHF) bands. For some cars a replacement suppressed regulator is available. Filter boxes may be used with non-suppressed regulators. But if not available, then for AM equipment a 2 microfarad or 3 microfarad capacitor may be mounted at the voltage terminal marked D+ or B+ of the regulator. FM bands may be treated by a feed-through capacitor of 2 or 3 microfarad.

Electronic voltage regulators are not always troublesome, but where necessary, a 1 microfarad capacitor from the regulator + terminal will help.

Integral electronic voltage regulators do not normally generate much interference, but when encountered this is in combination with alternator noise. A 1 microfarad or 2 microfarad capacitor from the warning lamp (IND) terminal to earth for Lucas ACR alternators and Femsa, Delco and Bosch equivalents should cure the problem.

Suppression methods – other equipment

Wiper motors – Connect the wiper body to earth with a bonding strap. For all motors use a 7 ampere choke assembly inserted in the leads to the motor.

Heater motors – Fit 7 ampere line chokes in both leads, assisted if necessary by a 1 microfarad capacitor to earth from both leads.

Electronic tachometer – The tachometer is a possible source of ignition noise – check by disconnecting at the ignition coil CB terminal. It usually feeds from ignition coil LT pulses at the contact breaker terminal. A 3 ampere line choke should be fitted in the tachometer lead at the coil CB terminal.

Horn – A capacitor and choke combination is effective if the horn is directly connected to the 12 volt supply. The use of a relay is an alternative remedy, as this will reduce the length of the interference-carrying leads.

Electrostatic noise – Characteristics are erratic crackling at the receiver, with disappearance of symptoms in wet weather. Often shocks may be given when touching bodywork. Part of the problem is the build-up of static electricity in non-driven wheels and the acquisition of charge on the body shell. It is possible to fit spring-loaded contacts at the wheels to give good conduction between the rotary wheel parts and the vehicle frame. Changing a tyre sometimes helps – because of tyres' varying resistances. In difficult cases a trailing flex which touches the ground will cure the problem. If this is not acceptable it is worth trying conductive paint on the tyre walls.

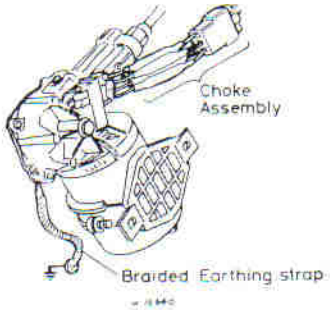


Fig. 12.15 Wiper motor suppression (Sec 42)

Fluorescent tubes – Vehicles used for camping/caravanning frequently have fluorescent tube lighting. These tubes require a relatively high voltage for operation and this is provided by an inverter (a form of oscillator) which steps up the vehicle supply voltage. This can give rise to serious interference to radio reception, and the tubes themselves can contribute to this interference by the pulsating nature of the lamp discharge. In such situations it is important to mount the aerial as far away from a fluorescent tube as possible. The interference problem may be alleviated by screening the tube with fine wire turns spaced an inch (25 mm) apart and earthed to the chassis. Suitable chokes should be fitted in both supply wires close to the inverter.

Radio/cassette case breakthrough

Magnetic radiation from dashboard wiring may be sufficiently intense to break through the metal case of the radio/cassette player. Often this is due to a particular cable routed too close and shows up as ignition interference on AM and cassette play and/or alternator whine on cassette play.

The first point to check is that the clips and/or screws are fixing all parts of the radio/cassette case together properly. Assuming good earthing of the case, see if it is possible to re-route the offending cable – the chances of this are not good, however, in most cars.

Next release the radio/cassette player and locate it in different positions with temporary leads. If a point of low interference is found, then if possible fix the equipment in that area. This also confirms that local radiation is causing the trouble. If re-location is not feasible, fit the radio/cassette player back in the original position.

Alternator interference on cassette play is now caused by radiation from the main charging cable which goes from the battery to the output terminal of the alternator, usually via the + terminal of the starter motor relay. In some vehicles this cable is routed under the dashboard, so the solution is to provide a direct cable route. Detach the original cable from the alternator output terminal and make up a new cable of at least 6 mm² cross-sectional area to go from alternator to battery with the shortest possible route. *Remember – do not run the engine with the alternator disconnected from the battery.*

Ignition breakthrough on AM and/or cassette play can be a difficult problem. It is worth wrapping earthed foil round the offending cable run near the equipment, or making up a deflector plate well screwed down to a good earth. Another possibility is the use of a suitable relay to switch on the ignition coil. The relay should be mounted close to the ignition coil, with this arrangement the ignition coil primary current is not taken into the dashboard area and does not flow through the ignition switch. A suitable diode should be used since it is possible that at ignition switch-off the output from the warning lamp alternator terminal could hold the relay on.

Connectors for suppression components

Capacitors are usually supplied with tags on the end of the lead, while the capacitor body has a flange with a slot or hole to fit under a nut or screw with washer.

Connections to feed wires are best achieved by self-stripping connectors. These connectors employ a blade which, when squeezed down by pliers, cuts through cable insulation and makes connection to the copper conductors beneath.

Chokes sometimes come with bullet snap-in connectors fitted to the wires, and also with just bare copper wire. With connectors, suitable female cable connectors may be purchased from an auto-accessory shop together with any extra connectors required for the cable ends after being cut for the choke insertion. For chokes with bare wires, similar connectors may be employed together with insulation sleeving as required.

VHF/FM broadcasts

Reception of VHF/FM in an automobile is more prone to problems than the medium and long wavebands. Medium/long wave transmitters are capable of covering considerable distances, but VHF transmitters are restricted to line of sight, meaning ranges of 10 to 50 miles, depending upon the terrain, the effects of buildings and the transmitter power.

Because of the limited range it is necessary to retune on a long journey, and it may be better for those habitually travelling long distances or living in areas of poor provision of transmitters to use an AM radio working on medium/long wavebands.

When conditions are poor, interference can arise, and some of the suppression devices described previously fall off in performance at very high frequencies unless specifically designed for the VHF band. Available suppression devices include reactive HT cable, resistive distributor caps, screened plug caps, screened leads and resistive spark plugs.

For VHF/FM receiver installation the following points should be particularly noted:

(a) Earthing of the receiver chassis and the aerial mounting is important. Use a separate earthing wire at the radio, and scrape paint away at the aerial mounting.
(b) If possible, use a good quality roof aerial to obtain maximum height and distance from interference generating devices on the vehicle.
(c) Use of a high quality aerial downlead is important, since losses in cheap cable can be significant.
(d) The polarisation of FM transmissions may be horizontal, vertical, circular or slanted. Because of this the optimum mounting angle is at 45° to the vehicle roof.

Other vehicle radio transmitters

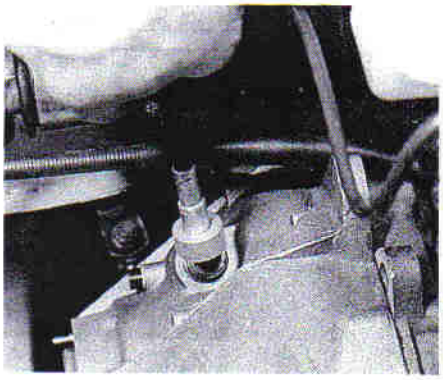
Besides CB radio, a considerable increase in the use of transceivers (ie combined transmitter and receiver units) has taken place in the last decade. Previously this type of equipment was fitted mainly to military, fire, ambulance and police vehicles, but a large business radio and radio telephone usage has developed.

Generally the suppression techniques described previously will suffice, with only a few difficult cases arising. Suppression is carried out to satisfy the 'receive mode', but care must be taken to use heavy

duty chokes in the equipment supply cables since the loading on 'transmit' is relatively high.

43 Speedometer cable – removal and refitting

1 Refer to Section 27 for disconnection of the cable from the instrument panel.
2 Disconnect the gearbox end by unscrewing the knurled nut on the gearcase (photo).
3 Once both ends are free, feed the cable through the engine bulkhead into the engine bay.
4 Refit in reverse order.



43.2 Disconnecting the speedometer cable from the gear case

44 Fault diagnosis – electrical system

Symptom	Reason(s)
No voltage at starter motor	Battery discharged Battery defective internally Battery terminals loose or earth lead not securely attached to body Loose or broken connections in starter motor circuit Starter motor switch or solenoid faulty
Voltage at starter motor – faulty motor	Starter brushes badly worn, sticking, or brush wires loose Commutator dirty, worn or burnt Starter motor armature faulty Field coils earthed
Starter motor noisy or rough in engagement	Pinion or flywheel gear teeth broken or worn Starter motor retaining bolts loose
Alternator not charging*	Drivebelt loose and slipping, or broken Brushes worn, sticking, broken or dirty Brush springs weak or broken Faulty regulator
**If all appears to be well but the alternator is still not charging, take the car to an automobile electrician for checking of the alternator*	
Battery will not hold charge for more than a few days	Battery defective internally Electrolyte level too low or electrolyte too weak due to leakage Plate separators no longer fully effective Battery plates severely sulphated Drivebelt slipping Battery terminal connections loose or corroded Alternator not charging properly Short in lighting circuit causing continual battery drain Faulty regulator
Ignition light fails to go out, battery runs flat in a few days	Drivebelt loose and slipping, or broken Alternator faulty Faulty regulator
Failure of individual electrical equipment to function correctly is dealt with alphabetically below	
Fuel gauge gives no reading	Fuel tank empty! Electric cable between tank sender unit and gauge earthed or loose Fuel gauge case not earthed Fuel gauge supply cable interrupted Fuel gauge broken
Fuel gauge registers full all the time	Electric cable between tank unit and gauge broken or disconnected
Horn operates all the time	Horn push either earthed or stuck down Horn cable to horn push earthed
Horn fails to operate	Blown fuse Cable or cable connection loose, broken or disconnected Horn has an internal fault
Horn emits intermittent or unsatisfactory noise	Cable connections loose Horn incorrectly adjusted

Symptom	Reason(s)
Lights do not come on	If engine not running, battery discharged Light bulb filament burnt out or bulbs broken Wire connections loose, disconnected or broken Light switch shorting or otherwise faulty
Lights come on but fade out	If engine not running, battery discharged
Lights give very poor illumination	Lamp glasses dirty Reflector tarnished or dirty Lamps badly out of adjustment Incorrect bulb with too low wattage fitted Existing bulbs old and badly discoloured Electrical wiring too thin not allowing full current to pass
Lights work erratically, flashing on and off, especially over bumps	Battery terminals or earth connections loose Lights not earthing properly Contacts in light switch faulty
Wiper motor fails to work	Blown fuse Wire connections loose, disconnected or broken Brushes badly worn Armature worn or faulty Field coils faulty
Wiper motor works very slowly and takes excessive current	Commutator dirty, greasy or burnt Drive spindle binding or damaged Armature bearings dry or unaligned Armature badly worn or faulty
Wiper motor works slowly and takes little current	Brushes badly worn Commutator dirty, greasy or burnt Armature badly worn or faulty
Wiper motor works but wiper blade remains static	Drive spindle damaged or worn Wiper motor gearbox parts badly worn

Key to Fig. 12.16

1 *Headlight and sidelight*
2 *Front indicator light*
3 *Side repeater light*
4 *Horn*
5 *Alternator*
6 *Voltage regulator*
7 *Condenser*
8 *Ignition coil*
9 *Distributor*
10 *Spark plugs*
11 *Cooling fan thermal switch*
12 *Water temperature sensor*
13 *Oil pressure switch*
14 *Starter motor*
15 *Cooling fan motor*
16 *Battery*
17 *16 amp line fuse*
18 *Heated rear window relay*
19 *Windscreen washer pump*
20 *16 amp fuse*
21 *Fuse box*
22 *Brake light switch*
23 *Direction indicator flasher unit*
24 *Brake failure warning light (certain models only)*
25 *Windscreen wiper relay*
26 *Windscreen wiper motor*
27 *Heater fan motor*
28 *Hazard warning flasher unit*
29 *Courtesy light microswitch*
30 *Reversing light switch*
31 *Heated rear window switch*
32 *Handbrake 'on' switch*
33 *Courtesy lights*
34 *Speedometer*
35 *Sidelights 'on' warning light*
36 *Fuel gauge*
37 *Main beam warning light*
38 *Low fuel level warning light*
39 *Direction indicators 'on' warning light*
40 *Coolant temperature warning light*
41 *Oil pressure warning light*
42 *No-charge warning light*
43 *Fuel gauge sender unit*
44 *Hand lamp socket (certain models only)*
45 *Main light switch*
46 *Direction indicators switch*
47 *Headlight main/dipped beam switch*
48 *Horn button*
49 *Heated rear window*
50 *Windscreen wash/wipe switch*
51 *Ignition switch*
52 *Cigar lighter*
53 *Handbrake 'on' warning light*
54 *Heater fan switch*
55 *Hazard warning light switch*
56 *Rear foglight switch*
57 *Rear light cluster*
58 *Rear foglight (alternative)*
59 *Reversing light*
60 *Number plate light*

Colour code for Fig. 12.16

A Blue
B White
C Orange
G Yellow
H Grey
L Light blue
M Brown
N Black
R Red
S Pink
V Green
Z Violet
AN Blue/black
BN White/black
GN Yellow/black
HN Grey/black
VN Green/black
HR Grey/red
AB Blue/white
NZ Black/violet
ZB Violet/white
BR White/red
GR Yellow/red
SG Pink/yellow
VB Green/white
AB Blue/white
HG Grey/yellow

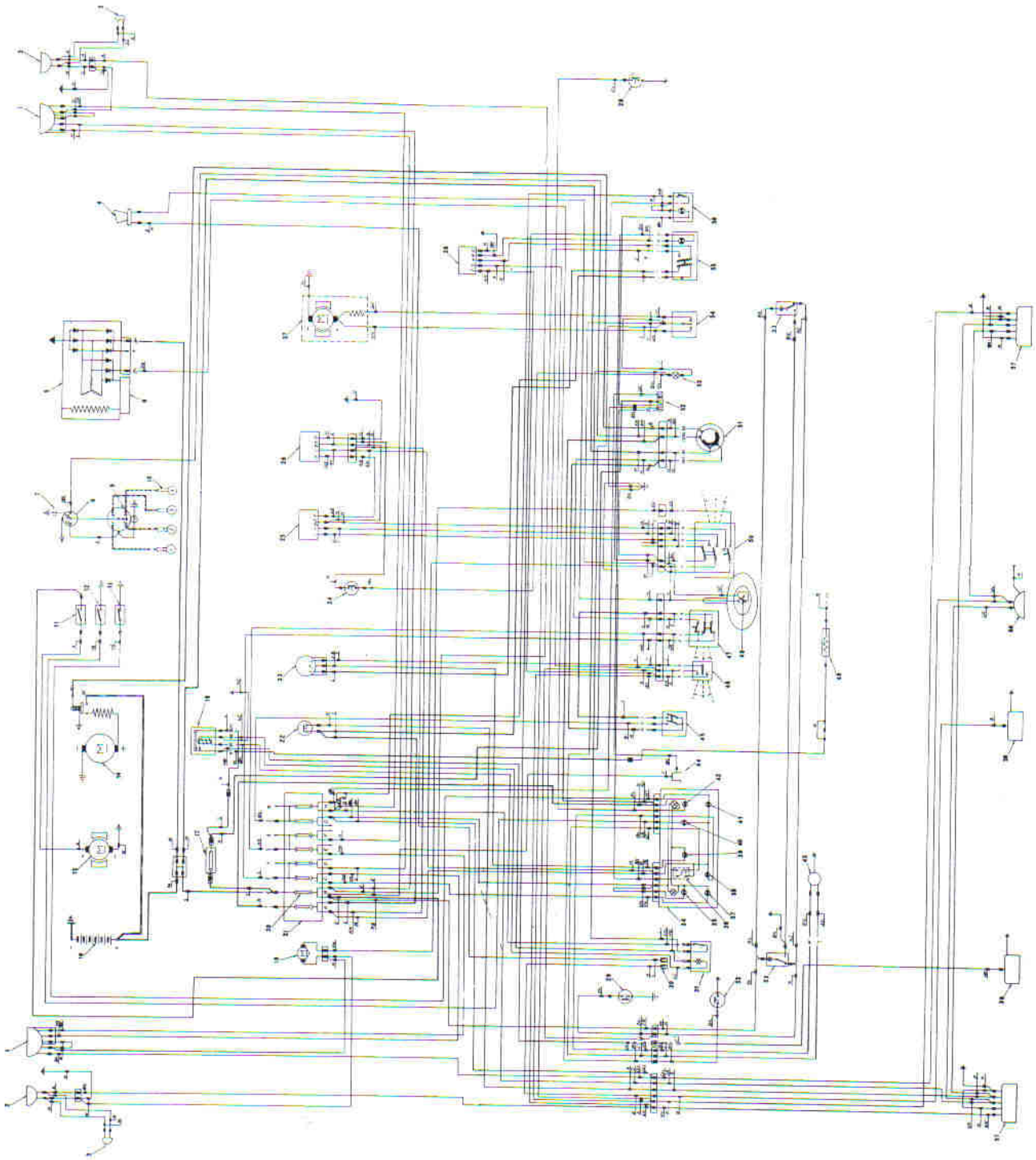


Fig. 12.16 Wiring diagram for 3/4/5 series models

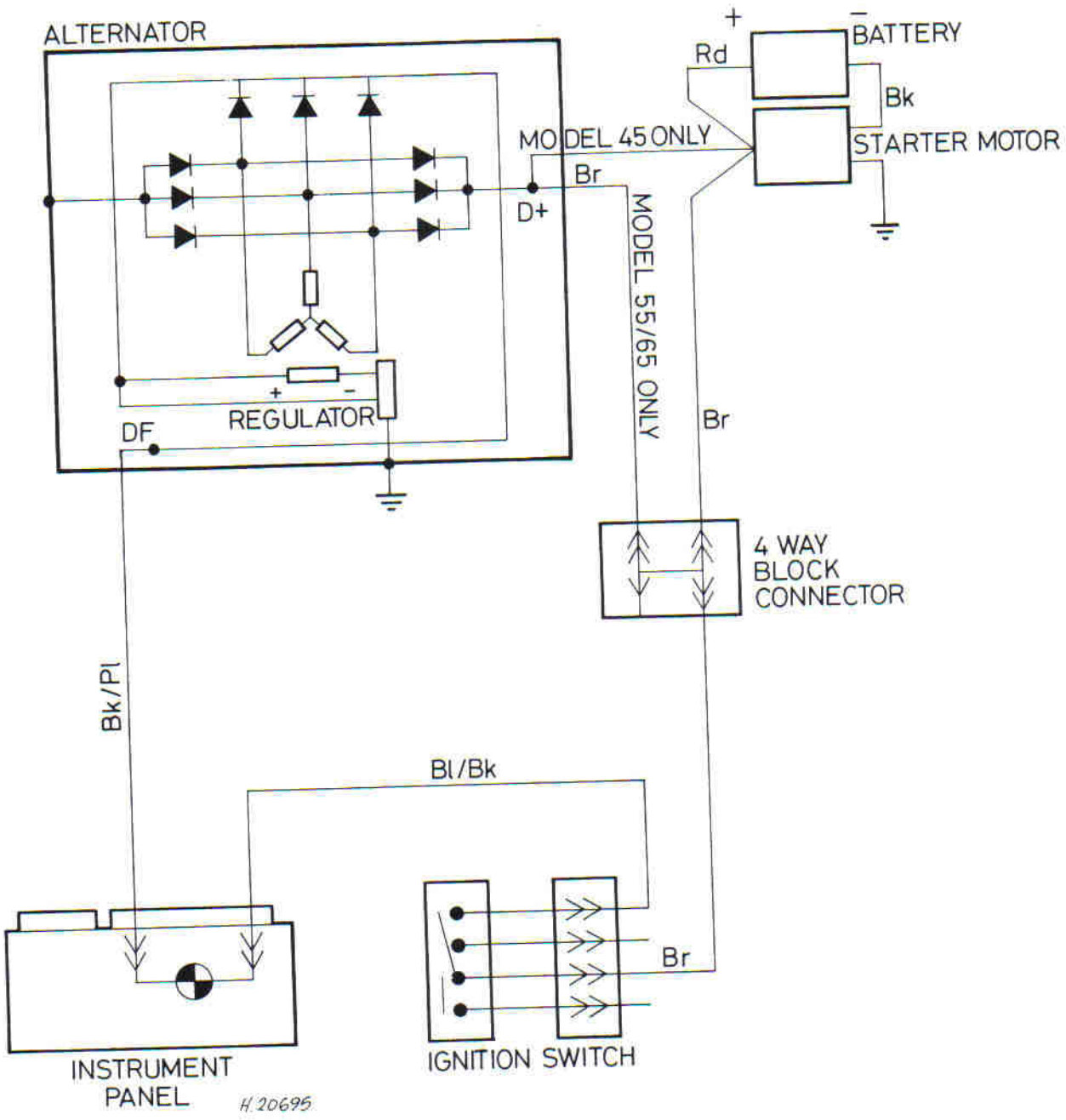


Fig. 12.17 Wiring diagram for 45, 55 and 65 models – charging system

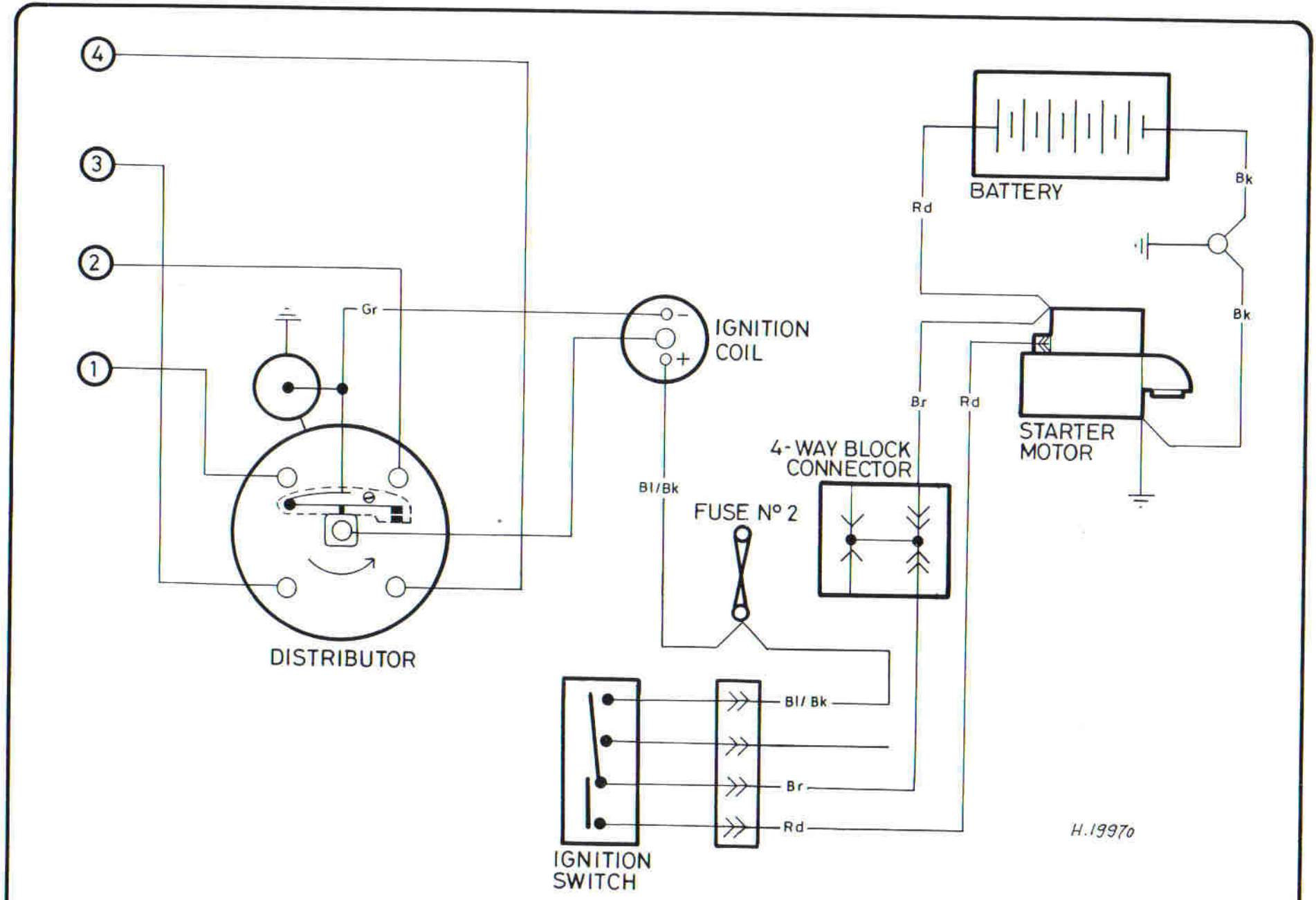


Fig. 12.18 Wiring diagram for 45 models – starter and ignition systems

Colour code for Figs. 12.17 to 12.29

No	Description
Br	Brown
Bl	Blue
Bk	Black
Gr	Green
Gy	Grey
Lt Bl	Light blue
Pi	Pink
Pl	Purple
Or	Orange
Rd	Red
Vi	Violet
Wt	White
Yl	Yellow

No	Description
Br/Bk	Brown/Black
Bk/Vi	Black/Violet
Gr/Bk	Green/Black
Gy/Bk	Grey/Black
Lt Bl/Bk	Light Blue/Black
Pi/Bk	Pink/Black
Rd/Bk	Red/Black
Rd/Gr	Red/Green
Vi/Wt	Violet/White
Vi/Bk	Violet/Black
Wt/Bk	White/Black
Wt/Rd	White/Red
Yl/Bk	Yellow/Black

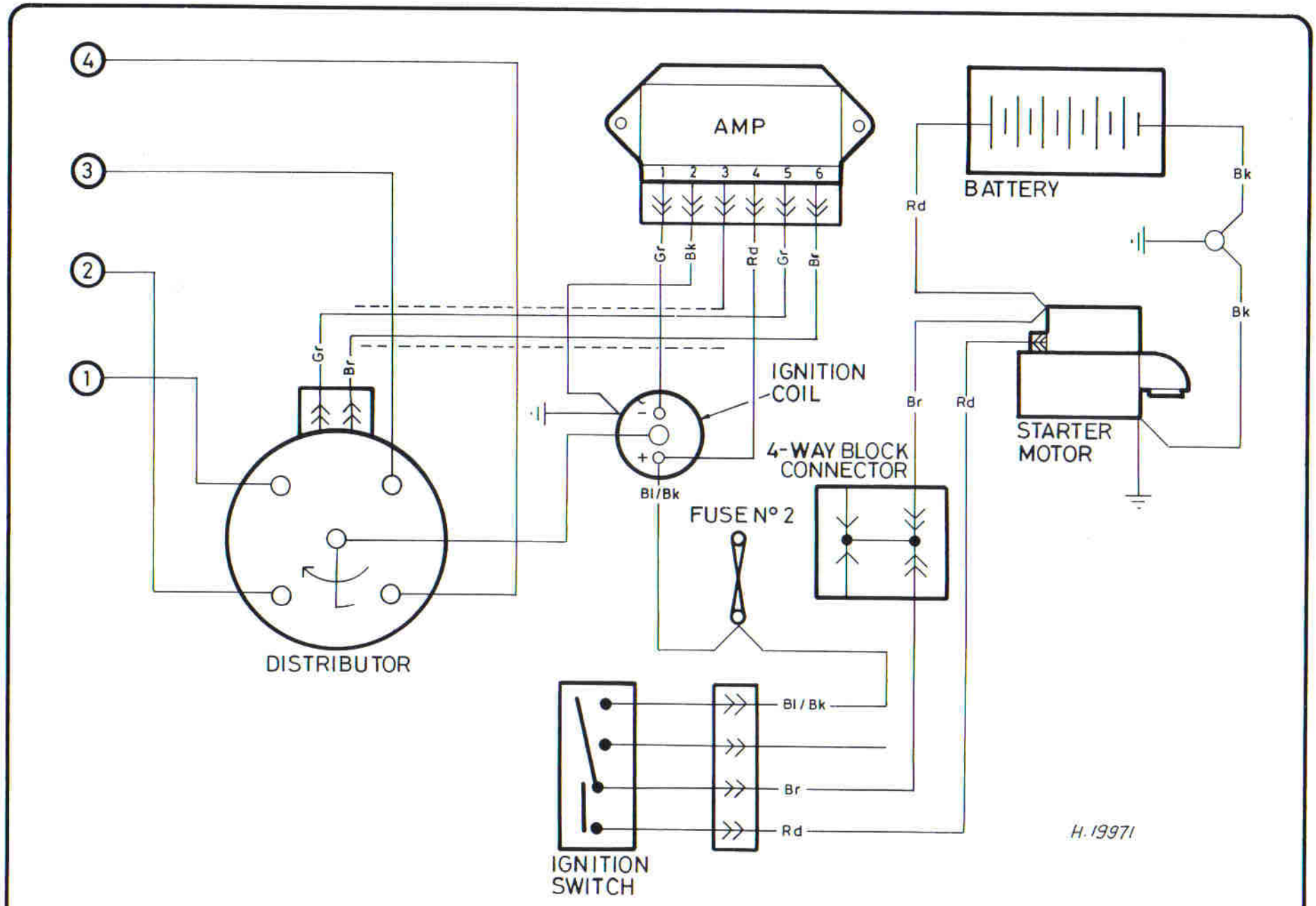


Fig. 12.19 Wiring diagram for 55 and 65 models – starter and ignition systems

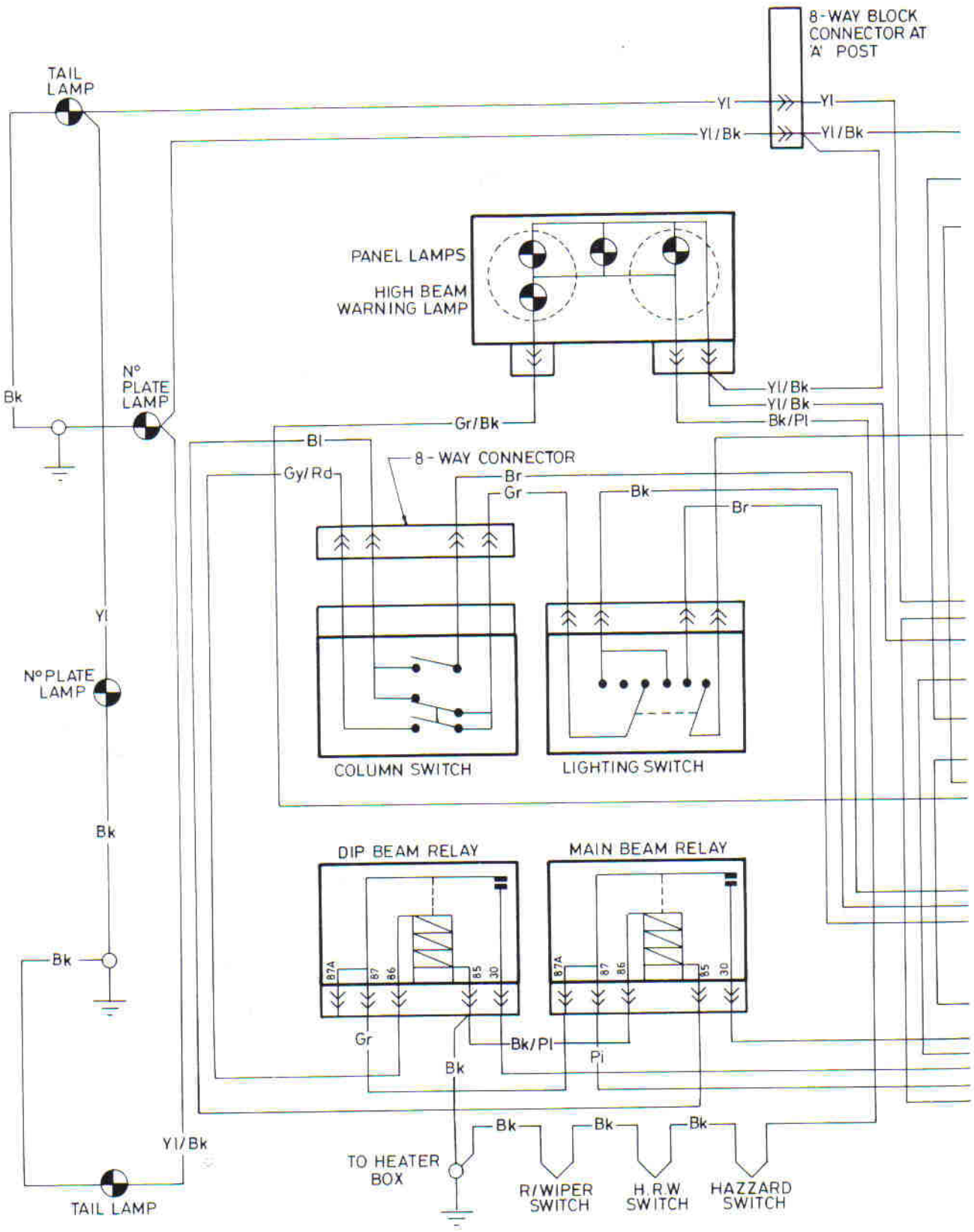


Fig. 12.20 Wiring diagram for 45, 55, and 65 models - exterior lights

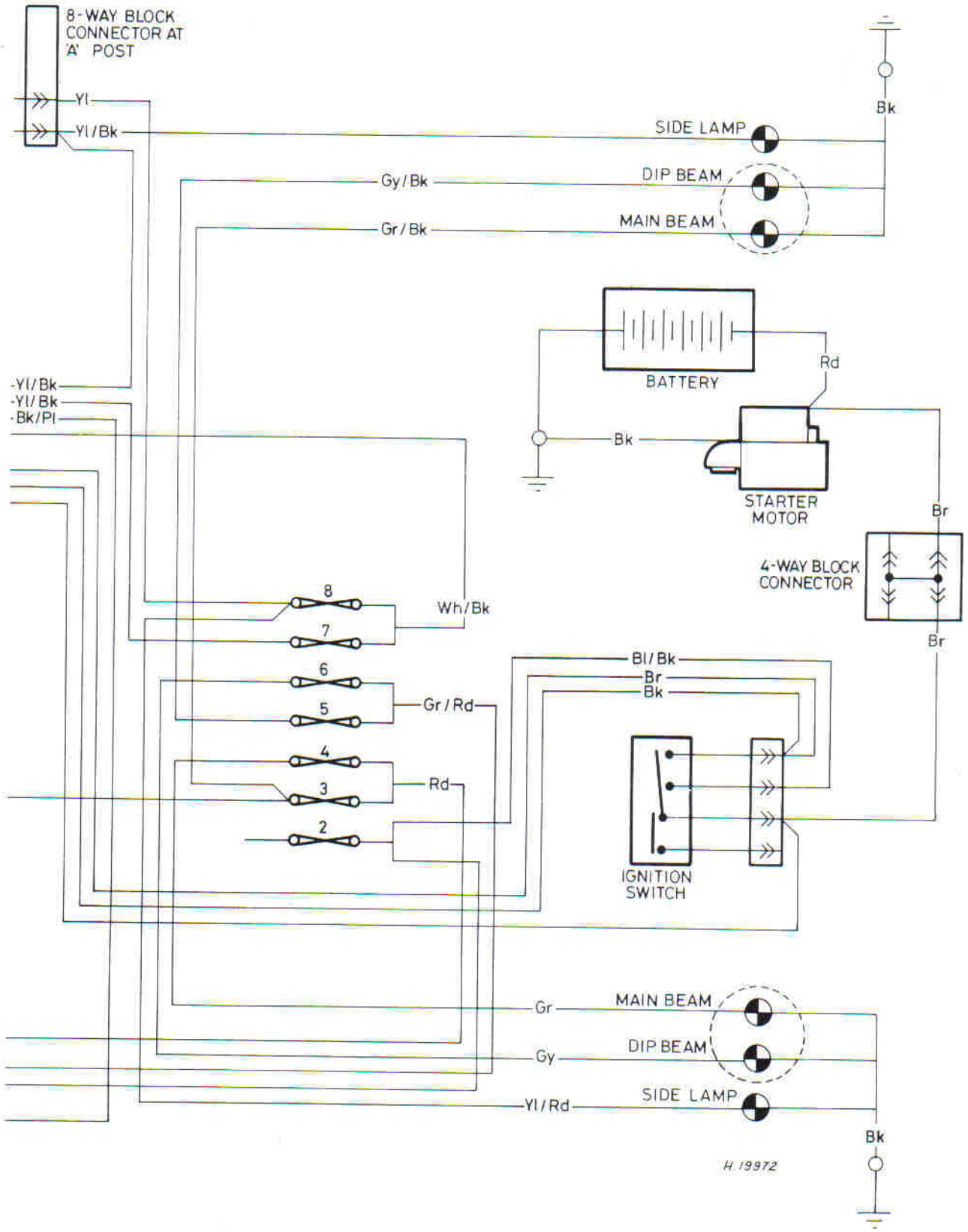


Fig. 12.20 (continued) Wiring diagram for 45, 55 and 65 models – exterior lights

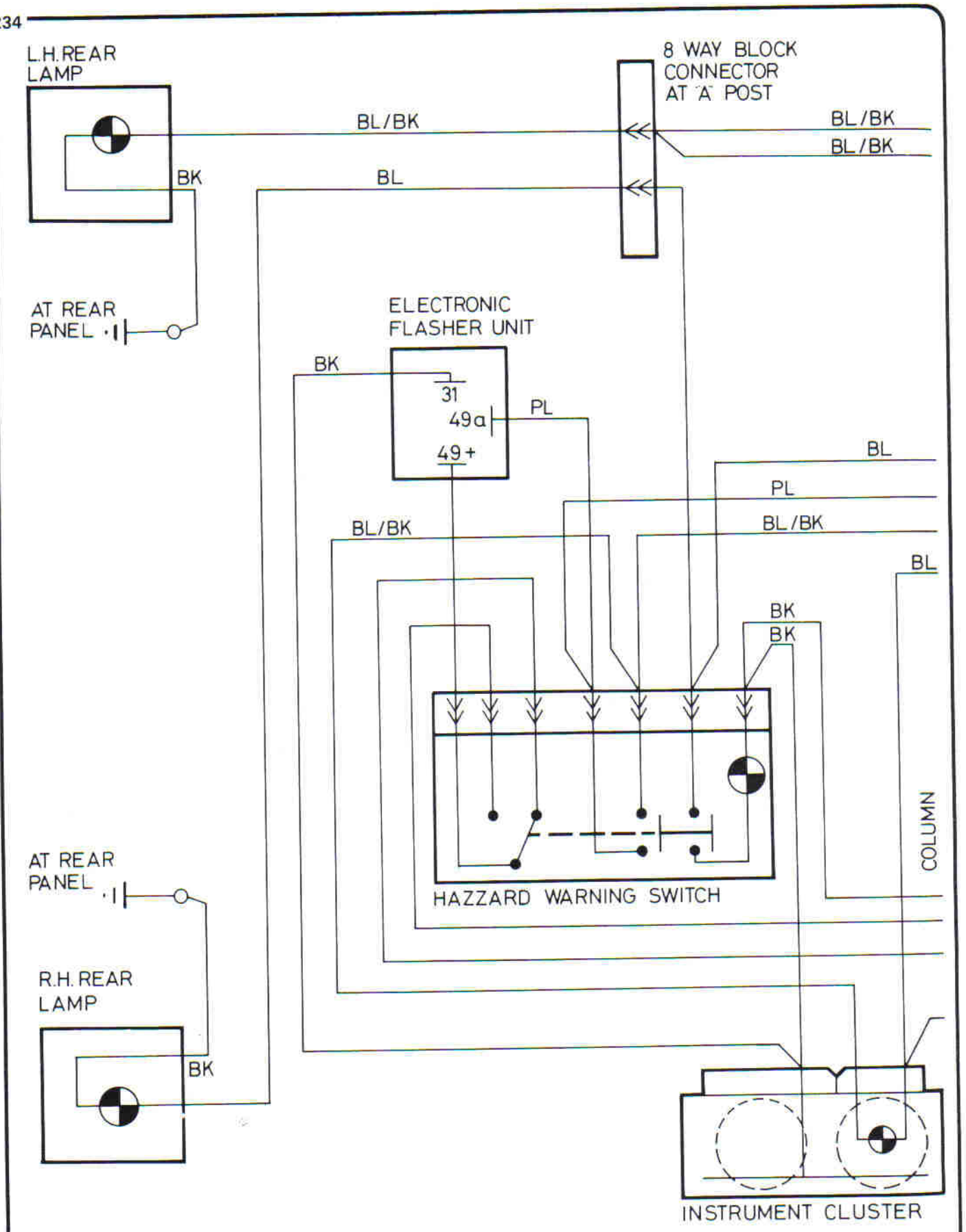


Fig. 12.21 Wiring diagram for late 45, 55 and 65 models – indicators and hazard warning lights

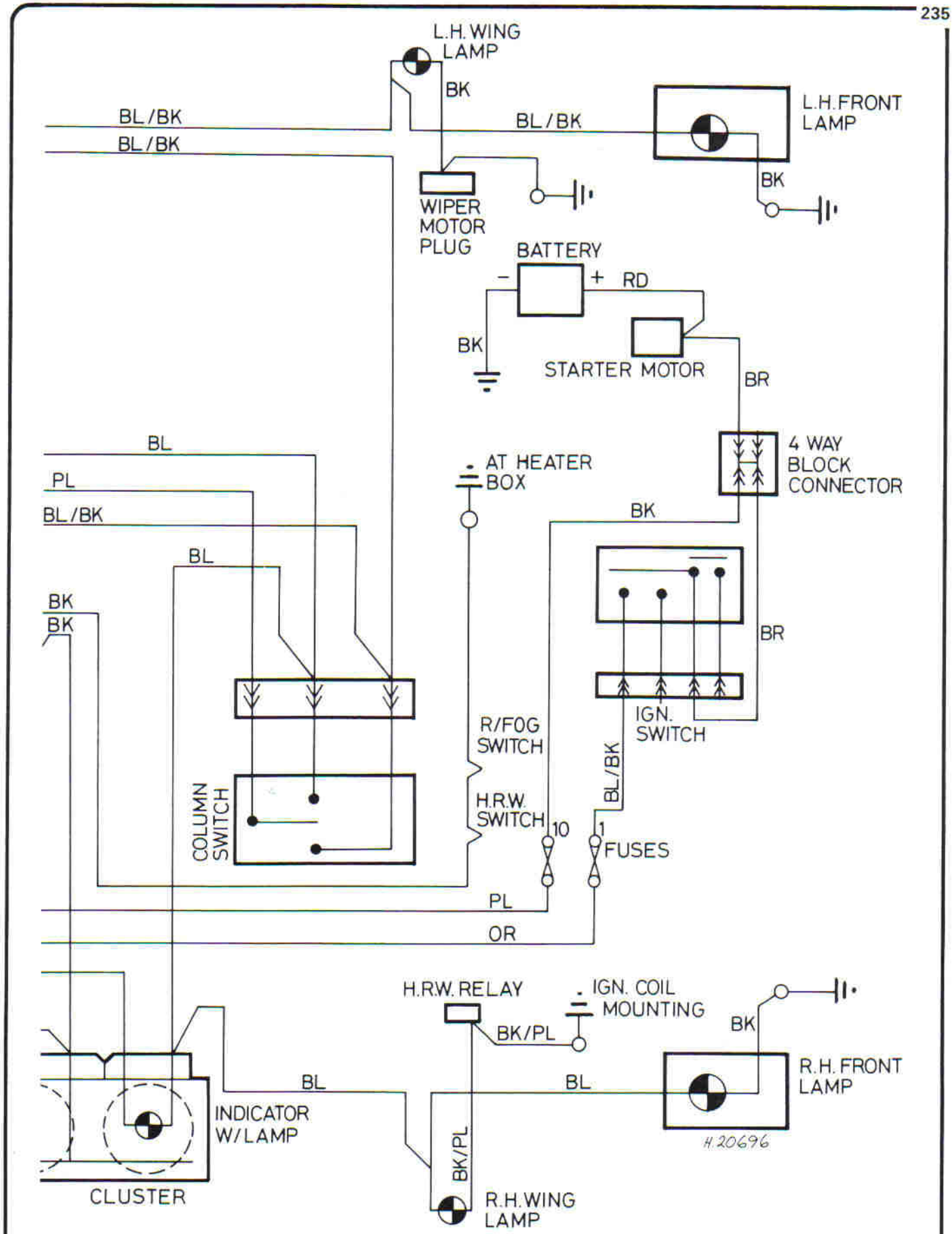


Fig. 12.21 (continued) Wiring diagram for late 45, 55 and 65 models – indicators and hazard warning lights

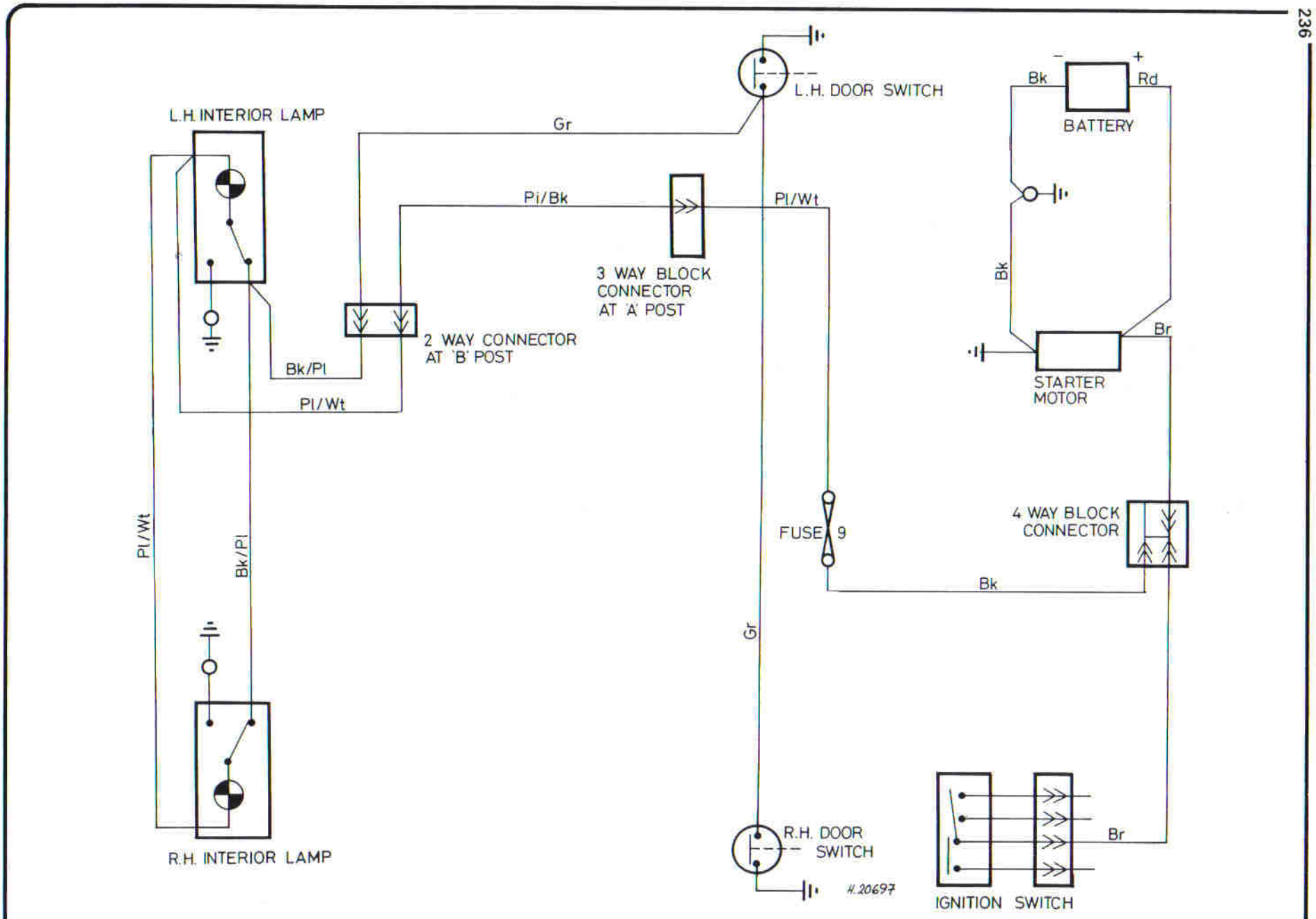


Fig. 12.22 Wiring diagram for 45, 55 and 65 models – interior lights (two-lamp system)

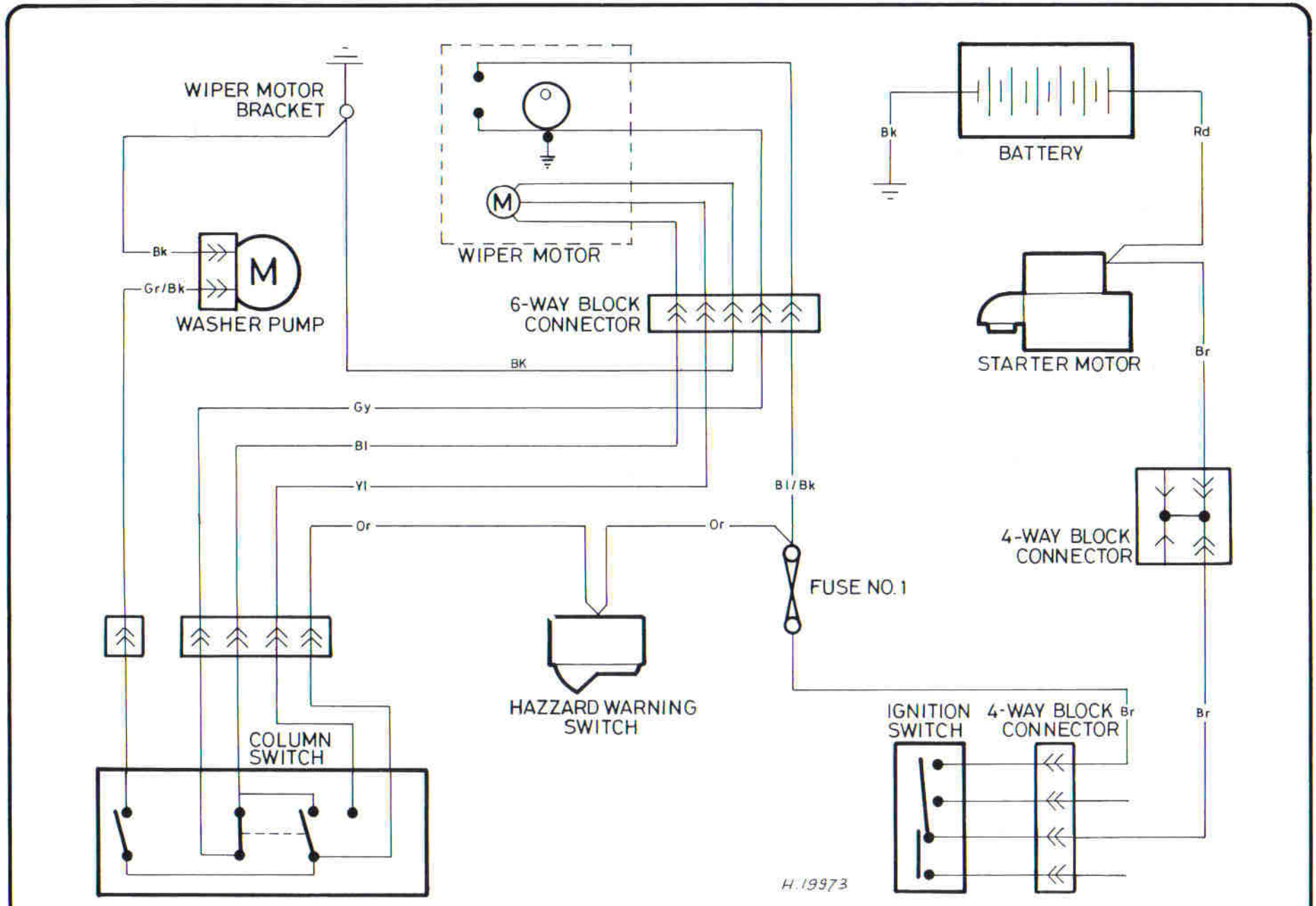


Fig. 12.23 Wiring diagram for 45, 55 and 65 models – windscreen wipers and washers

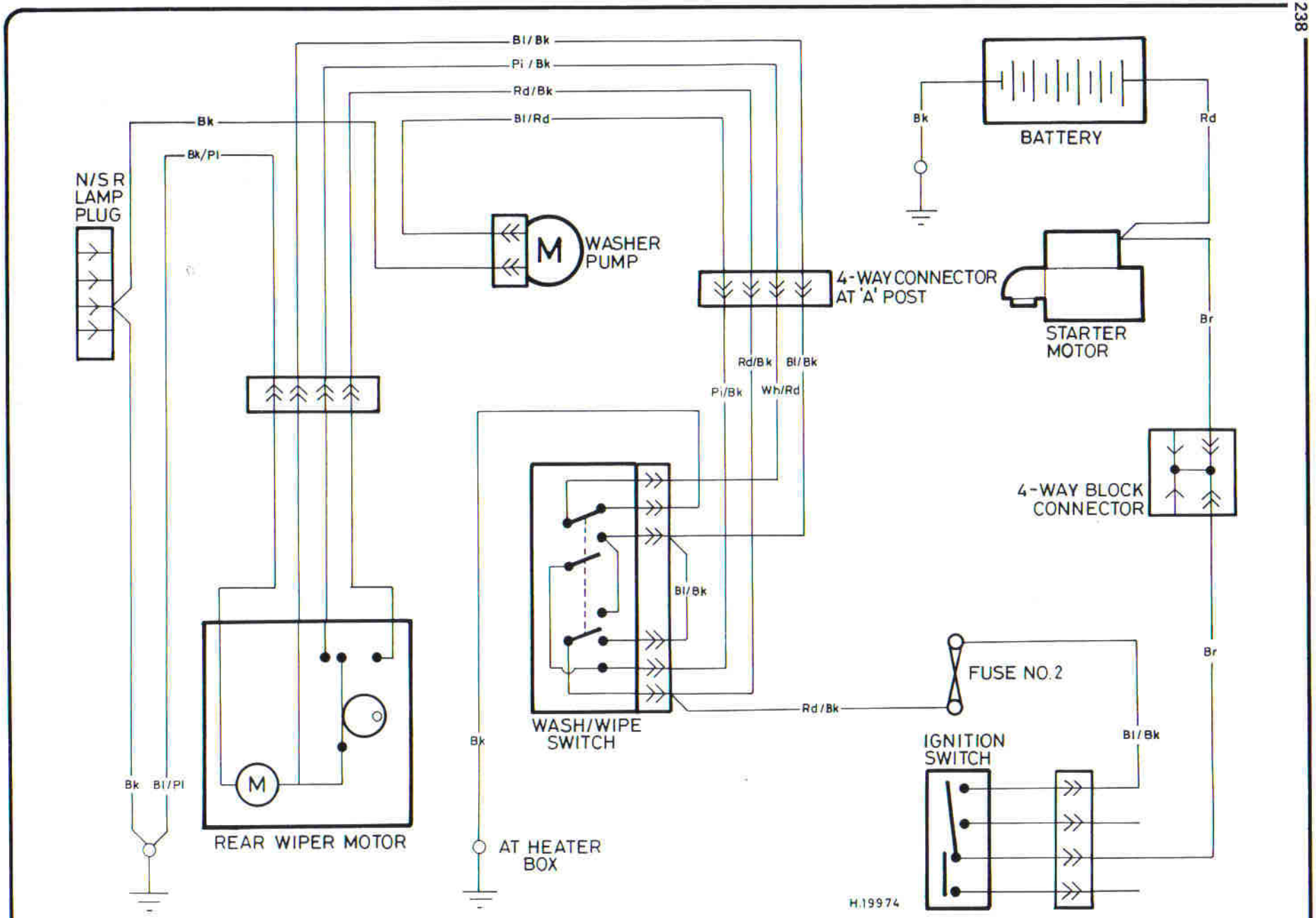


Fig. 12.24 Wiring diagram for 45, 55 and 65 models – rear window wiper and washer

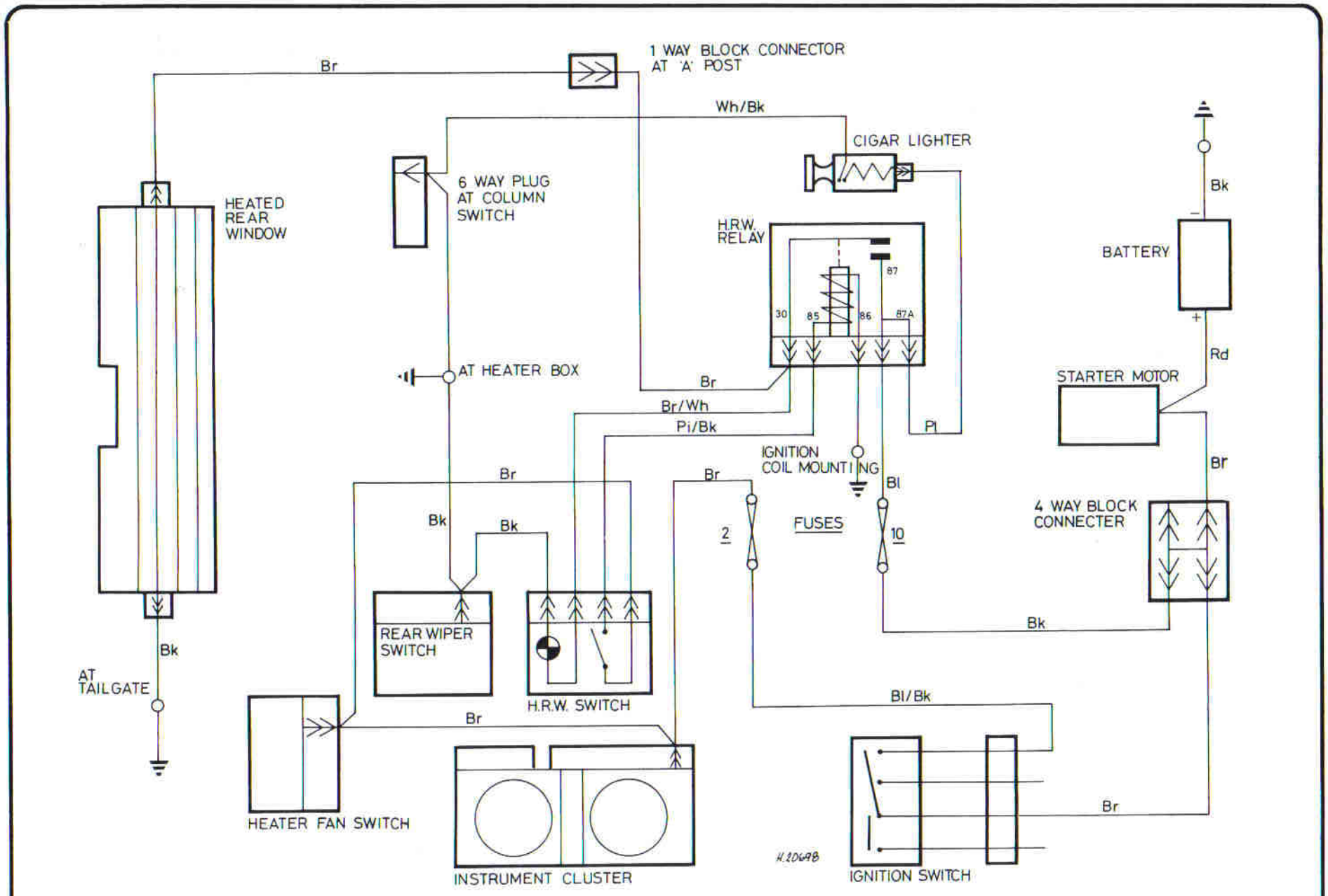


Fig. 12.25 Wiring diagram for 45, 55 and 65 models - heated rear window and cigar lighter

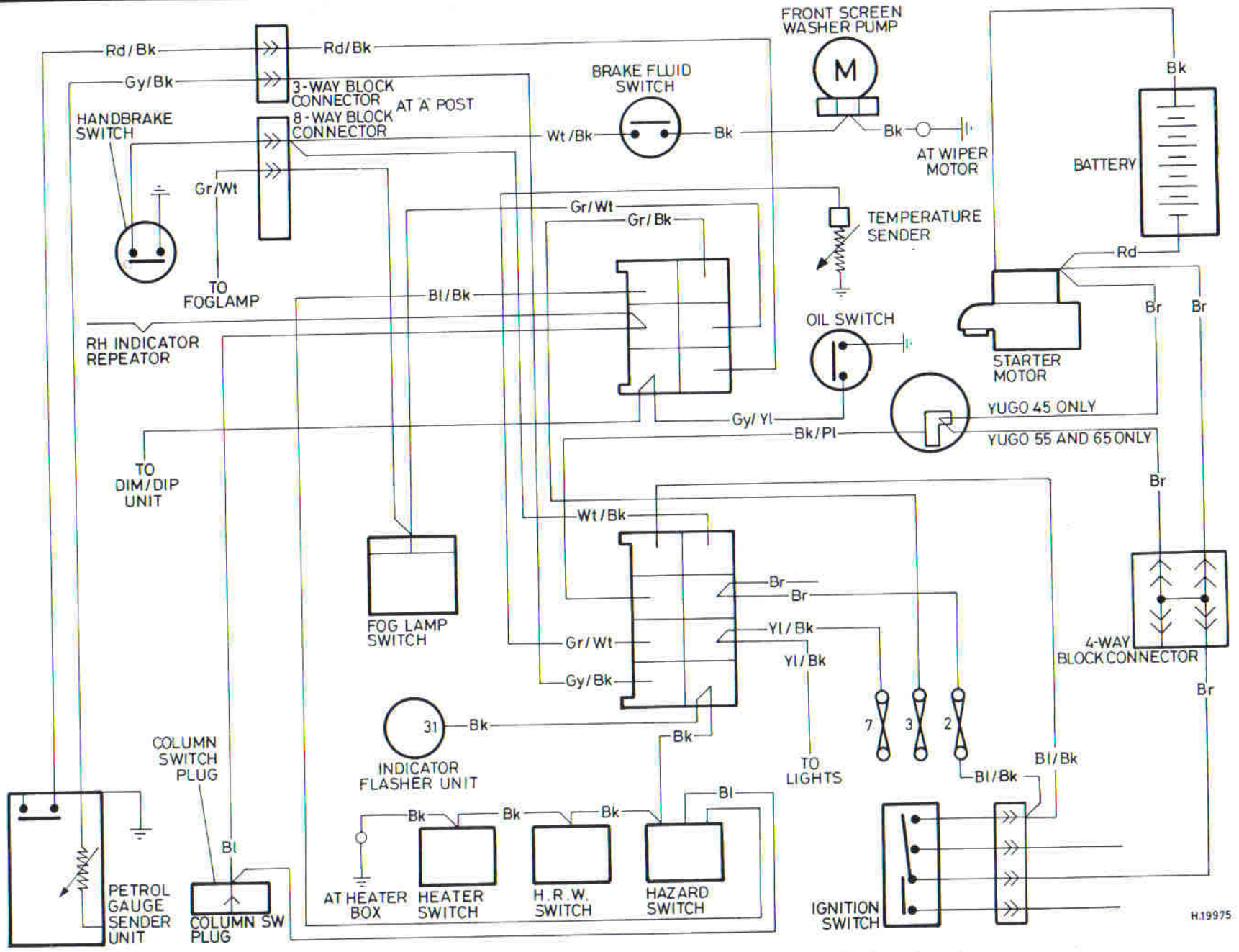


Fig. 12.26 Wiring diagram for 45, 55 and 65 models – instrumentation (electronic flasher unit type)

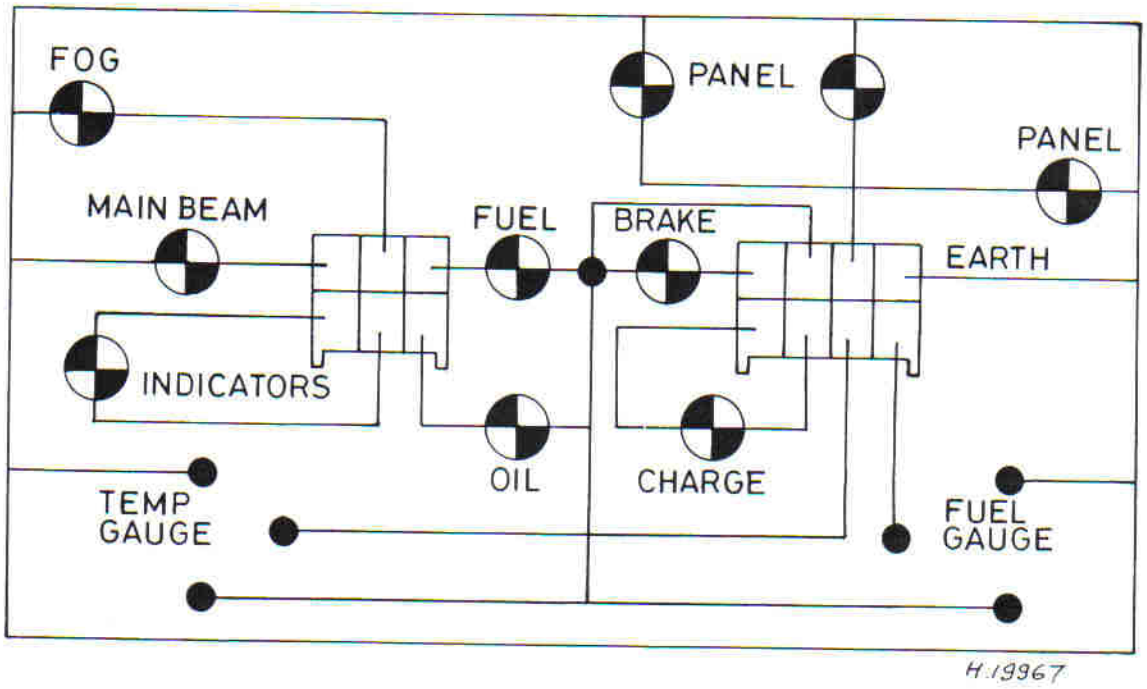


Fig. 12.27 Wiring diagram for 45, 55 and 65 models - instrument panel (electronic flasher unit type)

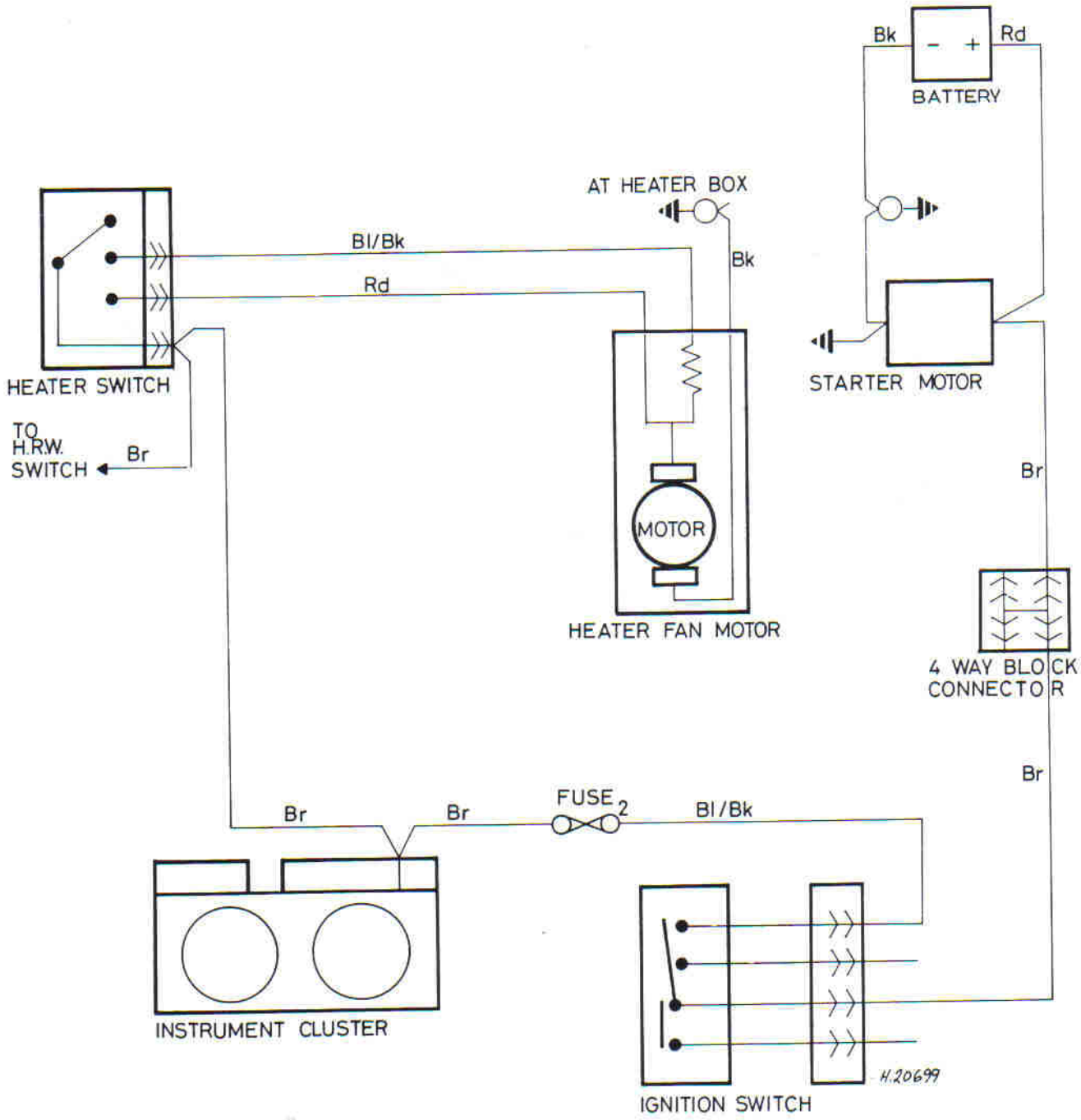


Fig. 12.28 Wiring diagram for 45, 55 and 65 models – heater fan

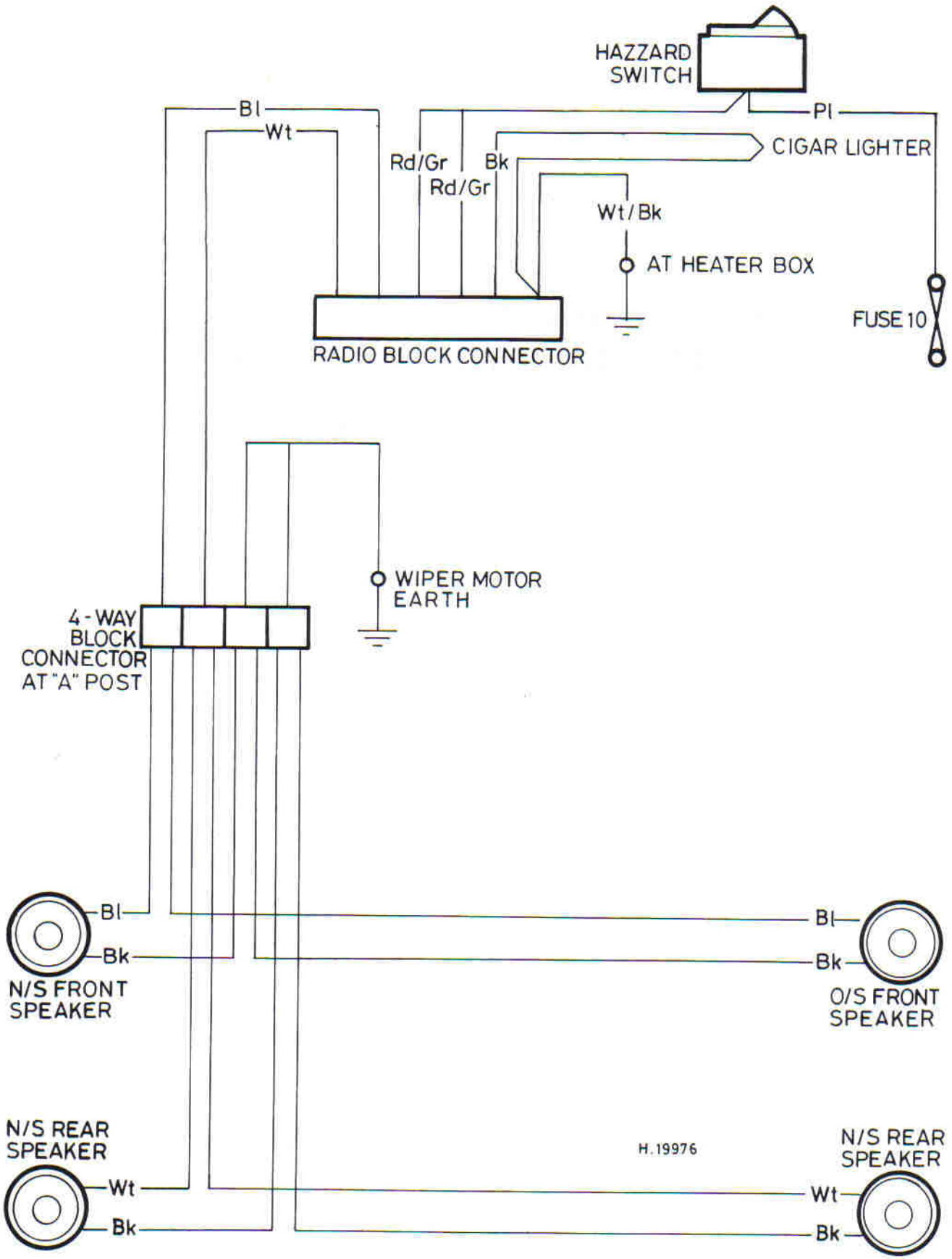


Fig. 12.29 Wiring diagram for 45, 55 and 65 models – radio speaker wiring

Chapter 13 Supplement: Revisions and information on later models

Contents

1 Introduction

This Supplement contains details of modifications made to the Yugo range since the publication of the first edition of the manual. It also contains some items of information which apply to all models.

The Sections in the Supplement follow the same order as the main Chapters in the book to which they relate. The Specifications are all grouped together for convenience, but they too follow Chapter order.

To use the Supplement to its best advantage, it should be referred to before starting a particular operation. Any variation from the information in the main Chapters can thus be noted at the outset.

2 Specifications

These Specifications are revisions of, or supplementary to, those given at the beginning of the preceding Chapters.

Fuel and exhaust systems

Carburettor – later models

Make	Carter Weber
Type	Twin barrel downdraught, with automatic choke
Application	Later 65A models
Calibration:	**Primary** / **Secondary**
Main jet	110 / 97
Air correction jet	170 / 250
Emulsion tube	F46 / F22
Idle fuel jet	50 / —
Adjustments:	
Float level	6 ± 1 mm (0.24 ± 0.04 in)
Idle speed	800 to 850 rpm
CO content at idle	0.5 to 1.5%
Fast idle speed	See text

Ignition system

Ignition timing for unleaded fuel

All models	5° BTDC at idle

Note: *Other modifications may be necessary before using unleaded fuel. Consult a Yugo dealer.*

Distributor (65A models with automatic choke carburettor)

Maximum advance:	
Centrifugal	19 ± 2° at 3800 engine rpm
Vacuum	19 ± 2° at 300 mbar

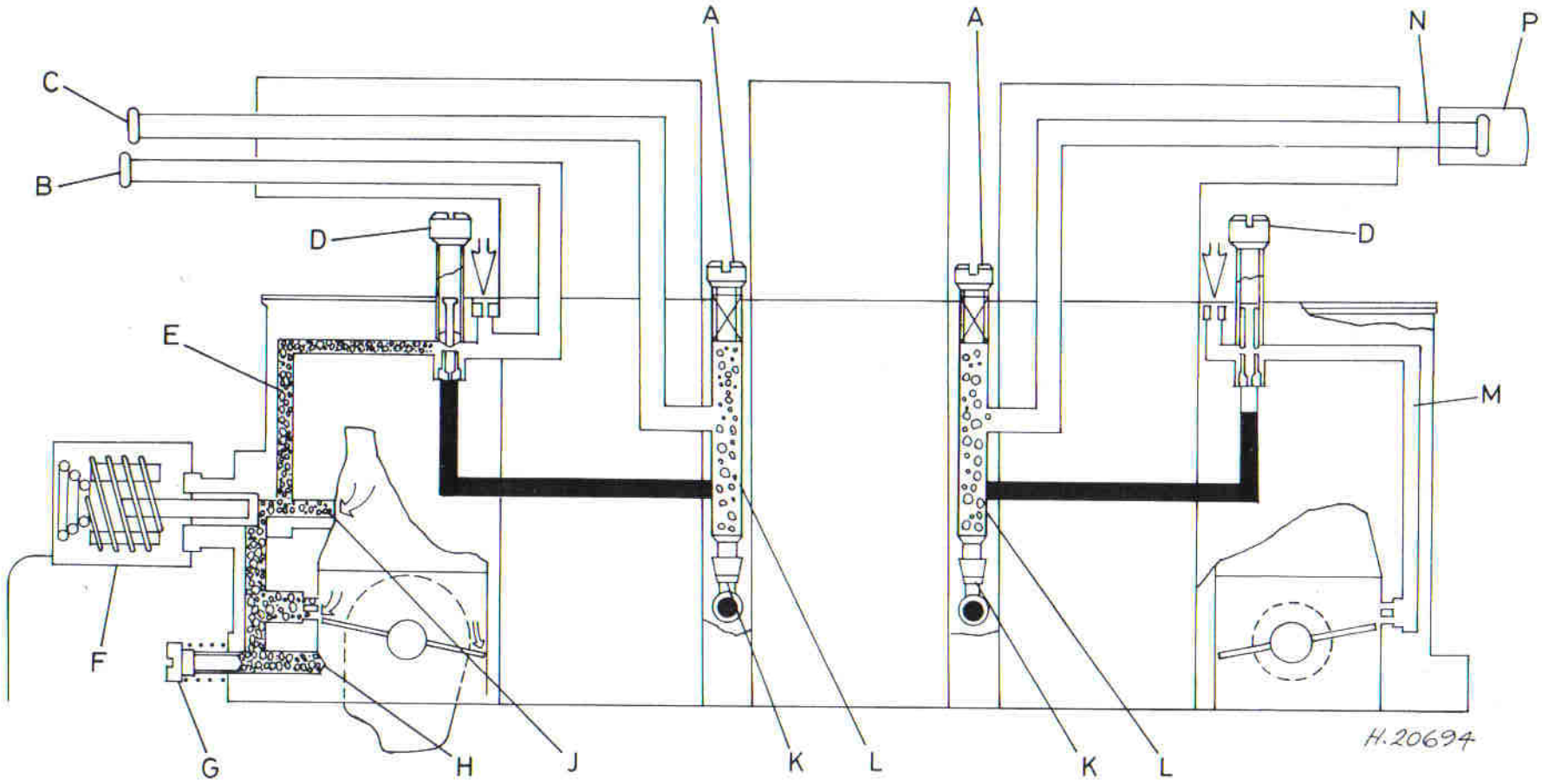


Fig. 13.1 Sectional view through Carter Weber carburettor (Sec 3)

A Air correction jets
B Primary idle air bleed
C Primary main air bleed
D Idle jets
E Idle mixture passage
F Idle cut-off solenoid
G Idle mixture adjustment screw
H Idle orifice
J Progression orifices
K Main fuel jets
L Emulsion tubes
M Progression mixture passage
N Secondary main air bleed
P Blanking cap

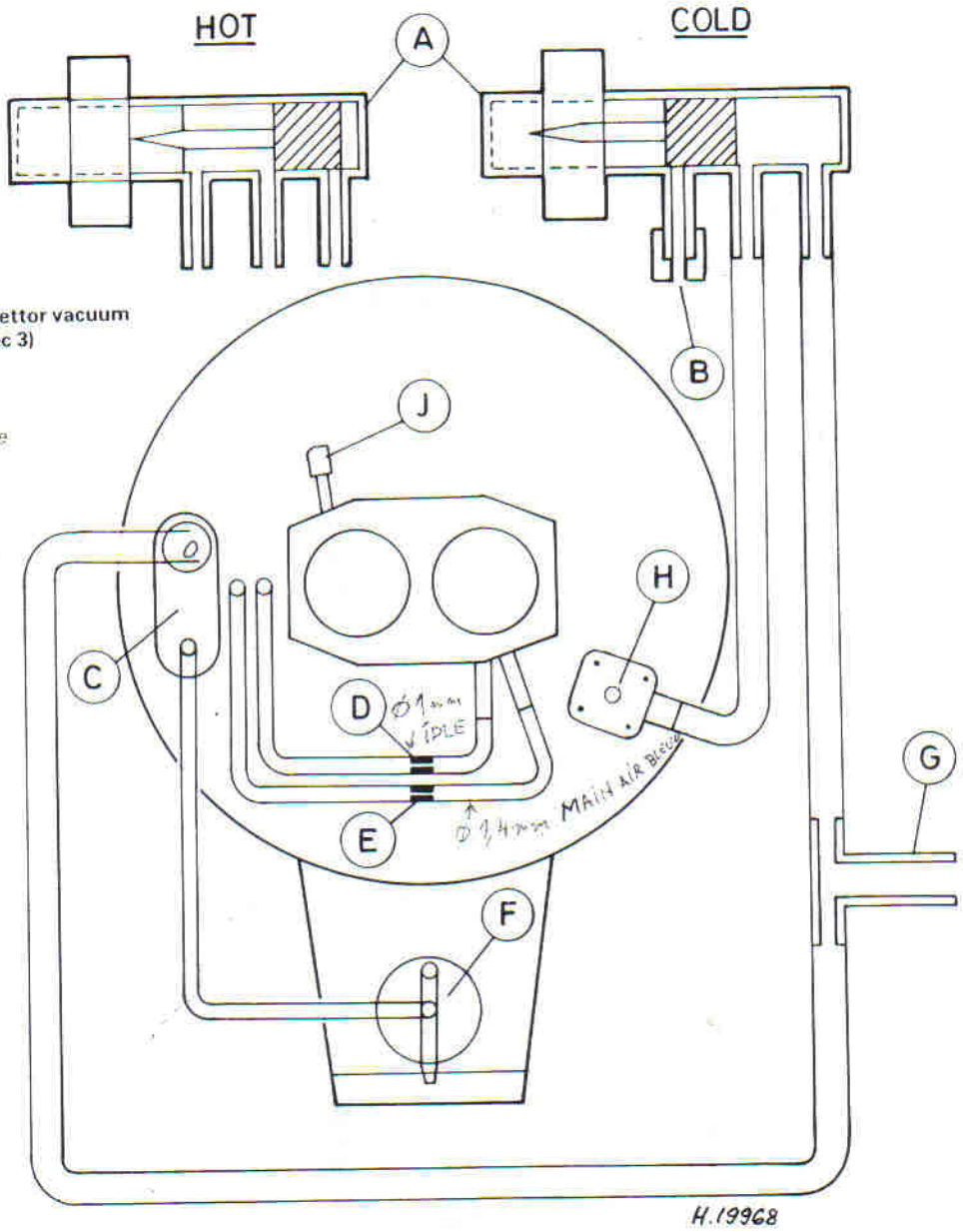


Fig. 13.2 Air cleaner and carburettor vacuum pipe connections (Sec 3)

A Vacuum switch
B Restrictor cap (1 mm hole)
C Air cleaner thermostatic valve
D Primary idle air bleed restrictor (1.0 mm)
E Primary main air bleed restrictor (1.4 mm)
F Air cleaner vacuum actuator
G Vacuum tapping on inlet manifold
H Fast idle actuator
J Secondary main air bleed (capped in use)

3 Fuel and exhaust systems

1 During 1990 model year a new carburettor and air cleaner were introduced on 65A models. These are described in this Section.

Thermostatically controlled air cleaner – description

2 Fitted to models with an automatic choke carburettor, the thermostatically controlled air cleaner automatically mixes hot and cold air to provide the optimum intake air temperature at all times. The 'summer/winter' adjustment is thus no longer applicable.

3 Operation of the air mixing flap is by a vacuum actuator. Vacuum for the actuator arrives via a thermostatic valve mounted in the air cleaner housing. As the temperature in the housing varies, the valve supplies more or less vacuum to the actuator and so changes the position of the flap.

4 Malfunction of the air temperature control will show up as slow warm-up and poor driveability when cold (stuck on cold) or as rough running, perhaps with poor fuel consumption, when hot (stuck on hot). Apart from checking the integrity of the vacuum lines there is little that the home mechanic can do. The valve and vacuum actuator are available separately and may be renewed if necessary.

Thermostatically controlled air cleaner – maintenance

5 Renew the air cleaner element at the specified intervals, or more frequently in dusty conditions.

6 At the same interval clean the PCV filter pad in the side of the air cleaner housing by washing it in solvent, or renew it if it is very dirty.

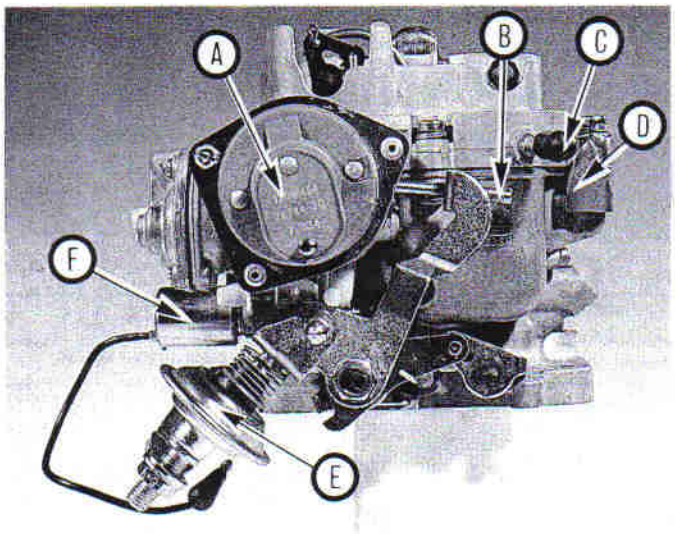
7 Periodically check the condition of the vacuum and breather pipes connected to the air cleaner body. Note that the small pipes which feed the carburettor air bleeds contain restrictor jets. If the pipes need renewing, the restrictor jets *must* be transferred.

Thermostatically controlled air cleaner – removal and refitting

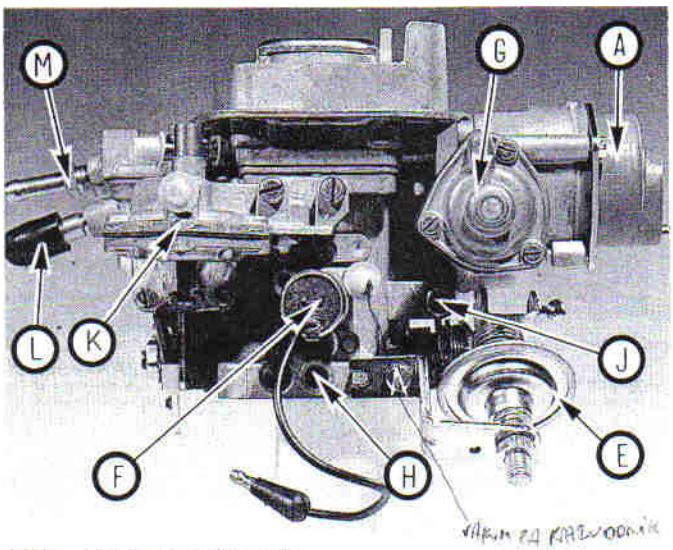
8 Remove the wing nut from the air cleaner lid. Remove the lid and the element.

9 Remove the nut which secures the air cleaner bracing strut to the camshaft cover.

10 Note the connections of the various breather and vacuum pipes to the air cleaner body. Make identification marks if necessary, then disconnect the pipes and lift off the air cleaner body.

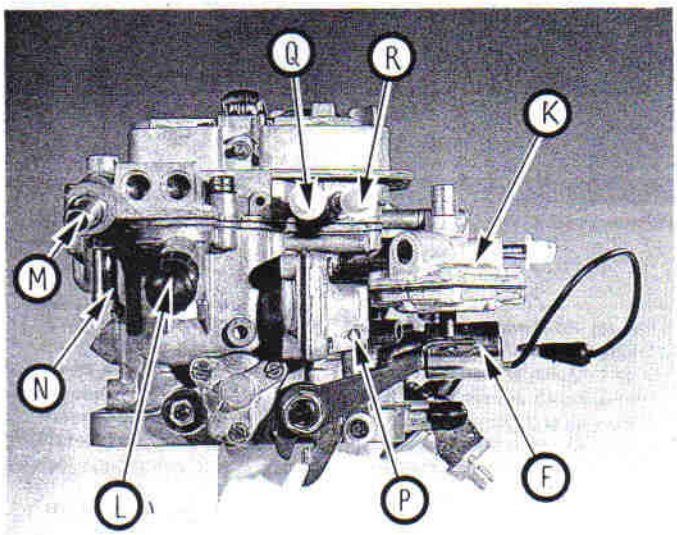


3.12A Carter Weber carburettor – choke housing side ...



3.12B ... adjustment screw side ...

A Automatic choke cover
B Fast idle adjustment screw
C Secondary air bleed (capped in use)
D Identification plate
E Dashpot
F Idle cut-off (anti-diesel) solenoid
G Choke pull-off diaphragm
H Idle mixture adjustment screw
J Idle speed adjustment screw
K Fast idle actuator
L Float chamber vent (capped in use)
M Fuel inlet
N Fuel return
P Accelerator pump
Q Primary idle air bleed
R Primary main air bleed



3.12C ... and fuel inlet side

11 Refit by reversing the removal operations.

Carter Weber carburettor – description

12 The Carter Weber carburettor, fitted to later 65A models, is a twin barrel downdraught unit with automatic choke. It closely resembles the well-established Weber 32 DFT design (photos).

13 Operation of the two barrels is sequential. The primary barrel alone is in use at idle and at small throttle openings. At intermediate throttle openings the secondary barrel starts to deliver mixture, until at full throttle both barrels are wide open. The sequential opening of the throttle valves is controlled mechanically.

14 An unusual feature of the carburettor is the provision of external air bleeds for the primary main and idle systems. These bleeds are fed by pipes from the air cleaner housing. There is a restrictor in each pipe (photo). The restrictors are not interchangeable. *Their correct fitting, and that of the other blanking caps and restrictors (Fig. 13.2) is critical to the correct operation of the carburettor.*

15 The automatic choke functions as follows. Before a cold start, the driver must depress and release the throttle pedal. This frees the choke valves, which close under the influence of a bi-metallic spring. The colder the spring is, the greater its closing force.

16 As soon as the engine starts, an electric heater in the bi-metallic spring housing receives current from the alternator. (The current feed is unrectified and will vary with alternator speed. At idle approximately 8 volts should be present.) As the heater warms up, the spring loses tension and the choke valves open.

17 During the warm-up period the choke valves need to be opened further under conditions of high manifold vacuum or wide throttle openings, both of which would otherwise cause an excessively rich mixture. Vacuum opening is achieved by a device known as the choke pull-off diaphragm. Opening in response to wide throttle is achieved both mechanically and by the offset mounting of the choke valves, which causes them to open in response to airflow.

18 As an additional aid to driveability during warm-up, a fast idle actuator increases the idle speed by opening the throttle valve slightly. The actuator is vacuum-operated, the vacuum arriving via a temperature-operated vacuum switch which is screwed into the coolant transfer pipe below the exhaust manifold. At low temperatures the switch is open and vacuum is applied to the actuator. At high temperatures the switch is closed and the vacuum is cut off.

19 A dashpot attached to the throttle linkage delays full closure of the throttle valves if the pedal is released suddenly. This reduces emissions of exhaust gas pollutants which would otherwise occur.

20 When the ignition is switched off, a solenoid valve (known as the idle cut-off or anti-diesel solenoid) closes the idle mixture passage, thus suppressing any tendency for the engine to run on. If this valve is defective or disconnected, the engine will idle roughly or will not idle at all.

Carter Weber carburettor – idle speed and mixture adjustment

21 Refer to Chapter 3, Section 10 for details of the adjustment procedure.

22 The location of the idle speed and mixture adjustment screws is shown in the accompanying photos.

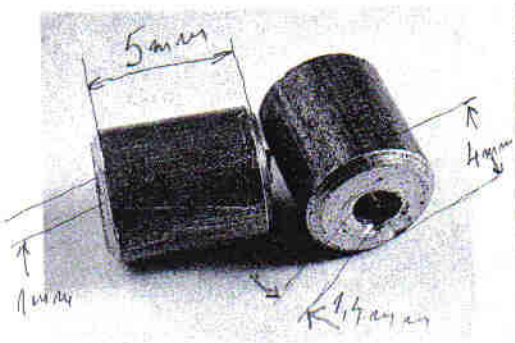
Carter Weber carburettor – removal and refitting

23 Disconnect the battery negative lead.

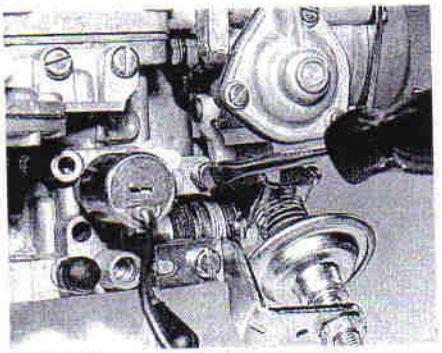
24 Remove the air cleaner as previously described.

25 Identify and disconnect the fuel feed and return hoses.

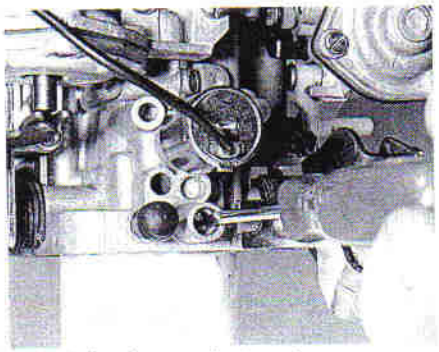
26 Identify the electrical connectors for the automatic choke and the



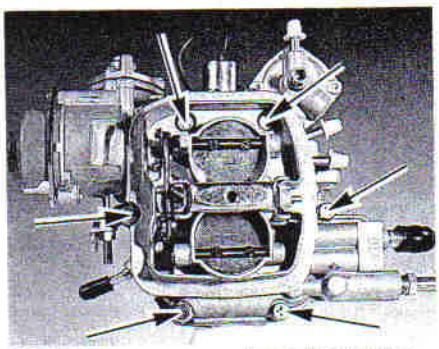
3.14 Close up of air bleed pipe restrictors. Main bleed hole is larger



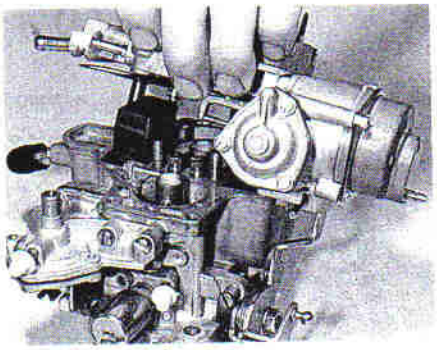
3.22A Idle speed adjustment screw



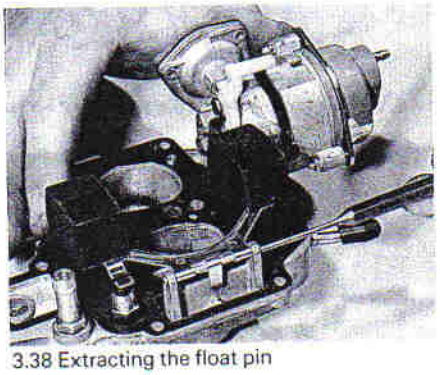
3.22B Idle mixture adjustment screw



3.36 Six screws (arrowed) securing the top cover



3.37 Removing the top cover



3.38 Extracting the float pin

anti-diesel solenoid, then disconnect them. *It is important that these two connectors are not mixed up.*

27 Identify and disconnect the fast idle actuator vacuum pipe and the distributor vacuum pipe.

28 Disconnect the throttle linkage.

29 Remove the four nuts and washers which secure the carburettor to the inlet manifold. Lift off the carburettor and recover the spacer and gaskets.

30 If it is wished to remove the air bleed pipes with their restrictors, make identifying marks so that they will be refitted to the same spigots.

31 Refit by reversing the removal operations, using new gaskets.

Carter Weber carburettor – dismantling

32 Refer to Chapter 3, Section 8.

33 The carburettor top cover can be removed for access to the floats, jets and automatic choke assembly without removing the carburettor from the engine. Remove the air cleaner and disconnect services and controls from the carburettor as necessary for access.

34 Similarly, peripheral items such as the fast idle device or the dashpot can be serviced without removing the carburettor.

35 Thoroughly clean the outside of the carburettor before beginning any dismantling.

Top cover

36 Remove the six screws and spring washers which secure the top cover (photo). Note the identification tag under one of the screws.

37 Lift off the top cover, unhooking the fast idle link from the choke housing at the same time (photo).

38 Extract the float pin, pushing it from one end with a nail or a pin punch (photo).

39 Lift away the floats. Recover the needle valve, which is hooked onto the float arm tongue (photo).

40 Remove the gasket (photo).

41 Unscrew the needle valve seat. Note the washer between the seat and the cover (photo).

Automatic choke assembly

Note: *During assembly at the factory the choke housing retaining ring is secured by a screw and two rivets. To dismantle the choke the rivet heads must be drilled or ground off, and small nuts and bolts used instead of rivets on reassembly. Before doing this ascertain that spares are available, and that warranty or other problems will not result.*

42 Make alignment marks on the various segments of the choke housing to aid reassembly, then drill or grind off the rivet heads and remove the securing screw to release the retaining ring (photo).

43 Remove the retaining ring and lift off the heater/bi-metallic spring assembly. Note how the hook in the end of the spring engages with the tab on the choke lever (photos).

44 Remove the heat shield from the choke lever housing (photo).

45 Remove the three screws which secure the choke lever housing to the top cover (photo). Note that the uppermost screw is longer.

46 Remove the choke lever housing from the cover, unhooking the lever arm from the operating rod. Note the O-ring which seals the vacuum passage (photos).

47 Remove the three screws which secure the pull-off diaphragm cover. Ease off the cover until the spring pressure is released then recover the spring and the piston/diaphragm assembly (photos).

Carburettor body

48 Identify the jets and unscrew them (photos).

49 Separate the jets from their holders or from the emulsion tubes (photo). If it is necessary to use pliers for this, protect their jaws with rag. Sediment can accumulate in the emulsion tubes: it is important to remove the jets so that the tubes can be cleaned.

50 Pull out the accelerator pump discharge beak. Note the O-ring (photo).

51 Remove the fast idle actuator securing screws. Remove the actuator, unhooking it from its lever (photos).

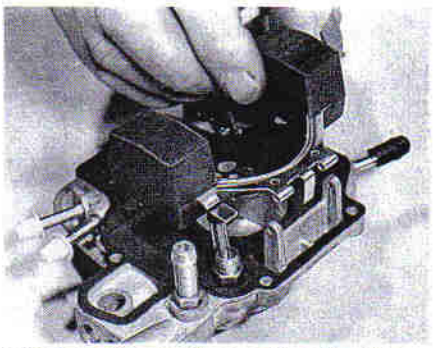
52 Remove the four screws which secure the accelerator pump cover. Ease off the cover until the spring pressure is released, then lift out the plunger/diaphragm assembly and the spring (photos).

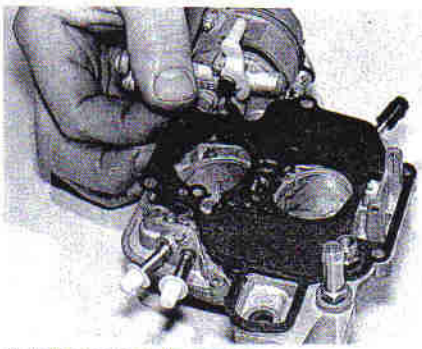
53 Remove the dashpot by removing the single screw which secures its bracket (photo). Do not disturb the locknut setting.

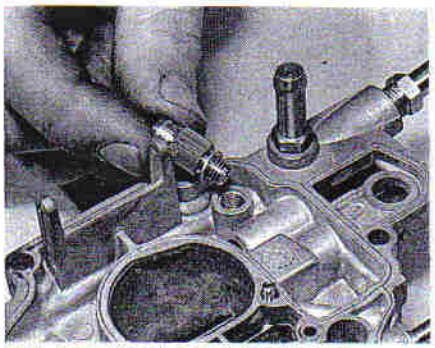
54 Remove the idle cut-off (anti-diesel) solenoid by unscrewing it from the body (photo). If it is not necessary to use pliers to unscrew it, protect their jaws with rag.

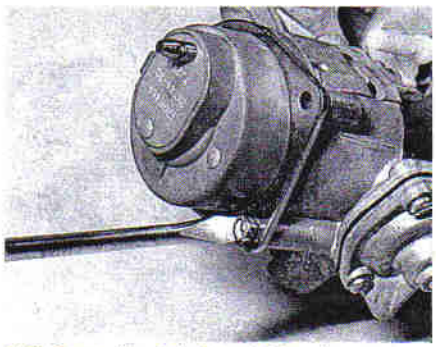
55 The enrichment device cover may be removed if wished, but this should not be necessary as there is nothing inside but a gasket (photo).

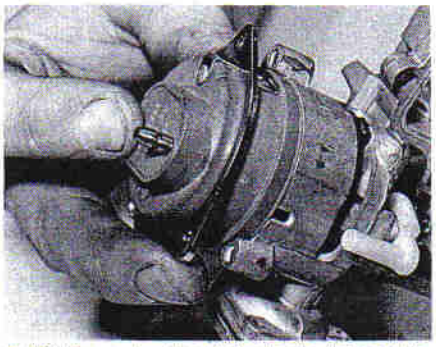
56 This is the normal limit of dismantling. If it is decided to strip out

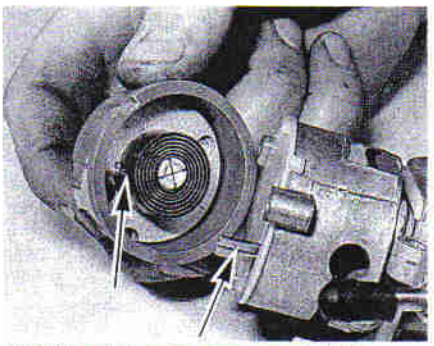

3.39 Removing the floats and needle valve

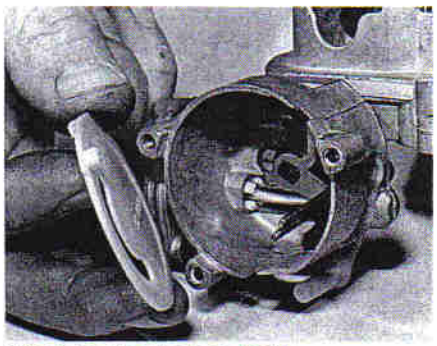

3.40 Removing the gasket

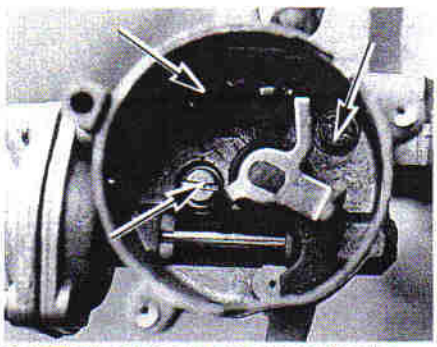

3.41 Removing the needle valve seat

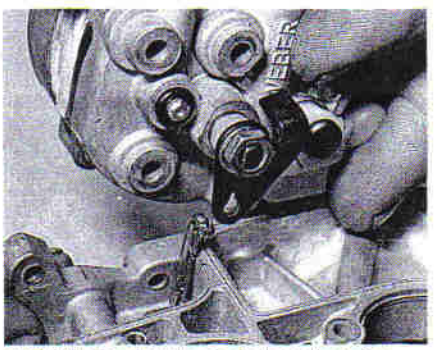

3.42 Removing a choke retaining ring screw

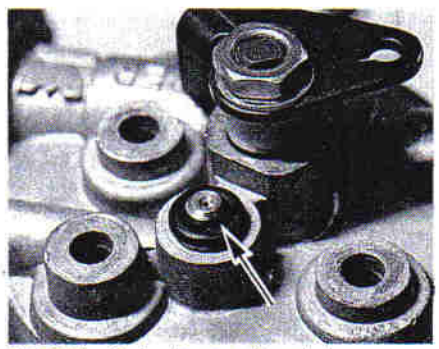

3.43A Removing the choke heater/bi-metallic spring

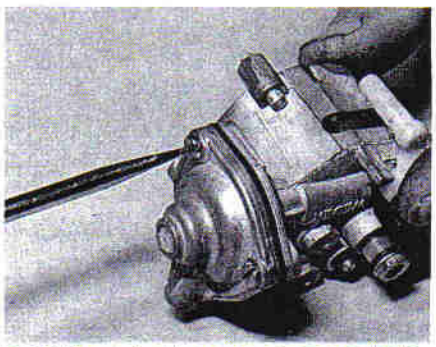

3.43B Hook in spring engages with tab (arrows)

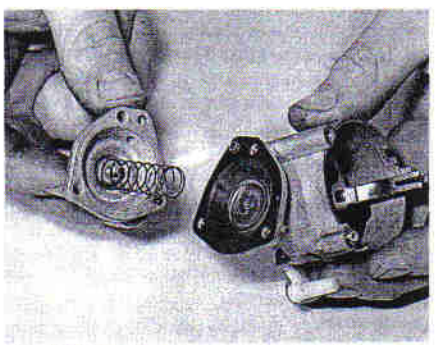

3.44 Removing the heat shield

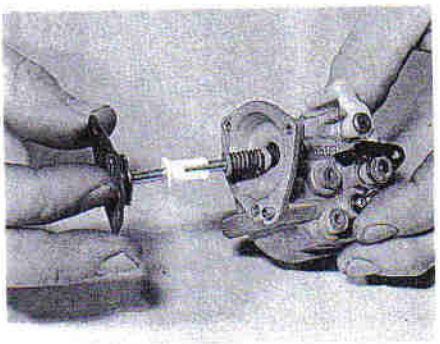

3.45 Three screws (arrowed) securing the housing to the cover


3.46A Removing the choke lever housing

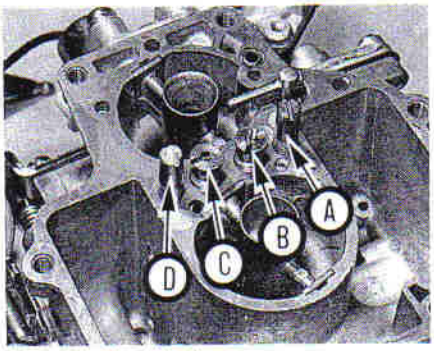

3.46B The O-ring (arrowed) seals the vacuum passage


3.47A Removing the screws from the choke pull-off diaphragm cover

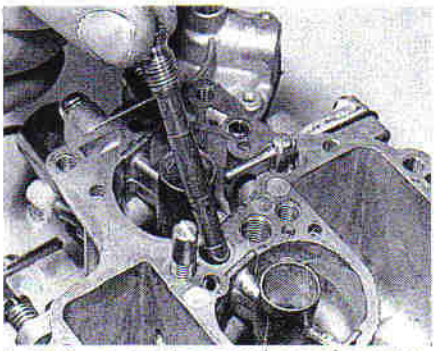

3.47B Removing the cover and spring ...



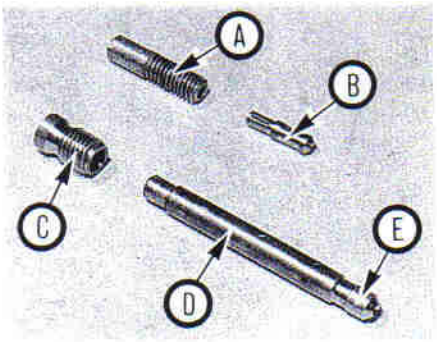
3.47C ... and the piston/diaphragm assembly



3.48A Jet identification
A Primary idle
B Primary main system
C Secondary main system
D Secondary idle

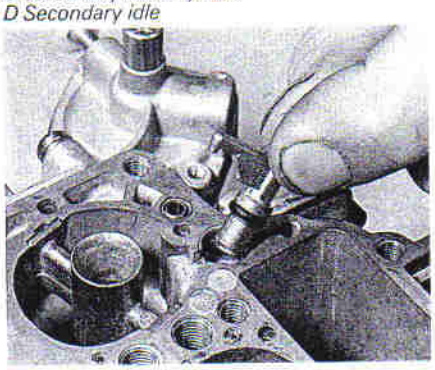


3.48B Removing the secondary main system jets

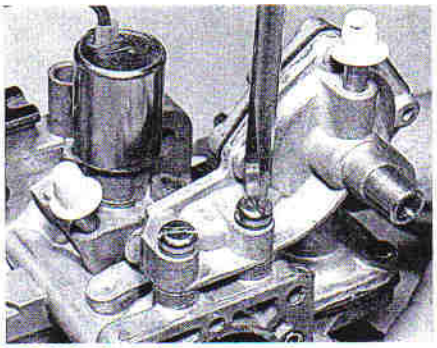


3.49 Separation of the jets

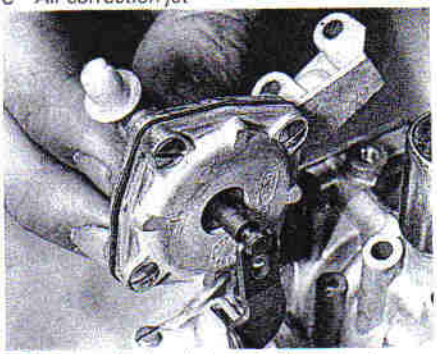
A Idle jet carrier
B Idle jet
C Air correction jet
D Emulsion tube
E Main fuel jet



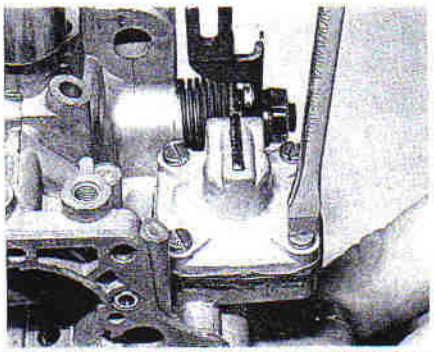
3.50 Removing the accelerator pump discharge beak



3.51A Remove the two screws ...



3.51B ... and unhook the fast idle actuator



3.52A Removing the accelerator pump cover screws

3.52B Removing the accelerator pump cover ...

the throttle valves and spindles, take careful note of the sequence and relationship of washers, spacers, control levers and springs. The throttle plate screws are staked to secure them and will be hard to unscrew; new screws should be used on reassembly and their ends staked. If one of these screws falls out in service it could do serious damage to the engine.

Carter Weber carburettor – reassembly

57 Blow through all jets and passageways. Obtain a repair or overhaul kit and use the new gaskets, O-rings, diaphragm etc contained in it.

58 Reassembly is now a reversal of dismantling. Depending on what has been disturbed, some or all of the following adjustments will be necessary.

Float level

59 With the top cover reassembled (including the gasket), hold the cover vertically with the floats hanging downwards. Measure the distance from the top of each float to the gasket (photo) The correct dimension is given in the Specifications. Adjust if necessary by bending the tongue on the float arm.

Dashpot

60 Slacken the dashpot locknut and screw the dashpot in or out until its plunger is just in contact with the throttle lever. From this position screw the dashpot one full turn towards the throttle lever. Hold the dashpot still and tighten the locknut.

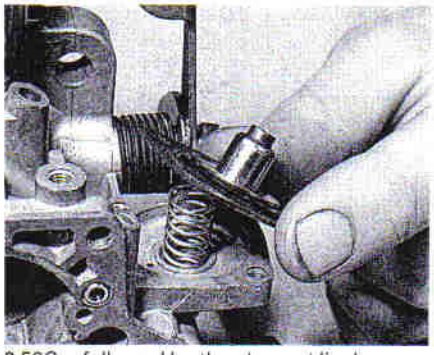
Running adjustments

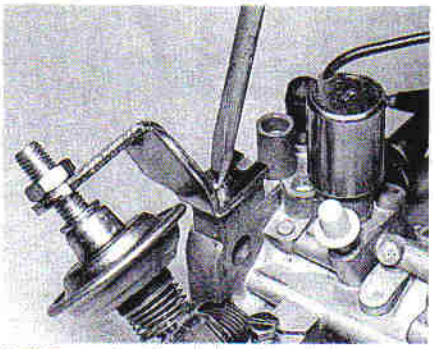
61 After refitting the carburettor, adjust the idle speed and mixture as previously described, then check and adjust the fast idle settings as described in this Section.

Carter Weber carburettor – automatic choke fast idle adjustments

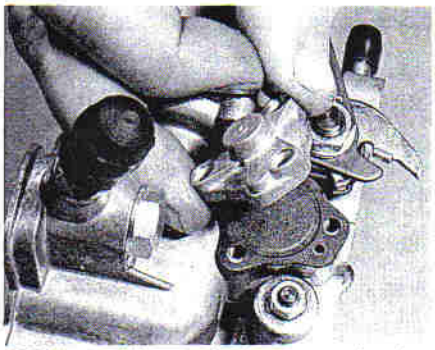
62 The only adjustments possible to the automatic choke are to the fast idle mechanisms. Before commencing, the engine must be at normal operating temperature and the basic idle speed and mixture must be correctly set.

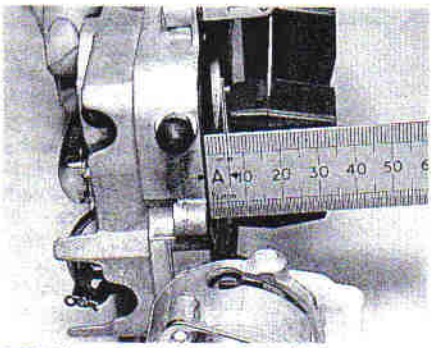
63 Remove the air cleaner. Close the choke valves by hand. Position the tip of the fast idle adjusting screw on the centre step of the three small steps on the cam (photo).


3.52C ... followed by the plunger/diaphragm and the spring

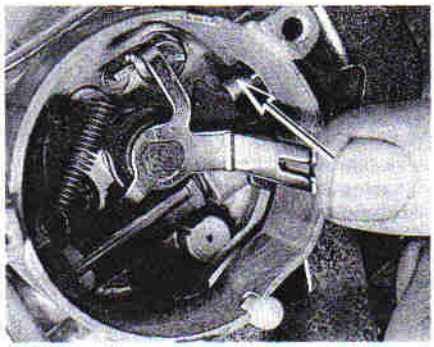

3.53 Removing the dashpot bracket screw


3.54 Removing the idle cut-off solenoid

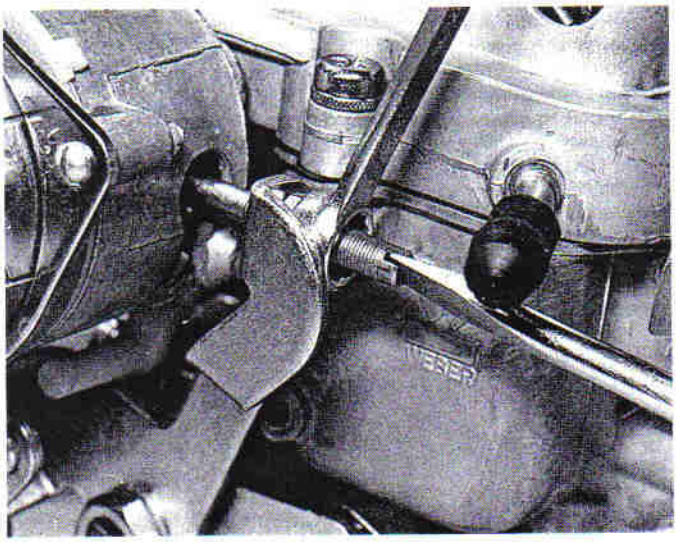

3.55 The enrichment device cover and gasket



3.59 Measuring the float level (A)


3.63 Fast idle screw on the centre step of the cam (arrowed).
The choke cover has been removed for visibility only

64 Open the choke valves by hand. Without touching the throttle (which would disturb the fast idle cam) start the engine.
65 Engine speed should now be in the region of 2900 rpm. Adjust if necessary by slackening the locknut and turning the fast idle adjusting screw (photo). Tighten the locknut without disturbing the screw setting when adjustment is correct.
66 Allow the engine to idle normally. Disconnect the switched vacuum pipe from the fast idle actuator and in its place connect full-time vacuum (the pipe running to the vacuum switch).
67 Engine speed should now rise to between 1400 and 1500 rpm. Adjust if necessary by turning the screw accessible through the actuator top hole.
68 Stop the engine, remake the original vacuum connections and refit the air cleaner.



3.65 Adjusting the fast idle

Vacuum switch (Carter Weber carburettor) - removal and refitting

69 Remove the air cleaner.
70 With the engine cold, depressurise the cooling system by removing the filler cap.
71 Follow the vacuum pipes from the carburettor to the switch (below the exhaust manifold) and disconnect them, noting which way round they are fitted.
72 Unscrew the switch from the coolant transfer pipe. Have something ready to plug the hole to prevent loss of coolant.
73 Before refitting make sure that the correct restrictor cap (with a 1 mm/0.04 in hole) is fitted to the unused port on the switch.
74 Apply a little sealant to the switch threads and screw it into position. Reconnect the vacuum pipes.
75 Top up the cooling system if necessary and refit the cap.
76 Refit the air cleaner. Run the engine and check that there are no coolant leaks from around the switch.

4 Ignition system

Bosch/Rudi Cajavec electronic ignition system - component interchangeability

1 The Bosch electronic ignition system described in Chapter 4 may be found with some or all components manufactured by the Yugoslavian company Rudi Cajavec.
2 When renewing ignition system components, note that complete units (distributor, control unit etc) from the two manufacturers are interchangeable, but individual components are not.

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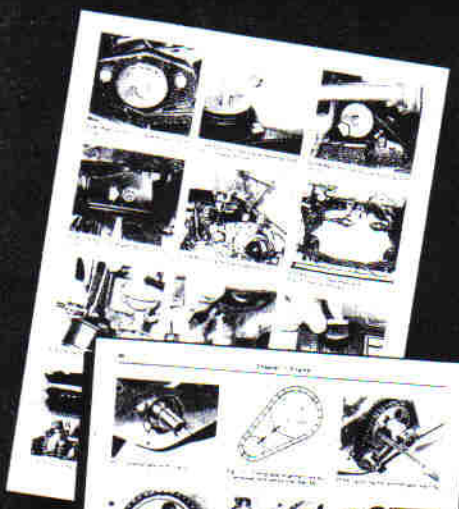

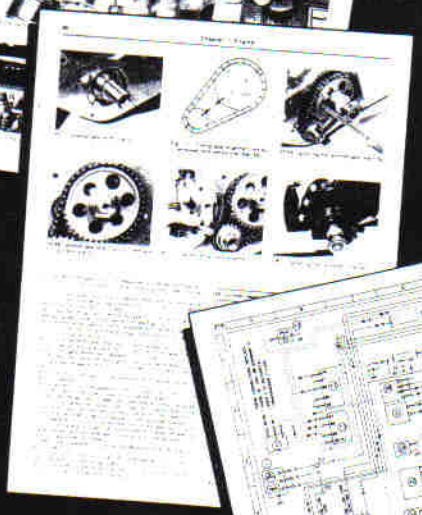

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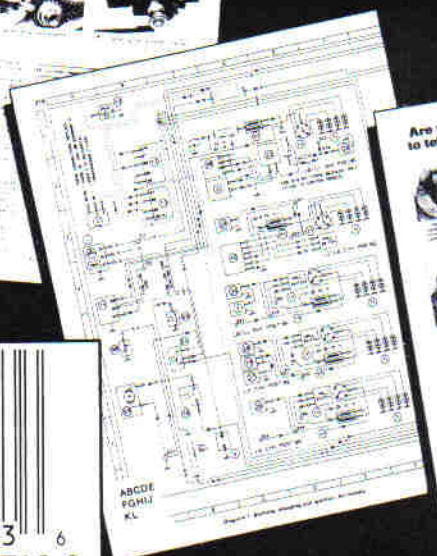

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